



## appendix 10

### Noise Assessment

Oceanic Coal Australia Limited

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# **Noise Impact Assessment**

## **West Wallsend Colliery**

### **Continued Operations Project**

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July 2010



# **Noise Impact Assessment**

## **West Wallsend Colliery**

### **Continued Operations Project**

**Prepared by**  
**Umwelt (Australia) Pty Limited**  
**on behalf of**  
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## Executive Summary

West Wallsend Colliery (WWC) is an underground colliery managed by Oceanic Coal Australia Limited (OCAL) on behalf of the Macquarie Coal Joint Venture. The colliery is located approximately 15 kilometres south-west of Newcastle on the western side of Lake Macquarie.

Underground mining at WWC has previously extended to the north and south of the pit top and longwall mining is currently progressing south-westerly beneath areas of bushland west of the F3 Freeway in longwall 38. The majority of the coal from WWC is washed and loaded onto trains at the Macquarie Coal Preparation Plant (MCPP) to be transported to Newcastle Port for export. Recently a small percentage of coal mined from West Wallsend has been transported from MCPP to Eraring Power Station via coal haul trucks on a private coal haul road.

The overall objective of the West Wallsend Continued Operations Project (WWCOP) application is to provide WWC with one updated approval for the continuation of operations at WWC. The WWCOP will not require significant changes to the existing underground mining or associated surface operations. The only substantial modification to the surface operations is the proposed construction of a mining services facility to the south of the pit top facility on Wakefield Road. The mining services facility will be used to provide a range of services to the underground mine and will include a ballast and concrete borehole, an emergency egress borehole and solcenic mixing stations.

This Noise Impact Assessment (NIA) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) as part of the Environmental Assessment (EA) for the WWCOP. This NIA has been undertaken in accordance with the NSW Industrial Noise Policy (INP) (Environment Protection Authority (EPA), 2000) with the objective of addressing the key issues relating to noise as required by the Director-General's Environmental Assessment Requirements for the WWCOP.

The NIA was based on the noise levels predicted by the Environmental Noise Model (ENM) of the existing operations. The assessment of the predicted noise levels against project-specific noise criteria was undertaken in accordance with *Section 10 – Applying the policy to existing industrial premises* of the INP (EPA, 2000)

The existing noise environment in the area surrounding the WWC was assessed in accordance with Section 3 of the INP (EPA 2000) using a combination of Acoustic Research Laboratories environmental noise loggers and attended noise monitoring. The results of the noise monitoring program were used to determine the Project-specific Noise Levels (PSNL) for the WWCOP.

The PSL reflects the most stringent noise level requirements from the noise levels derived from both the intrusive and amenity criteria. They set the benchmark against which noise impacts and the need for noise mitigation are assessed. For existing operations the PSL are not mandatory but supply the initial target levels that are used to derive the achievable noise limits based on the implementation of feasible and reasonable control measures.

Monitoring results show that the night-time Rating Background Levels (RBLs) in the region surrounding the WWC pit top and No. 2 Vent Fan are generally around 34 dB(A). However, the day-time and evening RBLs are only 1 to 3 dB above the night-time noise levels. The corresponding Intrusiveness Criteria range from 39 dB(A) during the night to a maximum of 41 to 42 dB(A) during the day and evening periods at Killingworth.

In the region surrounding No. 3 Vent Fan and the proposed Wakefield Road mining services facility the background noise levels range from 40 to 45 dB(A) depending on the proximity to and the number of vehicles on the F3 Freeway. The corresponding Intrusiveness Criteria range from a minimum of 45 dB(A) during the evening to a maximum of 50 dB(A) during the day-time period.

The presence of local domestic noise sources, local traffic noise and natural ambient noises such as birds and insects has some impact on the day-time and evening background noise environment. The ambient noise levels can also, depending on proximity, be affected by existing industrial activities and by other features such as the F3 Freeway located to the west of Killingworth.

A noise model was developed to simulate the currently approved mining operations at WWC pit top, including No. 2 Vent Fan, using the current infrastructure layout, equipment schedule and equipment location provided by OCAL. When assessing potential noise impacts, the model incorporated identifiable noise source data, meteorological data and surrounding terrain characteristics including the layout of the pit top area and any substantial barrier effects from buildings or structures. The model was used to predict the contributed noise levels from the WWC and No. 2 Vent Fan at the nearest potentially affected receivers. A validation assessment was undertaken at monitoring locations in Killingworth and Barnsley to calibrate the model. Noise models were also prepared to represent the type of equipment likely to be used during the construction of the Wakefield Road mining services facility and for the ongoing operation of No. 2 Vent Fan and the proposed Wakefield Road mining services facility.

Meteorological data for the period October 2007 to December 2008 was sourced from Pasminco's weather station at Cockle Creek located approximately 5 kilometres east of WWC. This data was analysed to determine the frequency of occurrence of prevailing winds and temperature inversions and was incorporated into the model.

The ENM's Single Point calculation feature was used to determine noise levels from the WWC pit top, vent fans and the mining services facility at the nearest residential receiver locations.

The ENM indicates the existing WWC pit top facilities have the potential to exceed the target PSLNs in both Killingworth and Barnsley under meteorological conditions that propagate noise from WWC pit top towards these receiver areas. The magnitude of the exceedances is up to 6 dB under the worst case meteorological conditions considered by the INP (EPA, 2000). Additionally, the predicted noise levels at the nearest residential receiver locations meet the recommended sleep disturbance noise goals established for the project. The current operation of the No. 2 Vent Fan exceeds the target PSLNs at the closest receiver location R7.

The operation of No. 3 Vent Fan and the proposed mining services facility are predicted to achieve the Project-specific Noise Levels for Wakefield under all worst case meteorological conditions. Additionally, the predicted noise levels associated with the mining services facility meet the construction noise goal for all residential receivers.

Predicted cumulative noise levels are also less than the recommended acceptable noise levels at all the potential receiver locations in the region surrounding WWC.

The results of the noise modelling indicate that the noise emissions from WWC have the greatest impact along eastern edge of Killingworth, exceeding the target night-time PSLNs by up to 6 dB during the occurrence of a temperature inversion and associated drainage wind. Therefore, in order to achieve the target PSLNs at Killingworth and other locations where exceedances occur, it will be necessary to implement a range of noise mitigation controls.

Firstly a 10 dB reduction in the noise level from the coal breaker is predicted to achieve a 3.1 dB reduction in the overall noise impact of the WWC pit top facility. A 15 dB reduction in the noise level from the coal breaker is predicted to achieve a 3.5 dB reduction.

In order to achieve the further attenuation of noise sources from the WCC pit top facility the following noise control measures should also be investigated:

- mitigation of the service conveyors from the crusher by installing 'low noise' idlers;
- mitigation of the bin loadout operations by maintaining a minimum amount of material in the bin at all times during loadout;
- review of loading procedures and operator training to optimise choke loading to minimise impact noise into the body of the bin; and
- review of bin design to assess the noise impacts of coal unloading on the walls of the bin.

The results of the noise modelling indicate that the noise emissions from No. 2 Vent Fan exceed the target night-time PSNL at the closest receiver location R7 by up to 7 dB. Increasing flow rate of the fan could also result in the exceedance of the target night-time PSNLs in Barnsley. Therefore, in order to achieve the target PSNLs at receiver location R7 and manage the impacts of the fan in Barnsley it will be necessary to implement a range of noise mitigation controls to reduce the noise levels generated by the fan. The selection and implementation of noise mitigation controls will be dependent on the future operational requirement of No. 2 Vent Fan and performance of the vent fan against the target PSNLs at location in the surrounding region.

Following the completion of any noise mitigation works it is recommended that OCAL implement a monitoring program that will specifically address:

- compliance with the project-specific noise level  $L_{Aeq}$ , 15 minute descriptor; and
- measurement and assessment of any transient noise levels using the sleep disturbance criteria descriptor of  $L_{A1}$ , 1 minute.

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## APPENDICES

- A      Glossary of Terms**
- B      INP Assessment Methodology**
- C      Assessment of the Existing Noise Environment**
- D      Noise Mitigation Control Strategies**

# 1.0 Introduction

## 1.1 Project Overview

West Wallsend Colliery (WWC) is one of a number of active mining operations within the Newcastle Coalfield of New South Wales (refer to **Figure 1.1**). WWC is an underground colliery managed by Oceanic Coal Australia Limited (OCAL) on behalf of Macquarie Coal Joint Venture. The colliery is located approximately 15 kilometres south-west of Newcastle on the western side of Lake Macquarie.

The majority of the coal from WWC is washed and loaded onto trains at the Macquarie Coal Preparation Plant (MCPP) to be transported to Newcastle Port for export. Recently a small percentage of coal mined from West Wallsend has been transported from MCPP to Eraring Power Station via coal haul trucks on a private coal haul road. The locations of the WWC Holding and other facilities operated by the Macquarie Coal Joint Venture in its Lake Macquarie Operations are shown on **Figure 1.1**.

The overall objective of the West Wallsend Continued Operations Project (WWCOP) application is to provide WWC with one updated approval for the continuation of operations at WWC. This includes updated planning approval for two small portions of the future workings of WWC which are currently approved for mining under the savings provisions of the Lake Macquarie Local Environmental Plan (LEP, 2004), the entire life of mine coal reserves for WWC, the existing pit top and other related ancillary surface facilities.

The WWCOP will not require significant changes to the existing underground mining or associated surface operations. That is, the existing operations will continue as per the current operations. The only substantial modification to the surface operations is the proposed construction of a mining services facility to the south of the pit top facility on Wakefield Road (refer to **Figure 1.2**).

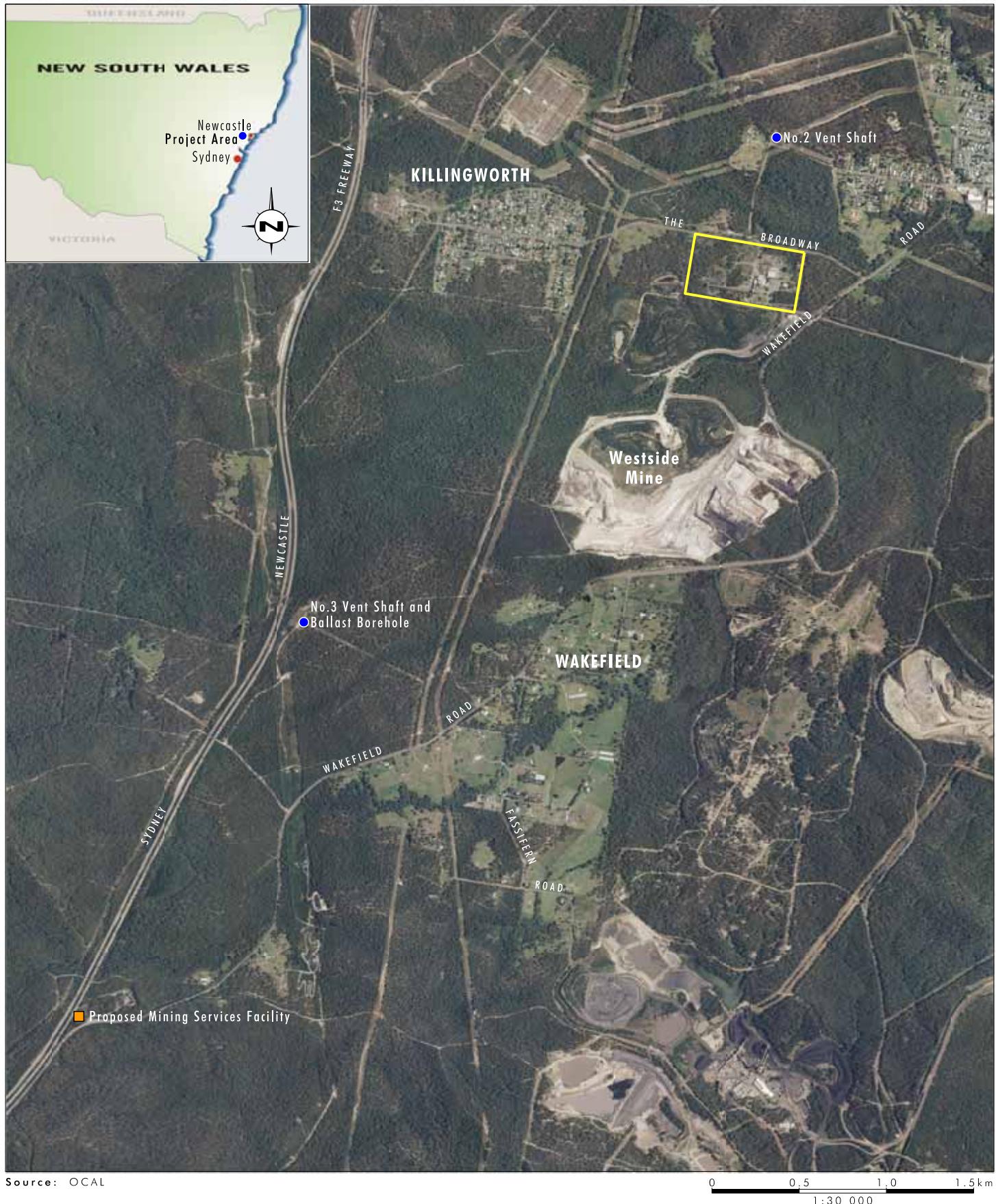
The WWCOP is identified as a Part 3A Project under *State Environmental Planning Policy - Major Development*, 2005, and requires the approval of the NSW Minister for Planning under the *Environmental Planning and Assessment Act 1979*.

## 1.2 Noise Impact Assessment

This Noise Impact Assessment (NIA) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) as part of the Environmental Assessment (EA) for the WWCOP. This NIA has been undertaken in accordance with the *NSW Industrial Noise Policy* (INP) (Environment Protection Authority (EPA), 2000) with the objective of addressing the key issues relating to noise as required by the Director-General's Environmental Assessment Requirements for the Project.

## 1.3 Director-General's Requirements

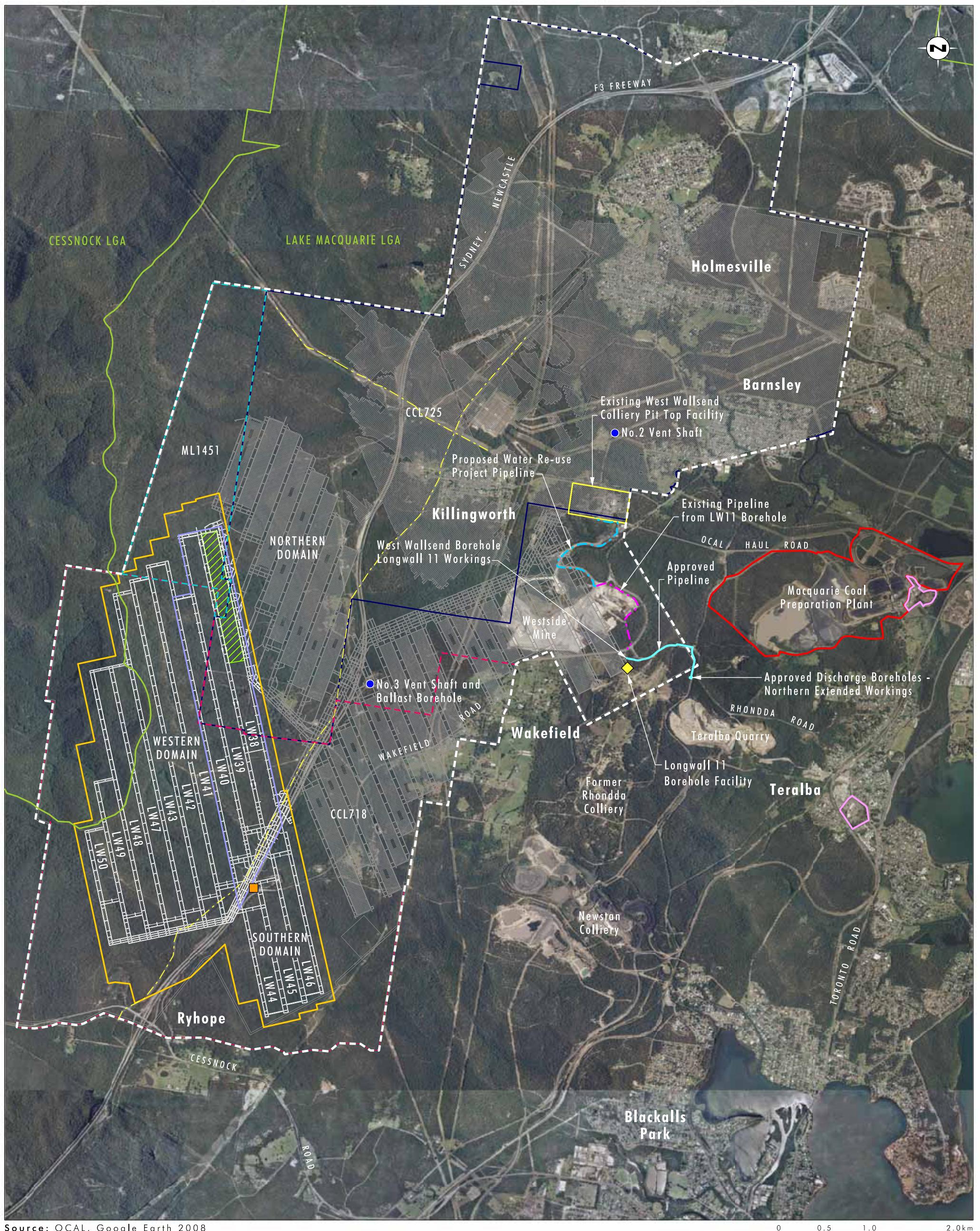
The Department of Planning (DoP) has issued Director-General's Requirements (DGRs) for the WWCOP that includes the preparation of a comprehensive noise assessment of the existing environment, potential impacts and proposed noise amelioration measures.



#### Legend

- Yellow rectangle: West Wallsend Colliery Pit Top Facility
- Blue square: Proposed Mining Services Facility

**FIGURE 1.1**  
**Locality Plan**



Source: OCAL, Google Earth 2008

0 0,5 1,0 2,0 km  
1:40 000

#### Legend

- CCL725
- CCL718
- ML1451
- Existing West Wallsend Colliery Pit Top Facilities
- Continued Underground Mining Area
- Proposed Underground Workings in the West Borehole Seam
- Longwall Progression as of 1st March 2010
- Former Underground Workings
- Approved SMP Area
- Teralba Colliery Areas
- Local Government Area
- Project Application Area
- Proposed Mining Services Facility
- Longwall 11 Borehole Facility
- Services Easement

**FIGURE 1.2**  
**West Wallsend Project**

The DGRs specify that this assessment should be undertaken in accordance with the following policies and guidelines:

- NSW Industrial Noise Policy (INP) (EPA, 2000);
- Environmental Criteria for Road Traffic Noise (EPA, 1999);
- Environmental Noise Control Manual (ENCM) (EPA 1994); and
- Interim Construction Noise Guideline (DECC 2008).

## 1.4 Methodology

To satisfy the requirements of the DGRs and relevant policies and guidelines, the Noise Impact Assessment has:

- identified noise sensitive locations likely to be affected by activities at the site and determined existing background and amenity noise levels at representative locations in accordance with the INP (refer to **Section 3.0**);
- determined the Project-specific Noise Levels for the operation based on the assessment of underlying background and amenity noise levels of the surrounding receiver areas. The determination of the achievable noise criteria is based on the requirements of Section 10 of the INP (EPA, 2000) (refer to **Section 1.5**);
- identified all noise sources from the WWC and determined the expected noise levels and noise characteristics (e.g. tonality, impulsiveness, etc) likely to be generated from the noise sources (refer to **Section 5.0**);
- determined the noise levels likely to be received at the most sensitive locations under both prevailing and adverse meteorological conditions (refer to **Section 5.0**);
- prepared noise contours for predicted 'worst case' meteorological conditions (refer to **Section 5.0**);
- compared the predicted noise levels with the appropriate noise criteria for the activity/operation being considered (refer to **Section 5.0**);
- discussed the findings from the predictive modelling and, where predicted noise levels exceeded the relevant noise criteria, recommended additional mitigation measures (refer to **Section 5.0**);
- assessed the effect of relevant noise mitigation measures incorporated into the predictive model (refer to **Section 5.0**);
- quantified the residual level of noise impact where relevant noise criteria cannot be met after application of all feasible and cost effective mitigation measures, where relevant (refer to **Section 5.0**);
- determined the most appropriate noise mitigation measures including both noise controls and management of impacts (refer to **Section 6.0**); and

- provided details of the noise monitoring program with monitoring to be undertaken at noise sensitive locations subject to the agreement of the owners/occupiers of those properties. Specific noise monitoring locations and proposed methodology are outlined in **Section 8.2**.

The computer-based modelling software package Environmental Noise Model (ENM) was used to predict the noise levels produced by the WWCOP in the surrounding environment. The ENM noise models were based on machine and plant sound power level data obtained from WWC or collected by Umwelt, digital terrain maps of the region surrounding the WWC prepared by Umwelt and the layout of the existing and proposed operations provided by WWC. The ENM model of the existing operations was validated by comparing the predicted noise levels with the results from the noise monitoring program.

The NIA was based on the noise levels predicted by the ENM model of the existing operations. The assessment of the predicted noise levels against project-specific noise criteria was undertaken in accordance with *Section 10 – Applying the policy to existing industrial premises* of the INP (EPA, 2000) (refer to **Section 1.5**).

The noise modelling and assessment process is further described in **Sections 4.0 and 5.0**.

A glossary of terms and abbreviations used in this report is provided in **Appendix A**.

A detailed summary of the INP (EPA, 2000) assessment methodology used for this NIA is provided in **Appendix B**.

## 1.5 Section 10 of the Industrial Noise Policy

*Section 10 – Applying the policy to existing industrial premises* of the INP (EPA, 2000) deals with application of the policy to existing industrial noise sources such as WWC. The approach established by the EPA was designed to allow established industries to adapt to changes in the noise expectations of the community while remaining economically viable. The methodology involves the measurement of actual noise levels produced by the source in question and a systematic reduction of the noise levels to an agreed achievable limit.

With respect to the methodology outline in **Section 1.4** the Project-specific Noise Levels determined from the assessment of the underlying background and amenity noise levels in the receiver areas surrounding WWC are not mandatory noise limits. The Project-specific Noise Levels provide the initial target levels that drive the process for assessing feasible and reasonable control measures. The achievable noise limits result from applying all the feasible and reasonable control measures to the operation.

## 2.0 Project Description

WWC commenced mining in the Lake Macquarie area in 1969 and currently operates under a number of existing development consents, existing mining leases and an approved Subsidence Management Plan (SMP).

WWC is located approximately 15 kilometres south-west of Newcastle in the City of Lake Macquarie. The WWC pit top facilities are located approximately 1 kilometre east of Killingworth and approximately 0.8 kilometres south-west of Barnsley (refer to **Figure 2.1**). No significant changes to the existing surface facilities are proposed as a part of the project application. The Project will include the construction of a mining services facility on Wakefield Road.

Underground mining has previously extended to the north and south of the pit top and longwall mining is currently progressing south-westerly beneath areas of bushland west of the F3 Freeway in longwall 38, as shown in **Figure 1.2**. The West Wallsend Continued Operations Project addresses the continuation of longwall mining at WWC in the two main areas referred to as the Western and Southern domains as shown in **Figure 1.2**. No significant changes to the existing underground mining operations are proposed as part of the project application.

The new mining services facility to be constructed on Wakefield Road (shown on **Figure 1.2**) will comprise a 20 metre by 35 metre compound and access road to Wakefield Road. The mining services facility will be used to provide a range of services to the underground mine and will include a ballast and concrete borehole, an emergency egress borehole and solcenic mixing stations.

Key features of the project are outlined in **Table 2.1** and shown on **Figure 1.2**.

**Table 2.1 – Overview of the WWC Continued Operations**

Major Project Components/Aspects	Proposed Operations
Limits on Extraction	Up to 5.5Mtpa Run of Mine (ROM)
Estimated Mine Life	Approximately 15 years of mining (21 year approval sought)
Operating Hours	24 hours per day, 7 days per week
Number of Employees	Approximately 390 Full Time Equivalents
Mining Methods	Underground Mining – longwall method
Mining Areas	All existing and proposed mining within CCL 718, 725 and ML 1451
Infrastructure	Existing West Wallsend Pit Top infrastructure Existing No.2, No.3 Vent Shafts and existing ballast borehole Existing Longwall 11 borehole facility Proposed future ventilation infrastructure and minor surface infrastructure Proposed Mining Services Facility

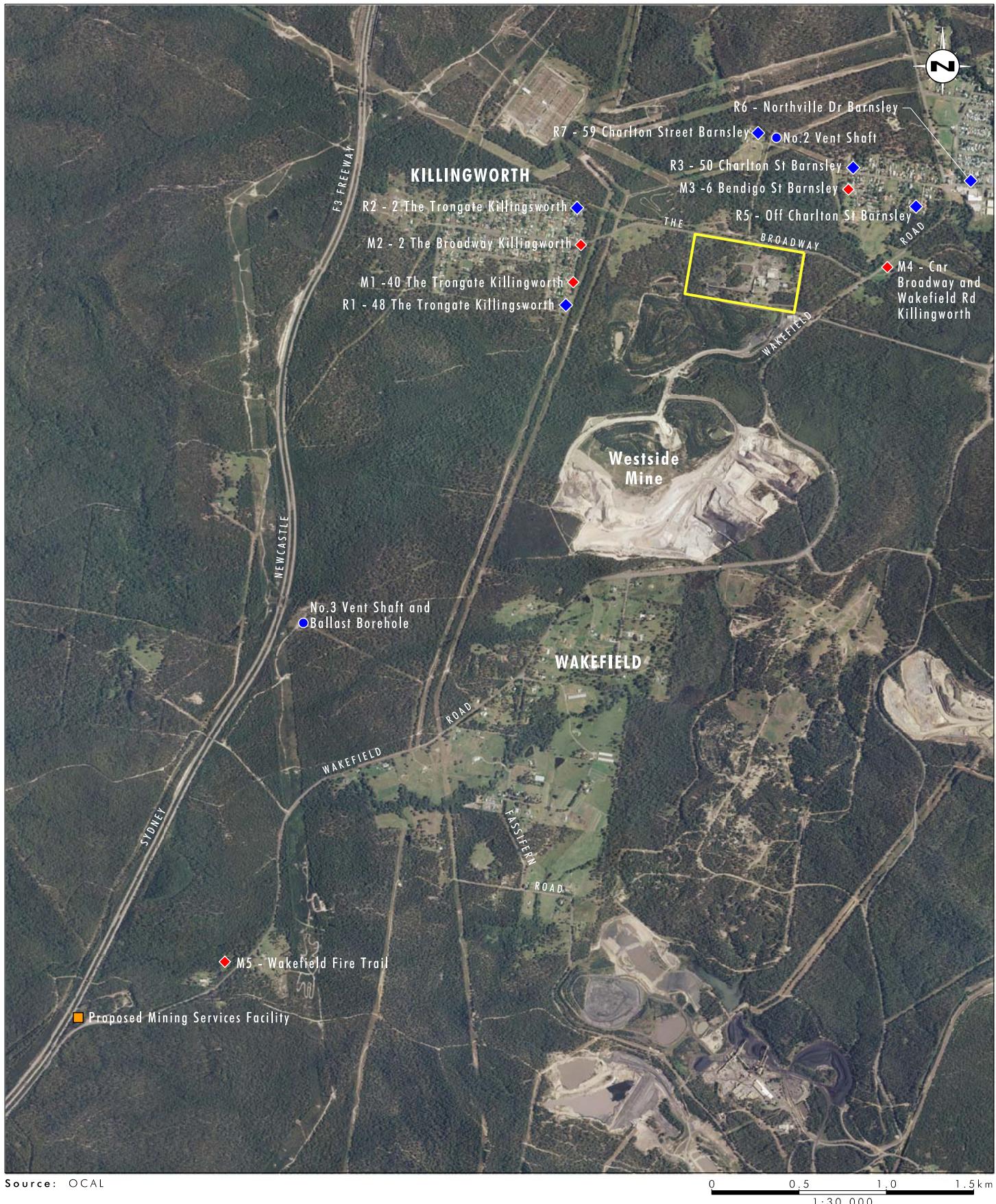


FIGURE 2.1

West Wallsend Colliery Operations  
Noise Monitoring and Receiver Locations

## 3.0 Existing Acoustic Environment and Assessment Criteria

### 3.1 Existing Noise Environment

The land use immediately surrounding the WWC pit top is mainly vacant land owned by OCAL. The residential areas of Killingworth and Barnsley are located approximately 1 kilometre to the west and 0.8 kilometres to the north-east, of the WWC pit top respectively. The nearest potential noise sensitive residential receivers, shown on **Figure 2.1**, are located in The Trongate, Killingworth to the west of WWC and in Bendigo Street, Barnsley to the north-east of WWC.

The proposed mining services facility will be located approximately 1 kilometre to the west of Wakefield. The nearest potential noise sensitive residential receivers are shown on **Figure 2.1**.

The existing noise environment in the area surrounding the WWC was assessed in accordance with Section 3 of the INP (EPA 2000) using a combination of Acoustic Research Laboratories environmental noise loggers and attended noise monitoring. The results of the noise monitoring program were used to determine the Project-specific Noise Levels for the WWCOP.

Monitoring locations M1 to M5, shown on **Figure 2.1**, are located to represent the nearest and/or most potentially affected residences to the west and north-east of WWC pit top facility and to the east of the proposed Wakefield Road mining services facility.

Details of the monitoring locations and noise monitoring programs are presented in **Table 3.1**.

**Table 3.1 - Details of the Noise Monitoring Program**

Monitoring Location	Location	Logger Serial No.	Measurement
M1	The Trongate (South) Killingworth	194538 12918	15:54 2/12/08 to 11:07 11/12/08 2 March 2009
M2	The Trongate (North) Killingworth	194449 12918	15:46 2/12/08 to 10:50 11/12/08 2 March 2009 and 4 December 2008
M3	Bendigo Street Barnsley	194637 12918	14:48 2/12/08 to 10:28 11/12/08 2 March 2009 and 4 December 2008
M4	Wakefield Road Barnsley	194539	12:15 3/12/08 to 11:15 11/12/08
M5	Wakefield Road Wakefield	12918	20 and 22 January 2010

The monitoring data from the environmental noise loggers and the attended monitoring program includes:

- date, time and temperature;
- ambient noise levels recorded as LAeq, 15minute and LA90, 15minute;

- maximum and minimum noise levels; and
- statistical noise levels representative of the ambient noise environment recorded as LA1, 15minute, LA10, 15minute, etc.

Run charts of the raw data from the environmental noise loggers and the determination of the corresponding Assessment Background Level (ABL), Rating Background Level (RBL) and mean, LAeq, Period (where Period = day, evening or night) are presented in **Appendix C**.

The monitoring data from the attended monitoring program includes:

- the recorded A-weighted 1/3 octave noise levels at 1 second intervals over the 15 minute observation period; and
- an assessment of the maximum LA1, 1 minute noise level recorded over the 15 minute observation period.

Run charts from the attended noise monitoring program and the corresponding LAeq, 15 minute, LA10, 15 minute, LA90, 15 minute and LA1, 1 minute noise levels are presented in **Appendix C**.

### 3.1.1 Environmental Noise Loggers

Environmental noise loggers were placed at locations M1 to M5 to monitor the ambient noise levels in the regions surrounding the WWC pit top. The results of the monitoring program, reported as the underlying Rating Background Level (RBL) and the Mean LAeq, period (where period = day, evening and night) are presented in **Appendix C** and summarised in **Table 3.2**.

**Table 3.2 – Monitoring Results, RBL and Mean LAeq, period dB(A)**

Monitoring Location	Time Period <sup>1</sup>	RBL	Mean LAeq, period
M1 - The Trongate (South) Killingworth	Day	33.7	47.4
	Evening	38.9	54.1
	Night	34.4	43.7
M2 - The Trongate (North) Killingworth	Day	35.2	49.9
	Evening	36.8	48.8
	Night	34.4	47.9
M3 - Bendigo Street Barnsley	Day	36.1	54.3
	Evening	37.6	52.9
	Night	33.5	46.7
M4 - Wakefield Road Barnsley	Day	41.4	67.7
	Evening	37.5	59.5
	Night	35.5	58.2
M5 - Wakefield Road Wakefield	Day	45	60
	Evening	40	61
	Night	42	52

Note 1: Monday to Saturday Day is 7.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm and Night 10.00 pm to 7.00 am; on Sundays and Public Holidays Day is 8.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm and Night 10.00 pm to 8.00 am.

The noise levels presented in **Table 3.2** represent the underlying level of noise present at the monitoring locations in the absence of the noise source under investigation. During the monitoring program, data affected by rain or wind speeds in excess of 5 m/s was excluded in accordance with the Section 3.4 of the INP (EAP, 2000). Meteorological data was obtained from the weather station maintained by Westside Mine.

### 3.1.2 Attended Noise Monitoring

Attended noise monitoring was undertaken at locations M1 to M3 and M5. The objectives of the attended noise monitoring program were to:

- assess the background ( $L_{A90}$ ) and ambient ( $L_{Aeq}$ ) noise levels within the residential receiver areas adjacent to WWC (M1 to M3) and the proposed mining services facility (M5);
- to identify existing sources of noise contributing to the ambient noise environment; and
- to determine the contribution from industrial noise sources to the existing ambient noise levels.

Attended noise monitoring was undertaken in the region surrounding the WWC pit top facility during the evening and night-time on the 2 to 4 March 2009 and during the night on 4 December 2009. Attended noise monitoring was also undertaken in the region to the east of the proposed mining services facility during the day-time, evening of 20 January 2010 and the night-time of 22 January 2010.

The results of the attended noise monitoring program are presented graphically in **Appendix C** and summarised in **Table 3.3**. The results in **Appendix C** include a low pass filter to remove insect noise in frequencies greater than 1 kHz.

**Table 3.3 – Attended Noise Monitoring Results, dB(A)**

Monitoring Location	Time Period	$L_{A90}$ , 15min	$L_{Aeq}$ , 15min	Industrial Contribution
M1 - The Trongate (South) Killingworth	Evening 2/03/09	38.5	41.0	37.0
	Night 2/03/09	37.5	39.0	37.0
M2 - The Trongate (North) Killingworth	Evening 2/03/09	43.0	46.0	40.0
	Night 2/03/09 4/12/09	37.0 44.3	39.0 47.9	35.0 44.0 <sup>1</sup>
M3 - Bendigo Street Barnsley	Night 2/03/09 4/12/09	36.0 45.6	43.0 <sup>2</sup> 42.4	30.0 <sup>2</sup> 40.0 <sup>1</sup>
M5 - Wakefield Road Wakefield	Day 20/01/10	45	60	0
	Evening 20/1/10	40	61	0
	Night 22/1/10	42	52	0

Note 1: Industrial noise from WWC Pit top

Note 2: Monitoring data affected by traffic noise

The noise environment in the area surrounding the WWC has also been measured as a part of a WWC bi-annual noise monitoring program. The quarterly results from the June 2006 to December 2008 monitoring programs undertaken by Global Acoustics are summarised in **Table 3.4**.

**Table 3.4 – Bi-annual Attended Noise Monitoring Results, dB(A)**

Monitoring Location	LA90, 15min	LAeq, 15min	Industrial <sup>1</sup> Contribution
M1 - The Trongate (South) Killingworth	36 to 42	39 to 44	33 to 40
M2 - The Trongate (North) Killingworth	35 to 40	39 to 42	35 to 39
M3 - Bendigo Street Barnsley	32 to 41	35 to 45	Inaudible to 42

Note 1: Noise contribution dependent on wind direction and wind speed includes WWC and other industrial sources.

## 3.2 Intrusiveness and Amenity Criteria

### 3.2.1 Application of the Industrial Noise Policy

The INP has two components for the assessment of industrial noise sources. They are intrusive noise impacts and noise amenity levels. When assessing the noise impact of industrial sources both components are considered for residential receivers. Generally however, only one will become the limiting criterion and form the Project-specific Noise Levels (PSNL) for the industrial source.

The PSLN reflects the most stringent noise level requirements from the noise levels derived from both the intrusive and amenity criteria. They set the benchmark against which noise impacts and the need for noise mitigation are assessed. For existing operations the PSLN are not mandatory but supply the initial target levels that are used to derive the achievable noise limits based on the implementation of feasible and reasonable control measures.

When setting the PSLN the INP recommends the application of the most stringent requirement so that the applicable PSLN both limits intrusive noise and protects noise amenity. The PSLN derived for the WWCOP are discussed further in **Section 3.3** and the achievable noise limits are discussed in **Section 5.0**.

### 3.2.2 Intrusiveness Criteria

The monitoring results presented in **Table 3.2** and **Appendix C** show that the night-time Rating Background Levels (RBLs) in the region surrounding the WWC pit top including the No. 2 Vent Shaft are generally around 34 dB(A). The presence of local domestic noise sources, local traffic noise and natural ambient noises such as birds and insects has some impact on the day-time and evening background noise environment. However, the day-time and evening RBLs are only 1 to 3 dB above the night-time noise levels. The corresponding Intrusiveness Criteria range from 39 dB(A) during the night to a maximum of 41 to 42 dB(A) during the day and evening periods at Killingworth (refer to **Section 3.3** for details).

In the region surrounding No. 3 Vent Shaft and the proposed Wakefield Road mining services facility the background noise levels range from 40 to 45 dB(A) depending on the proximity to and the number of vehicles on the F3 Freeway. The corresponding Intrusiveness Criteria ranges from a minimum of 45 dB(A) during the evening to a maximum of 50 dB(A) during the day-time period (refer to **Section 3.3** for details). The run charts of the monitoring data presented in **Appendix C** indicates that ambient noise levels of 35 to 37 dB(A) are possible during periods when there is minimal traffic on the F3 Freeway. The monitoring results at M4, also located adjacent to Wakefield Road, but further away from the F3 Freeway, provided background noise level 2 to 4 dB quieter than at monitoring location M5.

### 3.2.3 Amenity Criteria

The ambient noise levels in the region surrounding the WWC pit top, the No.2 Vent Shaft, the No.3 Vent Shaft and the proposed Wakefield Road mining services facility is effected by local domestic noise sources, insects, birds and local traffic. The ambient noise levels can also, depending on proximity, be affected by existing industrial activities and by other features such as the F3 Freeway located to the west of Killingworth. To limit continuing increases in noise levels due to industrial development, the INP (EPA, 2000) has identified maximum ambient noise levels for typical receiver areas and land uses. The recommended acceptable and maximum ambient noise levels in Table 2.1 of the INP for suburban land use has been reproduced in **Table 3.5**. The Amenity Criteria is then determined by comparing the existing ambient noise level with the recommended acceptable ambient noise levels.

**Table 3.5 – Amenity Criteria – Recommended L<sub>Aeq</sub> Noise Levels from Industrial Noise Sources, dB(A)**

Type of Receiver	Indicative Noise Amenity Area	Time of Day <sup>1</sup>	Recommended L <sub>Aeq</sub> Noise Level	
			Acceptable	Recommended Maximum
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
School Classroom – internal	All	Noisiest 1 hour period	35	40
Area specifically reserved for passive recreation	All	When in use	50	55
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note 1: For Monday to Saturday, Day-time 7.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm – 7.00 am  
On Sundays and Public Holidays, Day-time 8.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm;  
Night-time 10.00 pm – 8.00 am.

The monitoring results presented in **Table 3.2** and **Appendix C** show that the ambient noise levels (reported as mean L<sub>Aeq</sub>, period where period = day, evening or night) in the region surrounding the WWC pit top and the No.2 Vent Shaft are influenced by a range of local noise sources including the WWC pit top facility, No.2 Vent Shaft, local traffic and traffic on the F3 Freeway. In accordance with Section 3.2 of the INP (EAP, 2000), the Amenity Criteria is based on the measured industrial noise levels, measured as L<sub>Aeq</sub>, period noise levels, less the contribution from the WWC pit top facility. The resulting Amenity Criteria range from 38 to 40 dB(A) during the night-time to a maximum of 55 dB(A) during the day-time.

The monitoring results presented **Table 3.4** indicate the ambient noise levels in the region surrounding the No.3 Vent Shaft and the proposed mining services facility on Wakefield Road are also influenced by a range of local noise sources including local traffic and traffic on the F3 Freeway. During the monitoring period there were no observed industrial noise sources influencing the ambient noise levels in the region to the east of the proposed Wakefield Road mining services facility. The resulting Amenity Criteria for the day-time, evening and night-time periods are 55, 45 and 40 dB(A) respectively.

### 3.3 Project-specific Noise Levels

The RBL and Intrusiveness Criteria were determined for each receiver location described in **Table 3.1**, in accordance with the INP (EPA, 2000). The assessment of the night-time and evening RBL also took into consideration the recommendations of the *DECC Application Note for the Assessment of Intrusiveness Criteria* (DECC, July 2006). The mean L<sub>Aeq</sub> and corresponding Amenity Criteria have also been determined for each monitoring location in accordance with the INP (EPA, 2000).

The assessment methodology and application of the DECC recommendations as noted above for day-time, evening and night-time PSNLs are presented in **Table 3.6**.

**Table 3.6 - Determination of the Project-specific noise levels, dB(A)**

Receiver	M1	M2	M3	M5
<b>Assessment of Day-time Noise Levels</b>				
Rating Background Noise Level	33.7	35.2	36.1	45
<b>Intrusiveness Criteria</b>	<b>39</b>	<b>40</b>	<b>41</b>	<b>50</b>
Acceptable Noise Level	55	55	55	55
Mean Measured L <sub>Aeq</sub>	47.4	49.9	54.3	61
Estimated Industrial L <sub>Aeq</sub> Noise Contribution <sup>1</sup>	up to 36	up to 36	up to 38	up to 35
<b>Amenity Criteria</b>	<b>55</b> <sup>2</sup>	<b>55</b> <sup>2</sup>	<b>55</b> <sup>2</sup>	<b>55</b> <sup>2</sup>
<b>Day-time Project-specific Noise Level</b> <sup>7</sup>	<b>39</b> <sup>3</sup>	<b>40</b> <sup>3</sup>	<b>41</b> <sup>3</sup>	<b>50</b> <sup>3</sup>
<b>Assessment of Evening Noise Levels</b>				
Rating Background Noise Level	33.7(38.9) <sup>4</sup>	35.2 (36.8) <sup>4</sup>	36.1(37.6) <sup>4</sup>	40.0
<b>Intrusiveness Criteria</b>	<b>39</b>	<b>40</b>	<b>41</b>	<b>45</b>
Acceptable Noise Level	45	45	40	40
Mean Measured L <sub>Aeq</sub>	45.1	48.8	52.9	62
Estimated Industrial L <sub>Aeq</sub> Noise Contribution <sup>1</sup>	up to 30	up to 32	up to 32	up to 30
<b>Amenity Criteria</b>	<b>45</b> <sup>2</sup>	<b>45</b> <sup>2</sup>	<b>45</b> <sup>2</sup>	<b>45</b> <sup>2</sup>
<b>Evening Project specific Noise Level</b> <sup>7</sup>	<b>39</b> <sup>3</sup>	<b>40</b> <sup>3</sup>	<b>41</b> <sup>3</sup>	<b>45</b> <sup>3</sup>
<b>Assessment of Night-time Noise Levels</b>				
Rating Background Noise Level	33.7(34.4) <sup>4</sup>	34.4	33.5	40 (42) <sup>6</sup>
<b>Intrusiveness Criteria</b>	<b>39</b>	<b>39</b>	<b>39</b>	<b>45</b>
Acceptable Noise Level	40	40	40	40
Mean Measured L <sub>Aeq</sub>	43.7	47.9	46.7	52
Estimated Industrial L <sub>Aeq</sub> Noise Contribution <sup>1</sup>	up to 30	up to 32	up to 32	up to 30
<b>Amenity Criteria</b>	<b>40</b> <sup>2</sup>	<b>40</b> <sup>2</sup>	<b>40</b> <sup>2</sup>	<b>40</b> <sup>2</sup>
<b>Night-time Project-specific Noise Level</b> <sup>7</sup>	<b>39</b> <sup>3</sup>	<b>39</b> <sup>3</sup>	<b>39</b> <sup>3</sup>	<b>40</b> <sup>5</sup>

**Note 1:** From industrial noise sources, not including WWC, such as Newcastle Substation, Westside Mine, Macquarie Coal Preparation Plant and Metromix Quarry.

**Note 2:** Set Amenity Criteria at the recommended acceptable noise level as existing industrial noise level is more than 6 dB below the recommended acceptable noise level.

**Note 3:** Measured as L<sub>Aeq</sub>, 15minute for comparison against the PSNL criteria.

**Note 4:** Set Evening RBL at the Day-time RBL as the Evening RBL, shown in brackets, is higher than the Day-time RBL as per DECC Application Note 2006.

**Note 5:** Measured as L<sub>Aeq</sub>, period for comparison against the PSNL criteria.

**Note 6:** Set Night-time RBL at the Evening RBL as the Night-time RBL, shown in brackets, is higher than the Evening RBL as per DECC Application Note 2006.

**Note 7:** For Monday to Saturday, Day-time 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Day-time 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

As a 24 hour 7 day per week operation, activities associated with the Project would be essentially the same during the day-time, evening and night-time. That is, the sources of noise at WWC are independent of the time of day and the day of the week. Therefore, under normal operating conditions, achieving the night-time criteria will result in the day-time and evening criteria also being achieved.

### 3.4 Sleep Disturbance Noise Goals

Criteria for assessing sleep disturbance has not been defined under the INP (EPA, 2000). The DECC provided an application note for the assessment of sleep disturbance (DECC July 2006) based on the prevention of sleep arousal by ensuring the LA<sub>1,1</sub>minute level of a noise source does not exceed the LA<sub>90</sub> background noise level by more than 15 dB. This is based on measurement outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

The relevant sleep disturbance noise goals for the residential receivers are provided in **Table 3.7**.

**Table 3.7 – Sleep Disturbance Criteria at Residential Receivers, dB(A)**

Receiver Location	Night-Time RBL LA <sub>90</sub> , 15 minute	Goal LA <sub>1,1</sub> minute
M1 - The Trongate (South), Killingworth	34.4	50
M2 - The Trongate (North), Killingworth	34.4	50
M3 - Bendigo Street, Barnsley	33.5	48
M5 - Wakefield Road, Wakefield	40.0	55

The location of each of the potential affected residential receivers and the nomination of the appropriate sleep disturbance noise goals for each of the respective receiver locations is discussed in **Section 5.2**.

### 3.5 Construction Noise Criteria

The Project will not require the construction of any addition facilities or equipment at the WWC pit top area. However, a new mining services facility will be constructed on Wakefield Road to the south-west of Wakefield (refer to **Figure 1.2**).

The DECC recognises that construction activities could potentially generate higher noise levels than those of actual operation. The INP (EPA 2000) does not cover construction activities and the *Interim Construction Noise Guideline* (DECC 2009) does not cover construction activities associated with mining developments. Section 171 of the *Environmental Noise Control Manual* (EPA, 1994) allows the criteria presented in **Table 3.8** to be applied.

**Table 3.8 - EPA Construction Noise Criteria, dB(A)**

Length of Construction Time <sup>1</sup>	Construction Noise Criterion
Up to 4 weeks	$LA_{10, 15\text{ minute}} < LA_{90}$ plus 20 dB
4 to 26 weeks	$LA_{10, 15\text{ minute}} < LA_{90}$ plus 10 dB
Greater than 26 weeks	$LA_{10, 15\text{ minute}} < LA_{90}$ plus 5 dB

Note 1 Time restrictions: Monday to Friday 7.00 am to 6.00 pm  
Saturday 7.00 am to 1.00 pm  
No construction on Sunday or Public Holidays

Source: *Environmental Noise Control Manual* (EPA, 1994)

The construction activities are expected to occur over a period of 3 to 6 months. As such the 4 to 26 weeks construction criterion of LA90 plus 10 dB would apply to the residential receivers in the vicinity of the proposed Wakefield Road mining services facility. Background noise monitoring from 20 and 22 January 2010 indicated the ambient day-time, evening and night-time RBLs adjacent to Wakefield Road were 45, 40 and 40 dB(A) respectively.

The construction activities for the proposed Wakefield Road mining services facility will occur during day-time hours, Monday to Friday and possibly Saturday to 1.00 pm. The project specific criteria for construction related noise at the closest affected residence is 55 dB(A).

### 3.6 Road Traffic Noise Criteria

Road traffic noise criteria are set out in the EPA Environmental Criteria for Road Traffic Noise (ECRTN) (1999). Based on the ECRTN, Wakefield Road is a collector road. The relevant road traffic noise criteria for the road associated with the proposed operations are provided in **Table 3.9**.

**Table 3.9 – Road Traffic Noise Criteria**

Type of Development	Criteria		Where Criteria are Already Exceeded
	Day <sup>1</sup>	Night <sup>2</sup>	
Land use developments with potential to create additional traffic on collector road	60 dB(A) LAeq, 1 hour	55 dB(A) LAeq, 1 hour	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments.  In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

Note 1: Daytime 7.00 am to 10.00 pm.

Note 2: Night time 10.00 pm to 7.00 am.

## 4.0 Noise Modelling

### 4.1 Methodology

The overall objective of the WWCOP application is to provide WWC with one updated approval for the continuation of operations at WWC. The aim of **Section 10** of the INP (EPA, 2000) is to set target noise levels for established industries designed to allow established industries to adapt to changes in the noise expectations of the community while remaining economically viable.

The Project-specific Noise Levels determined in **Section 3.3** are not mandatory noise limits for WWC but provide the initial target levels that drive the process for assessing feasible and reasonable control measures. The achievable noise limits applicable to WWC are then derived from the application of all the feasible and reasonable control measures to the operation.

Two methods are available for assessing the noise impacts of an existing industrial noise source. The first method is to measure the actual noise impacts. The second is to model the noise sources using an appropriate commercially available software package. The first method is subject to the influence of meteorological conditions, changes in operations, the contribution of other noise sources on the noise measurement and the choice of monitoring location, and cannot take into account the application of potential control measures. If a model can be developed that accurately reflects the existing operations then the influence of these factors can be negated.

The methodology used in the assessment of the WWCOP is a combination of both of these methods, in that the measurement of the actual noise impacts has been used to validate a noise model developed for WWC. This model has then been used to assess the feasible and reasonable control measures that could be applied to the operation.

Section 6 of the INP (EPA, 2000) requires noise level predictions to take into account all significant noise sources that may reasonably be expected when the plant or facility in question is fully operational. One method of determining the impact of numerous noise sources at a receiver is to develop a computer model of the proposed operations using a commercially available software package. The model used for this assessment was Environmental Noise Model (ENM), developed by RTA Technology Pty Ltd. ENM is recognised and accepted by the DECC as a computer modelling program suited to predicting noise impacts from industrial noise sources.

The computer model incorporated identifiable noise source data, meteorological data and surrounding terrain characteristics including the layout of the pit top area and any substantial barrier effects from buildings or structures. The model was used to predict the contributed noise levels from the WWC at the nearest potentially affected receivers.

ENM can either calculate noise levels at specified receiver locations (single point calculation) or generate noise level contours over a defined area (contour calculation). The single point calculation feature of ENM was used to assess the noise impacts from the existing WWC pit top (refer to **Section 4.2**). The effect of the control measures that could be applied to the operation under the meteorological conditions identified by the INP (EPA, 2000) as potentially enhancing source to receiver noise propagation were then assessed in **Section 4.3**. Contour calculations were then performed for the most significant meteorological scenario to assess the potential impacts on the surrounding receiver areas.

The single point calculation feature of ENM was also used to assess the noise impacts from the construction phase and operational phase of the Wakefield Road mining services facility (refer to **Section 4.2**).

## 4.2 Noise Model of the WWC Pit Top

### 4.2.1 Operational Noise Sources

Noise models were prepared to represent the type of equipment currently in use at WWC pit top including No.2 Vent Shaft. The sound power levels (SWL) presented in **Table 4.1** were determined from site survey data collected at WWC by Umwelt or from the Umwelt reference database. WWC will operate 24 hours per day, 7 days per week.

**Table 4.1 - Operating Sound Power Levels – WWC Pit Top**

Equipment Description	Sound Power Level
Conveyor Drive (enclosed)	100 dB(A)
Highway Truck	96 dB(A)
Drift Conveyor	90.1 dB(A) / metre
Service Conveyor	90.1 dB(A) / metre
Breaker	115 dB(A)
Bin loading/ truck loading operations	105 dB(A)
No.2 Vent Shaft at 30% Capacity	Fan Discharge - 88 dB(A) Motor Room - 92 dB(A)

### 4.2.2 Noise Model Calibration

A noise model was developed to simulate the currently approved mining operations at WWC pit top using the current infrastructure layout, equipment schedule and equipment location provided by OCAL.

The validation assessment was undertaken at monitoring locations in Killingworth (equivalent M1 and M2) and Barnsley (equivalent to M3) (refer to **Figure 2.1**) under the following weather conditions:

- 0.5 to 1.0 m/s northerly wind;
- 20 to 25 degrees Celsius (°C);
- 75 to 85% relative humidity (R.H.);
- light cloud cover; and
- light or no inversion present.

The noise levels predicted using the Single Point calculation feature of ENM and the corresponding noise monitoring results are presented in **Table 4.2**.

**Table 4.2 – Calibration of ENM Model Representing the Current Operations**

Receiver Area	Description	Estimated Contribution L <sub>Aeq</sub> , 15 minute	Predicted Noise Level L <sub>Aeq</sub> , 15 minute
Killingworth	48 The Trongate, Killingworth	36 to 37 dB(A)	37 dB(A)
Killingworth	2 The Broadway, Killingworth	35 to 40 dB(A)	38 dB(A)
Barnsley	51 Charlton St, Barnsley	35 dB(A)	36 dB(A)

The results in **Table 4.2** indicate that the ENM model provides a fair representation of the actual impacts of the WWC operations at the time the noise monitoring was undertaken.

## 4.3 Noise Model of No.3 Vent Shaft and the Wakefield Road Mining Services Facility

### 4.3.1 Operational Noise Sources

An ENM model was prepared to represent No.3 Vent Shaft and the type of equipment likely to be used at the Wakefield Road mining services facility. The SWLs were determined from site survey data collected at WWC by Umwelt or from the Umwelt reference database and are presented in **Table 4.3**. WWC will operate the Wakefield Road mining services facility 24 hours per day, 7 days per week.

**Table 4.3 - Operating Sound Power Levels – No.3 Vent Shaft and Wakefield Road Mining Services Facility**

Equipment Description	Sound Power Level
No.3 Vent Shaft at 100% Capacity	Fan Discharge - 114 dB(A) Motor Room - 95 dB(A)
Pumps	85 dB(A)
Compressor Enclosure	80 dB(A)
Service Elevator	70 dB(A)
Bin loading/ truck unloading operations	85 dB(A)

### 4.3.2 Construction Activities – Wakefield Road Mining Services Facility

The proposed construction activities at the Wakefield Road mining services facility will include site preparation, civil works and the construction of the site services, buildings and access road.

Noise source models representative of the acoustically significant plant and equipment proposed for use in the construction phase of the project were developed for ENM based on the typical machinery and equipment as shown in **Table 4.4**. The SWLs for the plant and equipment were sourced from the Umwelt reference database and from data provided by West Wallsend Colliery.

**Table 4.4 – Construction Sound Power Levels**

Equipment Description	Sound Power Level
Front end loader	113 dB(A)
Vibratory roller/compactor	103 dB(A)
Mobile crane	110 dB(A)
Generator	109 dB(A)
Concrete boom pump	108 dB(A)
Concrete truck	110 dB(A)
Delivery truck	85 dB(A)
Hand tools	105 dB(A)

## 4.4 Meteorological Conditions

The INP (EPA, 2000) notes that there are two approaches for the assessment of meteorological effects, such as gradient winds and temperature inversions, on propagating the noise from the source to the receiver. The simple method is to use default conditions outlined in the INP. Alternatively, the local meteorological data can be used to determine weather conditions that would be expected to occur at a particular site for a significant period of time.

Meteorological data for the period October 2007 to December 2008 was sourced from Pasminco's weather station at Cockle Creek located approximately 5 kilometres east of WWC. This data was analysed to determine the frequency of occurrence of prevailing winds and temperature inversions.

### 4.4.1 Wind

Wind has the potential to increase noise impacts at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind usually obscures noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the affected area. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30 per cent of the time during any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Section 5 of the INP requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The collated meteorological data for the 2008 period was analysed to determine prevailing wind conditions likely to influence the propagation of noise at WWC and is summarised in **Table 4.5**.

**Table 4.5 - INP Prevailing Wind Assessment**

Season	Wind Direction	Frequency of Occurrence (%)			
		Calm	0.5 m/s to 2 m/s	2 m/s to 3 m/s	0.5 m/s to 3 m/s
<b>Day-time</b>					
Summer	SSE±45°	6.9%	13.9%	10.5%	24.4%
Autumn	S±45°	18.7%	26.9%	8.2%	<b>35.1%</b>
Winter	WNW±45°	15.4%	23.7%	7.1%	<b>30.8%</b>
Spring	SSE±45°	6.8%	16.8%	9.1%	25.9%
<b>Evening</b>					
Summer	ENE±45°	10.5%	26.3%	10.4%	<b>36.7%</b>
Autumn	S±45°	44.6%	19.6%	3.8%	23.5%
Winter	SW±45°	47.4%	20.4%	4.6%	25.0%
Spring	NE±45°	19.5%	27.1%	5.7%	<b>32.7%</b>
<b>Night-time</b>					
Summer	S±45°	43.5%	20.5%	4.2%	24.7%
Autumn	S±45°	63.5%	18.8%	0.9%	19.7%
Winter	SSW±45°	48.4%	13.0%	3.1%	16.1%
Spring	S±45°	40.4%	15.7%	3.7%	19.4%

The results of the wind analysis indicate that prevailing winds occur greater than 30 per cent of the time during autumn and winter day-time periods, and during summer and spring evening periods. The majority of the winds occur in the range 0.5 to 2 m/s. Therefore as part of the noise assessment the following prevailing wind scenarios will be considered:

- 2 m/s southerly wind will be considered during the autumn day-time period;
- 2 m/s WNW wind during the winter day-time period;
- 2 m/s ENE prevailing wind will be considered during the summer evening period; and
- 2 m/s NE wind will be considered during the spring evening period.

#### 4.4.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30 per cent of the total night-time (i.e. the evening and night-time periods) during winter, or about two nights per week.

Meteorological data was assessed in accordance with INP methodology to determine the likelihood of temperature inversions during the winter evening and night-time periods. These results are presented in **Table 4.6**.

**Table 4.6 - Inversion Analysis Summary – Frequency of Stability Classes during Winter Evening and Night-time Periods**

Pasquill-Gifford Stability Class	Frequency of Stability Class
A	0.0%
B	0.0%
C	0.0%
D	45.4%
E	20.4%
F & G	34.2%

The assessment found that the frequency of occurrence of F and G atmospheric stability categories exceeds 30 per cent during the winter evening and night-time periods. Therefore, an additional meteorological scenario representing a temperature inversion using the INP default temperature lapse rate of 3 degrees per 100 metres will be considered in this NIA.

#### 4.4.3 Drainage Flow

Drainage flow is the low level wind associated with the flow of cold air from higher elevations to lower elevations during the presence of a temperature inversion.

The residential properties surrounding the WWC are generally lower in elevation with no intervening topography. The drainage flow in the vicinity of the WWC is therefore generally influenced to a ridge line to the south of the mining area.

Based on the above, drainage flow supporting noise propagation from sources within the proposed WWC operations is likely to occur from a southerly to south-easterly direction.

#### 4.4.4 Meteorological Parameters

The noise model was used to predict noise levels under calm and prevailing atmospheric conditions. The meteorological conditions under which noise predictions were made are presented in **Table 4.7**.

**Table 4.7 - Meteorological Conditions for Noise Modelling**

Scenario	Temperature (°C)	Humidity (%)	Wind Speed (m/s)	Wind Direction (deg from North)	Temperature Gradient (°C/100 m)
Calm	20	65	-	-	-
Autumn - Day-time	15	65	2	180	-
Winter - Day-time	15	65	2	292.5	-
Spring – Evening	15	65	2	45	-
Summer – Evening	20	65	2	67.5	-
Winter – Night-time with Inversion	8	85	-	-	3
Winter – Night-time with Inversion and Drainage Flow	8	85	0.5	180	3

## 5.0 Noise Predictions

WWC will continue to operate continuously 7 days per week 24 hours per day. As a result, the most stringent noise level target that would be set for the mining operation will be night-time Project-specific Noise Level. Based on the analysis of the existing noise environment surrounding the Project this equates to a night-time target noise level criteria of 38 dB(A) in Killingworth, 39 dB(A) in Barnsley and 40 dB(A) in Wakefield to the east of the mining services facility.

WWC noise emissions were modelled using four representative meteorological scenarios to determine compliance with the PSNLs.

### 5.1 Predicted Operational Noise Levels

ENM's Single Point calculation feature was used to determine noise levels from the WWC pit top and the mining services facility at the nearest residential receiver locations under the meteorological conditions described in **Section 4.4**. The results are presented in **Table 5.1** and are compared to the target Project-specific Noise Levels representative of each locality.

**Table 5.1 - Predicted Noise Levels Under Representative Operating Conditions**

Locality	Period	Predicted Noise Level, dB(A) LAeq, 15 minute							Target Project Specific Noise Levels
		Calm	South wind	WNW wind	NE wind	ENE wind	Inversion	Inversion+ Drainage Flow	
R1 - Killingworth The Trongate (South)	Day	33	31	30	-	-	-	-	39
	Evening	34	-	-	38	39	-	-	39
	Night	34	-	-	-	-	39	39	39
R2 - Killingworth The Trongate (North)	Day	38	<b>42</b>	36	-	-	-	-	40
	Evening	38	-	-	<b>41</b>	<b>43</b>	-	-	40
	Night	39	-	-	-	-	<b>43</b>	<b>44</b>	39
R3 - Barnsley Charlton St	Day	36	39	38	-	-	-	-	41
	Evening	36	-	-	34	34	-	-	41
	Night	37	-	-	-	-	39	<b>40</b>	39
R4 - Barnsley Bendigo St	Day	37	40	41	-	-	-	-	41
	Evening	37	-	-	35	35	-	-	41
	Night	38	-	-	-	-	<b>41</b>	<b>41</b>	39
R5 - Barnsley off Charlton St	Day	34	36	37	-	-	-	-	41
	Evening	34	-	-	31	31	-	-	41
	Night	35	-	-	-	-	37	37	39
R6 - Barnsley Northville Dr	Day	<30	33	34	-	-	-	-	41
	Evening	<30	-	-	<30	<30	-	-	41
	Night	30	-	-	-	-	34	35	39
R7 - Barnsley Charlton St (West)	Day	<b>45</b>	<b>46</b>	<b>45</b>	-	-	-	-	41
	Evening	<b>45</b>	-	-	<b>45</b>	<b>45</b>	-	-	41
	Night	<b>45</b>	-	-	-	-	<b>46</b>	<b>46</b>	39
Wakefield (Locality) Wakefield Rd	Day	<30	<30	<30	-	-	-	-	50
	Evening	<30	-	-	<30	<30	-	-	45
	Night	<30	-	-	-	-	<30	<30	40

The existing WWC pit top facilities have the potential to exceed the target Project-specific Noise Levels in both Killingworth and Barnsley under meteorological conditions that propagate noise from WWC towards these receiver areas. The magnitude of the exceedances in the closest residential receiver areas is up to 6 dB under the worst case meteorological conditions considered by the INP (EPA, 2000). The magnitude of the exceedances in the single residential receiver (R7) adjacent to the No. 2 Vent Shaft is up to 7 dB under the worst case meteorological conditions.

The No. 3 Vent Shaft and proposed mining services facility are predicted to achieve the Project-specific Noise Levels for Wakefield under all worst case meteorological conditions.

The contour calculation model was used to determine the noise levels generated by the WWC pit top and No. 2 Vent Shaft under the worst-case meteorological condition at night-time with temperature inversion and drainage flow (refer to **Table 5.1**). The results of the contour calculation model are presented in **Figure 5.1**.

## 5.2 Sleep Disturbance

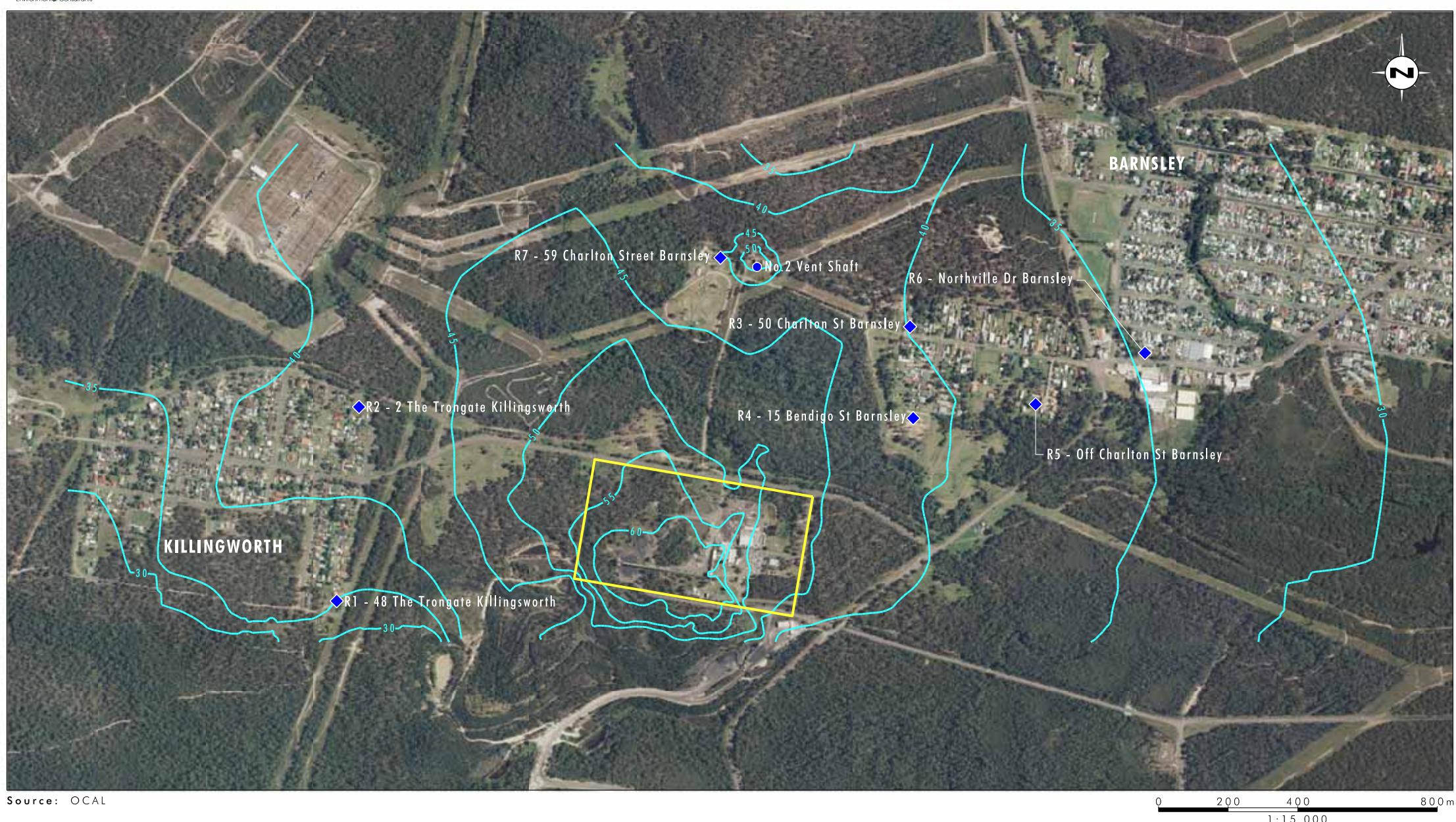
In assessing sleep disturbance, typical  $L_{Amax}$  noise levels experienced at the nearest residential receivers were predicted using the ENM Single Point Calculation feature based on the maximum sound power levels of acoustically significant plant and equipment. Noise sources that could potentially lead to sleep disturbance include:

- reversing beepers;
- rock in the breaker; and
- crushed coal dropping into the raw coal bin when it is empty.

The resulting sleep disturbance noise levels predicted are presented in **Table 5.2**.

**Table 5.2 - Predicted Sleep Disturbance Noise Levels, dB(A)**

Locality	Predicted Noise Level			Sleep Disturbance Noise Goal $L_{A1,1\text{minute}}$
	Calm	Inversion	Inversion + Drainage Flow	
R1 - Killingworth The Trongate (South)	31	37	36	50
R2 - Killingworth The Trongate (North)	40	48	48	50
R3 - Barnsley Charlton St	34	36	37	48
R 4 - Barnsley Bendigo St	35	37	38	48
R5 - Barnsley off Charlton St	32	34	34	48
R6 - Barnsley Northville Dr	< 30	30	31	48
R7 - Barnsley west end of Charlton St	45	46	46	48
Wakefield (Locality) Wakefield Rd	< 30	< 30	< 30	52



#### Legend

- Yellow box: Existing West Wallsend Colliery Pit Top Facility
- Cyan lines: Night Time Noise Contour
- Blue diamond: Receiver Location

FIGURE 5.1

Predicted Noise Contours -  
Temperature Inversion and Drainage Flow

The predicted noise levels in **Table 5.2** meet the recommended sleep disturbance noise goals outlined in **Section 3.4** at all residential receivers.

## 5.3 Construction Noise Levels

The Single Point Calculation model was used to determine noise levels at the nearest residential receiver locations for the construction phase of the Wakefield Road mining services facility activities under calm and adverse weather conditions. The predicted LAeq, 15 minute construction noise levels are presented in **Table 5.3** and are compared to the relevant construction noise criteria.

**Table 5.3 – Predicted Construction Noise Levels, dB(A)**

Locality	Predicted Noise Level			Construction Noise Goal LAeq,15minute
	Calm	WNW wind	NE wind	
Wakefield (Locality) Wakefield Rd	< 30	< 30	< 30	55

The predicted noise levels in **Table 5.3** meet the construction noise goal outlined in **Section 3.5** at all residential receivers.

## 5.4 Road Traffic Noise Assessment

The Project will not generate any additional road traffic associated with the WWC pit top. Haulage of coal is covered under a separate existing development consent, which does not form part of this Project Application.

The proposed mining services facility will result in minor additional traffic movements during both the construction period and operation. The proposed mining services facility is located in an existing disturbed area between Wakefield Road and the F3 Freeway. The proposed site is influenced by road traffic primarily from the F3 Freeway.

All access to the proposed mining services facility will be from Wakefield Road, which is a rural collector road. Under the ECRTN, land use developments with potential to create additional traffic on a collector road should not lead to an increase in exiting noise levels of more than 2 dB.

The proposed mining services facility will generate up to two heavy vehicles per day delivering stone and other materials. WWC operations offices will also access the proposed mining services facility (up to three vehicles per day) for general operational supervision. Based on existing traffic volumes, an additional 10 vehicle movements per day generated by the proposed mining services facility will equate to an increase of approximately 0.03 dB.

The construction period for the proposed mining services facility will be approximately six months and will not generate significant traffic movements. Any potential noise generation from the construction of the proposed mining services facility would be minor and not impact on road traffic noise levels.

## 6.0 Noise Mitigation

As a result of the predicted exceedances of the target Project-specific Noise Levels, as presented in **Table 5.1**, strategies should be considered to reduce the noise impact on offsite receivers from the WWC facilities.

The three main strategies for noise control are:

- **controlling noise at the source** - There are three approaches to controlling noise generated by the source: Source elimination; Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA);
- **controlling the transmission of noise** - There are two approaches: the use of barriers and land-use controls which attenuate noise by increasing the distance between source and receiver; and
- **controlling noise at the receiver** - There are two approaches: negotiating an agreement with the landholder or acoustic treatment of dwellings to control noise.

The above noise mitigation controls and strategies to achieve noise goals are detailed in **Appendix D**.

If unacceptable noise impacts from a development persist after noise mitigation action has been undertaken, Section 8 of the INP (EPA, 2000) provides a process for negotiating an agreement between the proponent and the affected party(ies).

### 6.1 WWC Pit Top Noise Control Strategy

The results outlined in **Section 5.1** indicate that the noise emissions from WWC pit top have the greatest impact along eastern edge of Killingworth, exceeding the target night-time Project-specific Noise levels by up to 6 dB during the occurrence of a temperature inversion and associated drainage wind.

The dominant noise sources include:

- the coal breaker, especially when handling rock;
- the load out from the raw coal bin;
- service conveyors, especially in elevated positions; and
- the coal trucks hauling the raw coal to the Macquarie Coal Preparation Plant.

In order to achieve the target Project-specific Noise Levels at Killingworth and other locations where exceedences occur, it will be necessary to implement a range of noise mitigation controls.

A 10 dB reduction in the noise level from the coal breaker is predicted to achieve a 3.1 dB reduction in the overall noise impact of the WWC pit top facility. A 15 dB reduction in the noise level from the coal breaker is predicted to achieve a 3.5 dB reduction.

A 5 dB reduction in the noise level from coal bin loadout or from one of the conveyors is predicted to achieve less than a 0.5 dB reduction in the overall noise impact of the WWC pit top facility. However, combined with a 15 dB reduction in the noise level from the coal

breaker the predicted reduction in the overall noise impact of the WWC pit top facility would be up to 5 dB.

To determine the extent of attenuation required, the effect of such controls has been modelled at the most adversely affected receiver. The most significant noise sources ranked from highest to lowest are presented in **Table 6.1**.

**Table 6.1 – Noise Source Ranking and Mitigation Options for Killingworth**

Noise Source	Unmitigated Contribution, dB(A)	Equipment Attenuation	
		Attenuation, dB	Mitigated Contribution, dB(A)
11 WWC Breaker	41.4	- 15	<b>26.4</b>
12 Bin loadout	35.4	- 5	30.4
13 Service conveyor (top of bin)	32.1		32.1
10 Service conveyor to loadout	31.5	- 5	<b>26.5</b>
9 Service conveyor from breaker	29.5	- 5	<b>24.5</b>
8 Service conveyor	28.7	-5	23.7
6 Truck	28.4		28.4
4 Truck	27.4		27.4
3 Truck	27		27
7 Drift conveyor	25.2		25.2
2 Truck	20.9		20.9
5 Truck	15.9		15.9
1 Drive room	15.3		15.3
<b>Total dB(A)</b>	<b>43.8</b>		<b>38.0</b>

To reduce noise levels from the WWC in the Killingworth receiver area during the evening and night-time periods, noise mitigation works on the coal breaker, service conveyors and bin loadout will result in the overall noise level from the WWC achieving the theoretical INP evening and night-time noise goals for the area of 38 dB(A). While the implementation of these noise mitigation works would enable WWC to achieve compliance with the target project-specific noise goals the economic feasibility of these mitigation works needs to be considered.

WWC is committed to mitigating the noise impact from the coal breaker by at least 10 dB by enclosing the existing coal breaker or, should it become economically feasible, replacing with the existing coal breaker with a new, quieter style of crusher or by employing an alternative process. Following the completion of this work, the achievable noise goal for Killingworth would be 41 dB(A) and the WWC pit top facility would achieve the target Project-specific Noise Levels in Barnsley.

In order to achieve the further attenuation of noise sources from the WCC pit top facility opportunities should be investigated to implement the following noise control measures:

- mitigation of the service conveyors from the crusher by installing 'low noise' idlers;
- mitigation of the bin loadout operations by maintaining a minimum amount of material in the bin at all times during loadout;

- review of loading procedures and operator training to optimise choke loading to minimise impact noise into the body of the bin; and
- review of bin design to assess the noise impacts of coal unloading on the walls of the bin.

## 6.2 No.2 Vent Shaft Control Strategy

The No. 2 Vent Fan services the ventilation needs of the northern section of the WWC underground workings and is also used as a secondary system to provided ventilation to the whole mine when No. 3 Vent Fan is undergoing maintenance. The No. 2 Vent Fan currently operates at 30 per cent capacity and is not a dominant noise source in the region surrounding the WWC pit top except at the residential receiver immediately adjacent to the vent shaft (refer to **Figure 5.1**). The results outlined in **Section 5.1** indicate that mitigation work would be required to reduce the noise emissions from the No. 2 Vent Shaft by up to 7 dB in order to achieve the target night-time Project-specific Noise Levels at the residential receiver immediately adjacent to the vent shaft.

The operation of the No. 2 Vent Fan at full capacity would increase the noise levels at the residential receiver immediately adjacent to the vent shaft by approximately 13 dB. The noise level in Killingworth would be increased by approximately 1 dB and while the noise levels in Barnsley would be increase by 4 to 5 dB

Attenuation of the No. 2 Vent Fan by 13 dB would enable the No. 2 Vent Fan to achieve 100 per cent capacity without increasing the noise levels in the region surrounding the WWC pit top except at the residential receiver immediately adjacent to the vent shaft. A 10 dB reduction in the noise from the No. 2 Vent Fan would enable the vent fan to run at 70 per cent capacity. Both options require further mitigation works to achieve an additional 7 dB attenuation in order to achieve the target night-time Project-specific Noise Levels at the residential receiver immediately adjacent to the vent shaft.

WWC is committed to managing the noise impact from the No. 2 Vent Shaft through the installation and maintenance of appropriate noise control measures on the vent shaft fan and motor room and, as appropriate, through negotiation with the adjacent affected landowner. The selection and installation of noise mitigation controls on the No. 2 Vent Fan will be dependent on the future operational requirement of the No. 2 Vent Fan and performance of the vent fan against the target PSNL's for each of the receiver locations in the surrounding region. The performance/noise impacts of the No. 2 Vent Fan will be assessed if the operational requirements of No. 2 Vent Fan vary as a result of changes in ventilation needs the WWC underground workings or as a result of the No. 3 Vent Fan undergoing maintenance.

Investigations into noise impacts of the No.2 Vent Fan will be implemented if the operational requirements of the No.2 Vent Fan are increased to greater than the current 30 per cent operating capacity. If the noise impacts are found to be unacceptable, WWC will enter into a Pollution Reduction Program regarding the attenuation of the No.2 Vent Fan as a part of WWC's Environment Protection Licence.

## 7.0 Cumulative Noise Assessment

The INP (2000) allows assessment of the potential cumulative noise impacts associated with existing and future developments by defining appropriate noise emission criteria with respect to maintaining the noise amenity at residential receivers and considering applicable consent limits. The cumulative impact of the WWC has been assessed in relation to preserving the noise amenity at the nearest residential receivers localities (refer to **Table 3.5**).

As discussed in **Appendix B**, the INP (2000) prescribes detailed methods for establishing project specific intrusive criteria and amenity criteria at potentially affected receivers for a development (in isolation). Potential cumulative noise impacts from existing and future developments is then addressed by the INP by ensuring that the appropriate noise emission criteria (and approved limits) are established with a view to maintaining acceptable noise amenity levels for residences.

The recommended amenity noise level for all receiver areas is 55 dB(A) LAeq, Day, 45 dB(A) LAeq, Evening and 40 dB(A) LAeq, Night (refer to **Table 5.1**). The predicted cumulative noise impacts of WWC with the nearest industrial source, Westside Mine, are presented in **Table 7.1**.

**Table 7.1 - Predicted Cumulative Noise Levels, dB(A)**

Locality	Period	WWC LAeq Noise Level	Other <sup>3</sup> Industrial LAeq Noise Level	Industrial Contribution LAeq, 15 minute	Estimated Cumulative Noise Level, LAeq, period	Recommended LAeq (ANL)
R1 - Killingworth The Trongate (South)	Day	37 <sup>1</sup>	36	40	37	55
	Evening	37	30	38	36	45
	Night	37	30	38	36	40
R2 - Killingworth The Trongate (North)	Day	40 <sup>1</sup>	38	42	39	55
	Evening	40	32	41	39	45
	Night	35	32	37	35	40
R3 - Barnsley Charlton St	Day	30 <sup>1</sup>	35	36	33	55
	Evening	30 <sup>1</sup>	32	34	32	45
	Night	30	32	34	32	40
R4 - Barnsley Bendigo St	Day	30 <sup>1</sup>	38	39	36	55
	Evening	30 <sup>1</sup>	32	34	32	45
	Night	30	32	34	32	40
R5 - Barnsley off Charlton St	Day	30 <sup>1</sup>	38	39	36	55
	Evening	30 <sup>1</sup>	32	34	32	45
	Night	30	32	34	32	40
R6 - Barnsley Northville Dr	Day	30 <sup>1</sup>	30	33	30	55
	Evening	30 <sup>1</sup>	34	35	33	45
	Night	30 <sup>2</sup>	34	35	33	40
R7 - Barnsley Charlton St (West)	Day	45	30	33	43	55
	Evening	45	34	35	43	45
	Night	45	34	35	43	40
Wakefield (Locality) Wakefield Rd	Day	30 <sup>1</sup>	35	36	33	55
	Evening	30 <sup>1</sup>	-	30	28	45
	Night	30 <sup>2</sup>	-	30	28	40

Note 1: Contribution from WWC for day-time and evening periods estimated to be the same as the night-time contribution.

Note 2: Inaudible from attended noise survey (refer to **Table 5.1**).

Note 3: Other potential contributing noise sources include Westside mine during the daytime, Killingworth Substation and Macquarie Coal Preparation Plant.

Predicted cumulative noise levels in **Table 7.1** are less than the recommended acceptable noise levels at all the potential receiver locations in the region surrounding WWC except at receiver location R7 immediately adjacent to No. 2 Vent Fan. The recommended night time amenity noise level at receiver location R7 is exceeded by up to 3 dB as a result of the continuous operation of No. 2 Vent Fan at 30 per cent capacity which elevates background noise levels in the area immediately surrounding the vent fan. As discussed in **Section 6.2**, WWC is committed to managing the noise impact from No. 2 Vent Shaft through the installation of appropriate noise control measures on the vent shaft fan and motor room if the capacity is proposed to be increased in the future and, as appropriate, through negotiation with the adjacent affected landowner.

## 8.0 Conclusions

### 8.1 Recommendations

Umwelt has undertaken a Noise Impact Assessment of the WWC operations in accordance with the INP.

The assessment indicates that under worst-case conditions the current operation has the potential to exceed theoretical target project specific noise goals based on the INP during the evening and night-time at some receiver areas.

To achieve the target evening and night-time Project-specific Noise Levels the economic feasibility of a range of noise control measures need to be considered. WWC is committed to attenuation on the coal breaker by at least 10 dB. This will result in a 3 dB reduction in the noise level from the WWC pit top facility. The achievable noise goal for Killingworth would be 41 dB(A), 3 dB above the target night-time Project-specific Noise Levels.

WWC is also committed to managing the noise impacts from the No. 2 Vent Fan. Depending on future operating requirements WWC will select and implement noise mitigation controls based on the performance of the vent fan against the target PSNL's for each of the receiver locations in the surrounding region. Further investigations into noise mitigation of the No. 2 Vent Fan will be implemented if the operational requirements of No. 2 Vent Fan are increased to greater than the current 30 per cent operating capacity. If the noise impacts are found to be unacceptable the WWC will enter into a Pollution Reduction Program regarding the attenuation of the No. 2 Vent Fan as a part of WWC's Environment Protection Licence. The monitoring of the noise impacts from and, the implementation of noise control measures on, the No. 2 Vent Fan and any negotiations with any effected party(s) will be in accordance with the INP (EPA, 2000) and will be managed in accordance with the requirements of WWC's Environment Protection Licence.

WWC will also investigate whether there are any feasible opportunities for further noise reduction at Killingworth in relation to:

- mitigation of the service conveyors from the crusher through the systematic replacement of noisy conveyor idlers;
- mitigation of the bin loadout operations by managing the level of raw coal in the bin or by providing sound attenuation to the bin;
- review of loading procedures and operator training; and

These noise control measures are discussed in detail in **Section 6.1**.

The assessment of the WWC pit top facility found that the WWC operations are expected to comply with the recommended sleep disturbance noise goals at all residential receivers localities surrounding the pit top facility.

The assessment also found that the proposed WWC mining services facility on Wakefield Road would achieve the Project-specific Noise Levels for the nearest potentially effected receiver and would also achieve the construction noise goals at the nearest potentially effected receiver.

## 8.2 Monitoring Program

Following the completion of any noise mitigation works it is recommended that OCAL implement a monitoring program that will specifically address:

- compliance with the project-specific noise level  $L_{Aeq, 15\text{ min}}$  descriptor; and
- measurement and assessment of any transient noise levels using the sleep disturbance criteria descriptor of  $L_{A1, 1\text{ min}}$ .

The noise monitoring should be based around an attended monitoring program that:

- measures  $L_{A90, 15\text{ min}}$  and  $L_{Aeq, 15\text{ min}}$  ambient noise levels;
- measures and/or calculates the contributed noise level from the operation;
- measures other statistical noise levels representative of the noise environment including the maximum and minimum noise levels measured during the interval; and
- records weather conditions at the monitoring site.

The monitoring program should be undertaken during periods of normal production with the objective of confirming the acoustic performance of the facility.

The installation of noise mitigation controls on the No. 2 Vent Fan will be dependent on the future operational requirement of the vent fan. The selection of the most appropriate noise mitigation controls will be based on the performance of the vent fan against the target PSNLs for each of the receiver locations in the surrounding region. The performance/noise impacts of No. 2 Vent Fan will be measured and assessed if the operational requirements of No. 2 Vent Fan change as a result of future ventilation needs for the WWC underground workings or as a result of No. 3 Vent Fan undergoing maintenance.

## 8.3 Reporting

Once the project specific noise levels, determined in accordance with the INP, have been adopted by OCAL, the monitoring results should be reviewed by the OCAL environmental representative to assess compliance with the goals outlined in **Section 3.0**. The monitoring results should also be reported in accordance with the relevant requirements (if any) of the project approval and Environmental Protection Licence for the facility.

## 9.0 References

Department of Environment and Climate Change, 2006. *INP application notes – July 2006*.

Department of Environment and Climate Change, 1999. *Environmental Criteria for Road Traffic Noise (1999)*.

NSW Environment Protection Authority, 1994. *Environmental Noise Control Manual*.

NSW Environment Protection Authority, 2000. *New South Wales Industrial Noise Policy*.

## **APPENDIX A**

### **Glossary of Terms**

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## Appendix A – Glossary of Terms

1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment background level - A single-figure background level representing each assessment period – day, evening and night (that is, three assessment background levels are determined for each 24-h period of the monitoring period). It is determined by taking the lowest 10th percentile of the $L_{90}$ level for each assessment period.
ANL	Acceptable Noise Level is an $L_{Aeq, period}$ (day, evening or night) listed in Table 2.1 of the INP as being a noise level from industrial sources that is recommended not to be exceeded, but may be exceeded in certain circumstances, in which case Table 2.1 lists a “Recommended Maximum” noise level which is 5 dB greater than the ANL, and which provides guidance on an upper limit to noise from industry.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
Background Noise Level	Defined (Industrial Noise Policy, section 3.1) as the underlying level of noise present in ambient noise when all unusual extraneous noise has been removed. It is considered to be represented by the $LA90$ usually measured over a 15 minute period.
Cumulative	Cumulative noise level is the total of noise from all sources. A cumulative assessment is required when noises from several industrial sources (existing, proposed and potential), each of which might be less than a criterion, can combine to cause a noise level in excess of the criterion.
Daytime Or Day	For Monday to Saturday 7.00am – 6.00pm; On Sundays and Public Holidays 8.00am – 6.00pm.
dB(A), dBA	Decibels A-weighted.
dB(L), dB(Lin)	Decibels Linear or decibels Z-weighted.
Decibel (dB)	The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud.
Evening	6.00pm to 10.00pm for all seven days of the week.
Gradient Wind	A hypothetical wind that is the summation of the horizontal components of winds that contributes to the vector direction being assessed.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
Intrusive noise	refers to noise (measured as $LAeq, 15$ minutes) that intrudes above the background level measured in the absence of the source by more than 5 dB.
LA10	The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis. Typically used to assess the impact of an existing operation on a receiver area and is referred to as the cumulative noise levels at the receiver attributable to the noise source.

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LA90	Background Noise Level. The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
LAmax	The maximum of the sound pressure levels recorded over an interval of 1 second.
LA1,1minute	The measure of the short duration high-level noises that cause sleep arousal. The noise level is measured as the percentile sound pressure level that is exceeded 1 per cent of measurement period with 'A' frequency weighting calculated by statistical analysis during a measurement time interval of 1 minute.
LAeq,t	Equivalent continuous sound pressure level - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time. Usually measured in dB with 'A' weighting.
LA <sub>n</sub>	Percentile level - A measure of the fluctuation of the sound pressure level which is exceeded 'n' per cent of the observation time.
Nighttime Or Night	For Monday to Saturday 10.00pm - 7.00am; On Sundays and Public Holidays 10.00pm - 8.00am.
Noise Affectation Zone	is the area around an industrial noise source where LAeq, 15 minute levels are above 5dB above the project-specific noise levels. .
Noise Management Zone	is the area around an industrial noise source where LAeq, 15 minute levels are between 1 and 5 dB above the project-specific noise levels or criteria
RBL	Rating background level - The overall single figure background level representing each assessment period over the whole monitoring period determined by taking the median of the ABLs found for each assessment period.
SPL (dBA)	Noise: Sound pressure level - The basic measure of noise loudness. The level of the root-mean-square sound pressure in decibels given by: $SPL = 10 \cdot \log_{10} (p/p_0)^2$ <p>where p is the rms sound pressure in pascals and <math>p_0</math> is the sound reference pressure at 20 <math>\mu</math>Pa. decibels.</p>
SWL	Sound power level - A measure of the energy emitted from a source as sound and is given by: $SWL = 10 \cdot \log_{10} (W/W_0)$ <p>where W is the sound power in watts and <math>W_0</math> is the sound reference power at <math>10^{-12}</math> watts.</p>

## **APPENDIX B**

# **INP Assessment Methodology**

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## Appendix B - INP Assessment Methodology

### Industrial Noise Policy

Responsibility for the control of noise emissions in NSW is vested in Local Government and the Department of Environment and Climate Change (DECC). The *NSW EPA Industrial Noise Policy* (INP), 2000, provides a framework and methodology for deriving limit conditions for consent and licence conditions. Using this policy the DECCW regulates premises that are scheduled under the *Protection of the Environment Operations Act, 1997* (POEO Act).

The specific INP (EPA, 2000) objectives are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve the noise amenity for specific land uses;
- to use the criteria as the basis for deriving project-specific noise levels;
- to promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;
- to outline a range of mitigation measures that could be used to minimise noise impacts;
- to provide a formal process to guide the determination of feasible and reasonable noise limits for consent or licence conditions that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The INP (EPA, 2000) is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operation of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

The application of the INP (EPA, 2000) involves the following processes:

- determining the project-specific noise levels (PSNL) from intrusiveness and amenity based measurement of the existing background and ambient noise levels. For existing industrial operations, the underlying level of noise present in the ambient noise, should be determined excluding the noise source under investigation;
- predicting or measuring the noise levels produced by the development; and
- comparing the predicted noise levels with the project-specific noise levels and assessing the impacts.

Where the project-specific noise levels are predicted to be exceeded the INP (EPA, 2000) provides guidelines on the assessment of feasible and reasonable noise mitigation strategies, including:

- ‘weighing up’ the benefit of the development against the social and environmental costs resulting from the noise impacts;
- establishment of achievable and agreed noise limits for the development in consultation with the consent authority; and
- undertaking performance monitoring of environmental noise levels to determine compliance with the consent and licence conditions.

## INP Assessment Methodology

There are two criteria to consider when establishing project-specific noise levels for the assessment of industrial noise sources. These criteria are:

- **the intrusive noise criterion**, which is based on the background noise level plus 5 dB. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP (EPA, 2000) and is based on the use of noise monitoring data or INP default RBL's to establish the assessable background noise levels; and
- **the noise amenity criterion**, which is based on the recommended noise levels in the INP (EPA, 2000) for prescribed land use. The recommended acceptable and maximum ambient noise levels are outlined in Table 2.1 of the INP (EPA, 2000). Table 2.2 of the INP (EPA, 2000) outlines the requirements for developments where the existing noise level from industrial noise sources is close to the acceptable noise level.

The relevant tables in Section 2 of the INP relating to the amenity criteria relevant to the project are presented in **Table B.1** and **Table B.2**.

**Table B.1 - Amenity Criteria - Recommended L<sub>Aeq</sub> Noise Levels from Industrial Noise Sources**

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L <sub>Aeq</sub> Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dB(A)	55 dB(A)
		Evening	45 dB(A)	50 dB(A)
		Night	40 dB(A)	45 dB(A)
	Suburban	Day	55 dB(A)	60 dB(A)
		Evening	45 dB(A)	50 dB(A)
		Night	40 dB(A)	45 dB(A)
	Urban	Day	60 dB(A)	65 dB(A)
		Evening	50 dB(A)	55 dB(A)
		Night	45 dB(A)	50 dB(A)
	Urban/Industrial Interface - for existing situations only	Day	65 dB(A)	70 dB(A)
		Evening	55 dB(A)	60 dB(A)
		Night	50 dB(A)	55 dB(A)
Area specifically reserved for passive recreation	All	When in use	50 dB(A)	55 dB(A)
Active recreation area (School playground, golf course)	All	When in use	55 dB(A)	60 dB(A)
Commercial premises	All	When in use	65 dB(A)	70 dB(A)
Industrial premises	All	When in use	70 dB(A)	75 dB(A)

Note 1: For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Note 2: The L<sub>Aeq</sub> index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

**Table B.2 - Modification to Acceptable Noise Level (ANL) to Account for Existing Levels of Industrial Noise**

Total Existing LAeq Noise Level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dB
≥ Acceptable noise level plus 2 dB	If existing noise level is likely to decrease in future acceptable noise level minus 10 dB If existing noise level is unlikely to decrease in future existing noise level minus 10 dB
Acceptable noise level plus 1 dB	Acceptable noise level minus 8 dB
Acceptable noise level	Acceptable noise level minus 8 dB
Acceptable noise level minus 1 dB	Acceptable noise level minus 6 dB
Acceptable noise level minus 2 dB	Acceptable noise level minus 4 dB
Acceptable noise level minus 3 dB	Acceptable noise level minus 3 dB
Acceptable noise level minus 4 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 5 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 6 dB	Acceptable noise level minus 1 dB
< Acceptable noise level minus 6 dB	Acceptable noise level

Note 1: ANL = recommended acceptable LAeq noise level for the specific receiver.

In assessing the noise impacts from industrial sources at residential receivers both the intrusive and amenity criteria are considered. For each period (day, evening and night) the most stringent of either the intrusive or amenity criteria becomes the limiting criterion and forms the project-specific noise level for the industrial source.

If the existing ambient noise level is close to the acceptable noise level, a new source must be controlled to preserve the amenity of the surrounding area. If the overall noise level from the industrial source already exceeds the acceptable noise level for the affected area, the LAeq noise level from a new source should meet the conditions set out in **Table B.2** above.

## INP Project-Specific Criteria

The INP (EPA, 2000) states that the criteria outlined in **Tables B.1** and **B.2** have been selected to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time. Provided the criteria in the INP (EPA, 2000) are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

**Table B.3** presents the methodology for assessing noise levels which may exceed the INP (EPA, 2000) project-specific noise assessment criteria.

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**Table B.3 - Noise Impact Assessment Methodology**

<b>Assessment Criterion</b>	<b>Project-Specific Criteria</b>	<b>Noise Management Zone</b>	<b>Noise Affectation Zone</b>
Intrusive	Rating background level plus 5 dB	$\leq 5$ dB above project-specific criteria	$\geq 5$ dB above project-specific criteria
Amenity	INP based on existing industrial level	$\leq 5$ dB above project-specific criteria	$\geq 5$ dB above project-specific criteria

For the purposes of assessing the potential noise impacts the project-specific, management and affectation criteria are further defined in the following sections.

#### Project-Specific Criteria

Most people in the broader community would generally consider exposure to noise levels that achieve the project-specific criteria to be acceptable.

#### Noise Management Zone

Depending on the degree of exceedance of the project-specific criteria (1 dB to 5 dB) noise impacts in this zone could range from negligible to moderate. It is recommended that management procedures be implemented including:

- prompt response to any issues of concern raised by community;
- noise monitoring on-site and within the community;
- refinement of on-site noise mitigation measures and plant operating procedures where practical;
- consideration of acoustical mitigation at receivers; and
- consideration of negotiated agreements with property holders.

#### Noise Affectation Zone

Exposure to noise levels corresponding to this zone (more than 5 dB above project-specific criteria) may be considered unacceptable by some property holders and implementation of the following measures may be required:

- discussions with relevant property holders to assess concerns and provide solutions;
- implementation of acoustical mitigation at receivers; and
- negotiated agreements with property holders.

## **Assessing Intrusiveness Criteria**

The DECC has provided an application note for the assessment of the intrusiveness criteria such that the level for night time is no greater than the evening and evening is no greater than the daytime level (DECC July 2006). The application note is reproduced below.

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### **When the RBL for evening or night is higher than the RBL for daytime**

<http://www.environment.nsw.gov.au/noise/applicnotesindustnoise.htm>

The results of long term unattended background noise monitoring can sometimes determine that the calculated Rating Background Level (RBL) for the evening or night period is higher than the RBL for the daytime period. These situations can often arise due to increased noise from for example insects or frogs during the evening and night in the warmer months or due to temperature inversion conditions during winter. The objective of carrying out long-term background noise monitoring is to determine existing background noise levels at a location that are indicative of the entire year.

In determining project-specific noise levels from the RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise levels for a particular development, it is generally recommended that the intrusive noise level for evening be set at no greater than the intrusive noise level for daytime. The intrusive noise level for night-time should be no greater than the intrusive noise level for day or evening. Alternative approaches to these recommendations may be adopted if appropriately justified.

## **Assessing Sleep Disturbance**

The DECC have provided an application note for the assessment of sleep disturbance (DECC July 2006). The application note is reproduced below.

### **Sleep disturbance**

<http://www.environment.nsw.gov.au/noise/applicnotesindustnoise.htm>

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

DEC reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, DEC recognised that current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DEC will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur
- time of day (normally between 10pm and 7am)
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. DEC will accept analysis based on either LA1, (1 minute) or LA, (Max).

## **APPENDIX C**

### **Assessment of the Existing Noise Environment**

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## Appendix C – Assessment of Existing Noise Environment

### Industrial Noise Policy Methodology

The NSW EPA *Industrial Noise Policy, 2000* (INP) documents the procedures for determining the project-specific noise levels for intrusiveness and amenity based on the measurement of the existing background and ambient noise levels.

The underlying ambient noise level is referred to as the background noise level and is represented by the LA90, 15 minute descriptor. The intrusiveness of an industrial noise source is generally considered acceptable if the predicted LAEq, 15 minute from the noise source does not exceed the background noise level by more than 5 dB when measured in the absence of the source. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP (EPA, 2000) and is the median value of the Assessment Background Levels (ABL) determined for the monitoring period.

To control and/or limit the increase in industrial noise levels, the INP (EPA, 2000) recommends acceptable and maximum ambient noise levels for typical receiver areas and land uses. The existing ambient noise level by the LAeq, period descriptor where the periods is the day, evening and/or night time during which the proposed development will operate. For a ‘high noise risk’ development the INP (EPA, 2000) suggests a minimum measurement period of one week is required in order to obtain sufficient data to determine the existing LAeq noise levels. For a ‘low noise risk’ development the INP (EPA, 2000) suggests a measurements made over a period of one day would be sufficient. The assessment of the existing LAeq noise levels is then used to determine the amenity criteria which are designed to control the overall impact from industrial noise sources.

The INP (EPA, 2000) notes that noise monitoring data should be excluded when the average wind speeds are greater than 5 m/s or when it is raining.

### Monitoring Program

The existing noise environment in the area surrounding the Project was assessed using a combination of Acoustic Research Laboratories environmental noise loggers, Project related attended noise monitoring and the results from attended noise monitoring associated with the routine monitoring programs for West Wallsend Colliery (WWC).

#### Environmental Noise Loggers

In December 2008 Acoustic Research Laboratories - Environmental Loggers Type EL-215 were used to measure the ambient noise levels in the region surrounding WWC. The noise loggers were calibrated using a Brüel & Kjær Type 4231 Noise Meter Calibrator, Serial Number 2130702. The noise monitors recorded A-weighted statistical noise levels at 15 minute intervals. Details of the noise monitoring schedule are presented in **Table C.1**.

The monitoring data from the environmental noise loggers included:

- ambient background and statistical noise levels for each 15 minute interval recorded as LA1, 15minute, LA10, 15minute, and LA90, 15minute;
- LAEq, 15minute noise levels; and
- maximum and minimum noise levels.

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**Table C.1 - Noise Monitoring Details for Environmental Loggers**

Monitoring Location	Location	Logger Serial No.	Measurement
M1	The Trongate (South) Killingworth	194538	15:54 2/12/08 to 11:07 11/12/08
M2	The Trongate (North) Killingworth	194449	15:46 2/12/08 to 10:50 11/12/08
M3	Bendigo Street Barnsley	194637	14:48 2/12/08 to 10:28 11/12/08
M4	Wakefield Road Barnsley	194539	12:15 3/12/08 to 11:15 11/12/08

Attended Noise Monitoring

The objective of the attended noise monitoring program was to determine the sources of noise contributing to the ambient noise environment and determine the contribution from WWC to the ambient noise environment levels. This information has been used to cross correlated the results from the environmental noise.

The details of the attended noise monitoring program used to assess the noise environment in the region surrounding WWC are presented in **Table C.2**. The attended noise monitoring program measurements were undertaken with a Svanek 959 integrating sound level meter, Serial Number 12918. During the attended monitoring surveys the noise meter was calibrated using a Svanek Model SV 30A Noise Meter Calibrator, Serial Number 14162.

The data collected during the attended noise monitoring program included:

- the recorded A-weighted 1/3 octave noise levels at 1 second intervals over a 15 minute measurement period;
- the results of a 1000 Hz low pass filter at 1 second intervals over the 15 minute measurement period;
- an assessment of the maximum LA1,1min noise level recorded over the 15 minute measurement period;
- the LAeq, 15 minute and LA90, 15minute noise levels for the 15 minute measurement period; and
- ambient background and statistical noise levels for each 15 minute interval recorded as LA1, 15minute, LA10, 15minute, and LA90, 15minute.

**Table C.2 - Details of Attended Noise Monitoring Program Used in Assessment**

Monitoring Location	Location	Noise Meter Serial No.	Measurement
M1	The Trongate (South) Killingworth	12918	2 March 2009
M2	The Trongate (North) Killingworth	12918	2 March 2009 and 4 December 2009
M3	Bendigo Street Barnsley	12918	2 March 2009 and 4 December 2009
M5	Wakefield Road Wakefield	12918	20 and 22 January 2010

Attended noise monitoring is also undertaken on a quarterly basis in the region surrounding WWC as apart of the routine environmental monitoring program. The results of the quarterly attended noise monitoring are presented in the Annual Environmental Management Report (AEMR) for WWC.

### Meteorological Data

Data on the weather conditions during each of the monitoring period was collected from the weather station at WWC and the former Pasminco operation at Boolaroo.

The meteorological data included:

- ambient temperature at 2 and 10 metres;
- wind speed; wind direction and stability class (or sigma-theta);
- humidity; and
- rainfall.

### **Existing Background and Amenity Noise Levels**

The results of the monitoring programs are presented in graphical form in the following section. This information has been use to determine the underlying noise environment represented by the background and amenity noise levels in the region surrounding WWC. The noise levels presented in **Table C.3** represent the underlying level of noise present at the monitoring locations in the absence of the noise source under investigation. These noise levels have been determined by filtering the monitoring data for wind speeds and wind directions that inhibit the propagation of noise from the existing operations towards each of the monitoring locations.

**Table C.3 – RBL and Mean L<sub>Aeq</sub>, dB(A)**

Time Period	Day (0700 to 1800)	Evening (1800 to 2200)	Night (2200 to 0700)
<b>M1, The Trongate (South), Killingworth</b>			
RBL	33.7	38.9	34.4
Mean L <sub>Aeq</sub>	47.4	45.1	43.7
<b>M2, The Trongate (North), Killingworth</b>			
RBL	35.2	36.8	34.4
Mean L <sub>Aeq</sub>	49.9	48.8	47.9
<b>M3, Bendigo St, Barnsley</b>			
RBL	36.1	37.6	33.5
Mean L <sub>Aeq</sub>	54.3	52.9	46.7
<b>M4, Wakefield Rd, Barnsley</b>			
RBL	41.4	37.5	35.5
Mean L <sub>Aeq</sub>	67.7	59.5	58.2
<b>M5, Wakefield Rd, Wakefield</b>			
RBL	45.0	40.0	42.0
Mean L <sub>Aeq</sub>	60.0	61.0	52.0

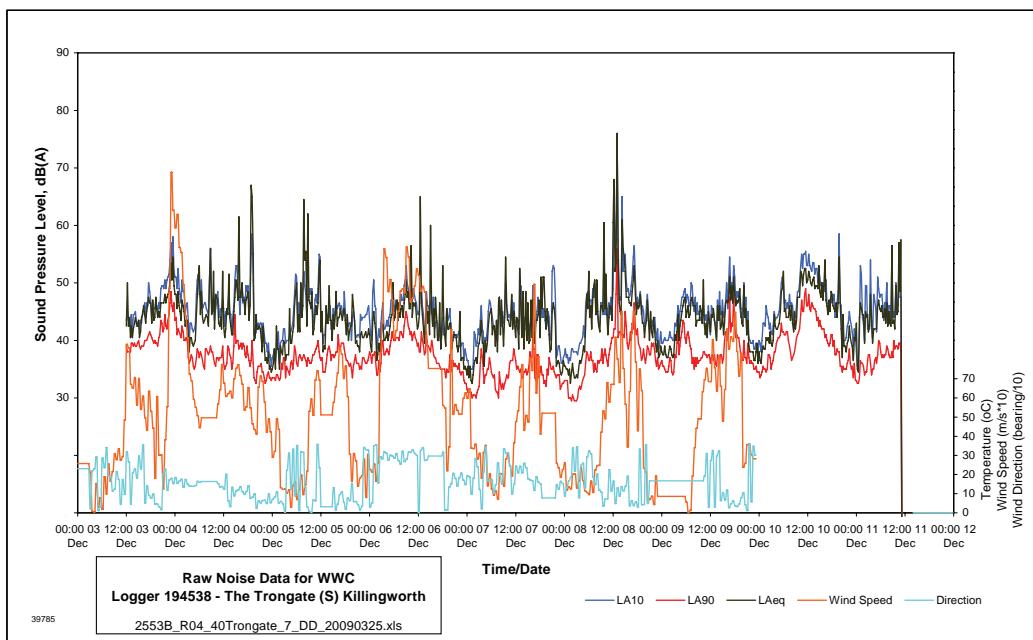
Note 1: Where the ABL is less than 30 dB(A) then ABL is set at 30 dB(A)

Note 2: ‘-’ denotes wind or rain effected results excluded in accordance with the INP

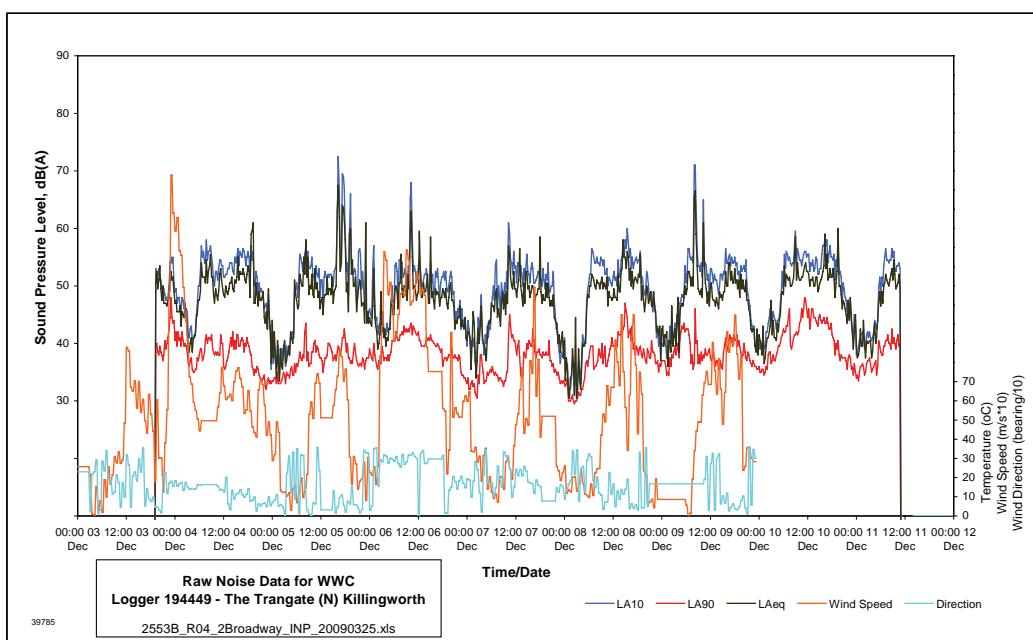
## Monitoring Results

### Environmental Noise Loggers

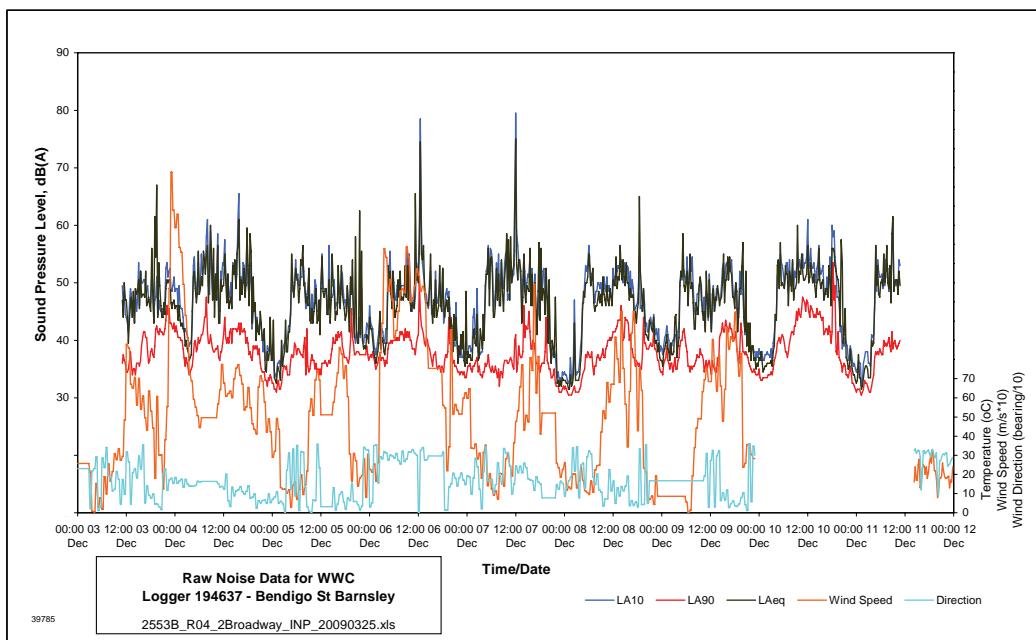
#### Raw Data Charts – M1, The Trongate (South), Killingworth



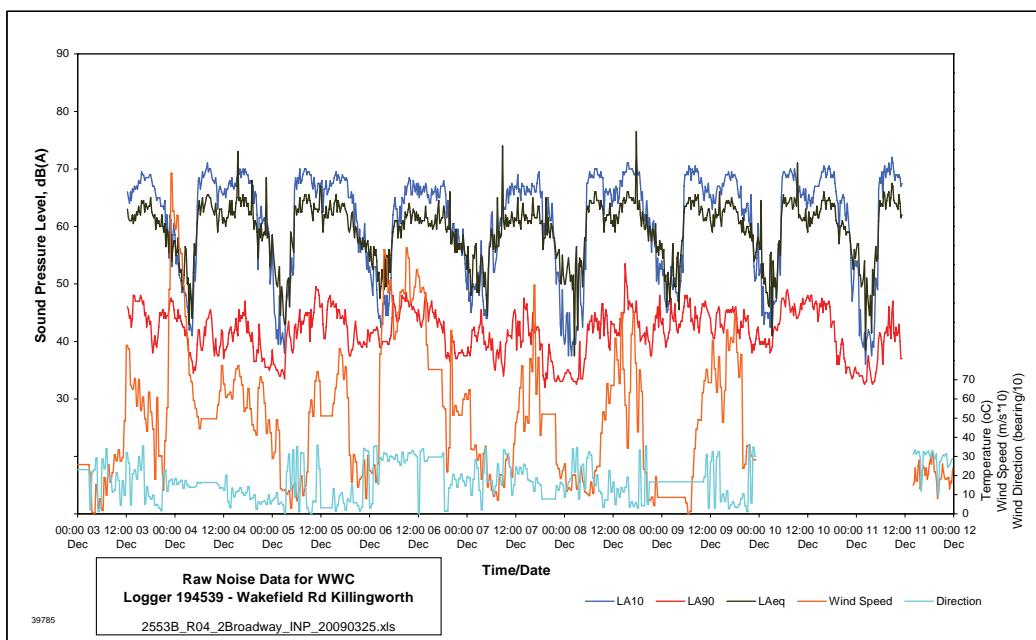
#### Raw Data Charts – M2, The Trongate (North), Killingworth



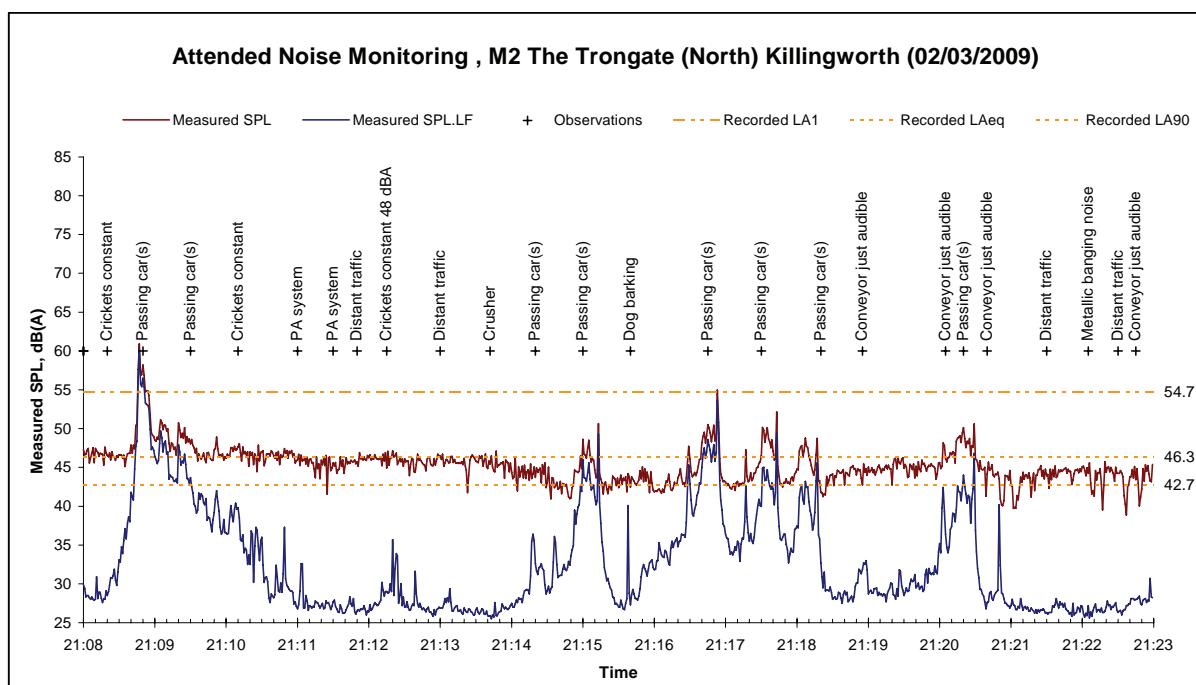
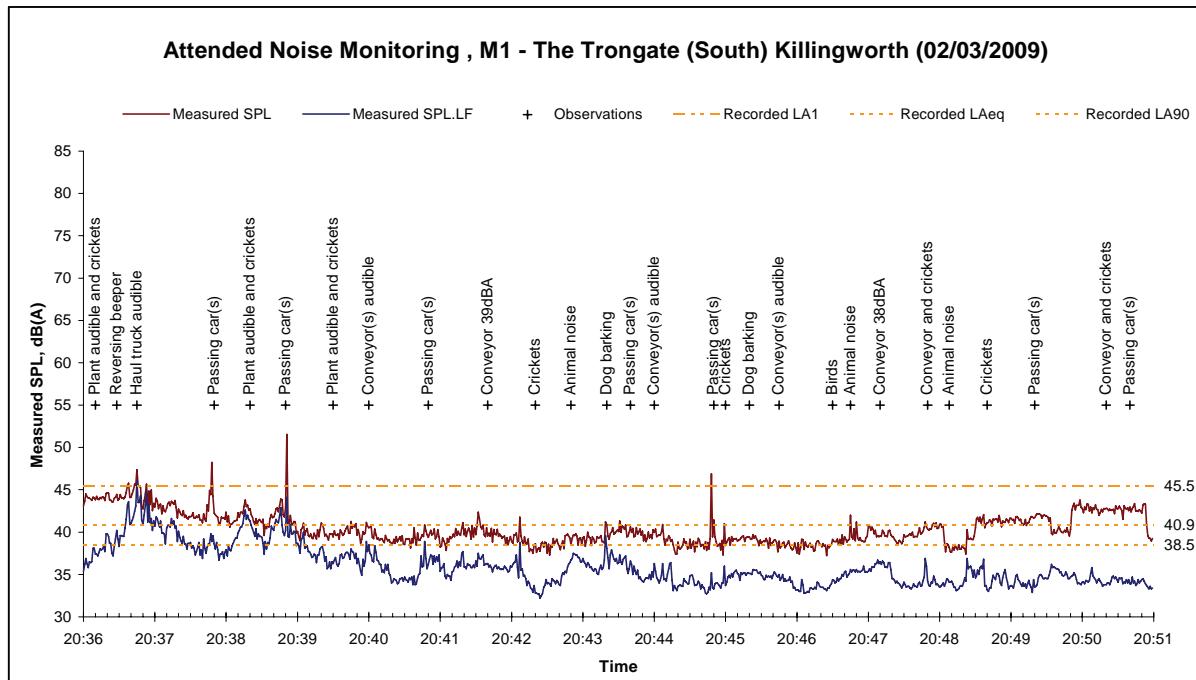
## Raw Data Charts – M3, Bendigo St, Barnsley

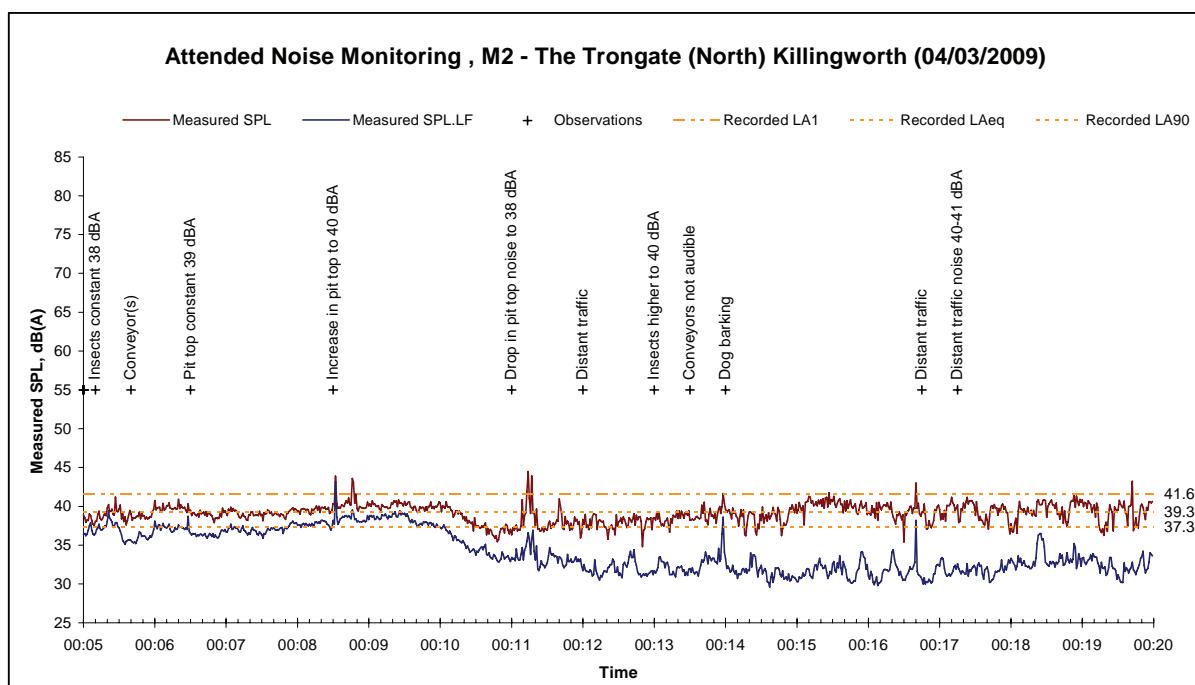
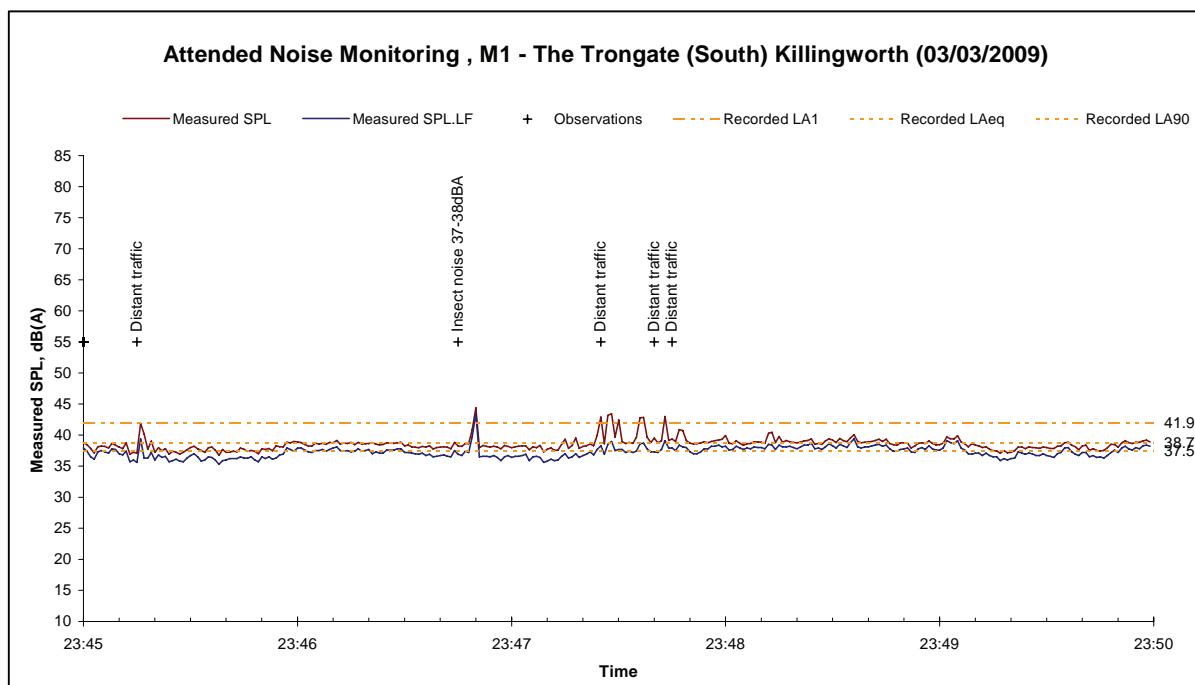


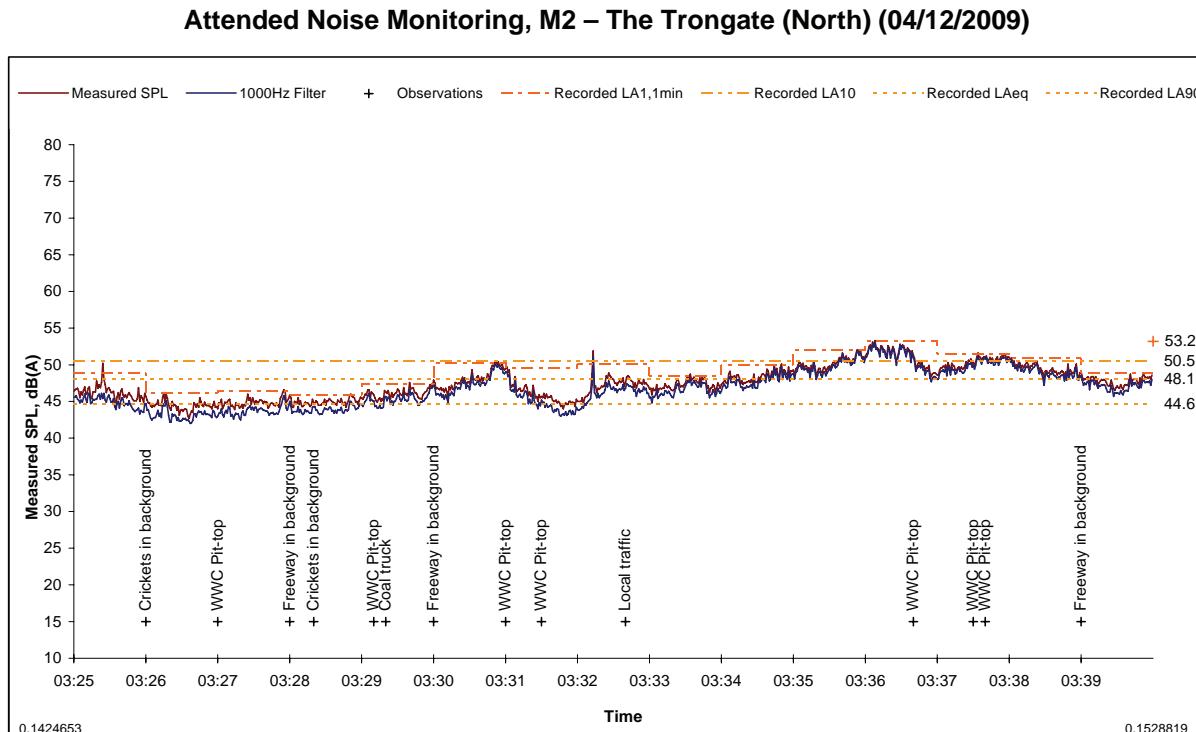
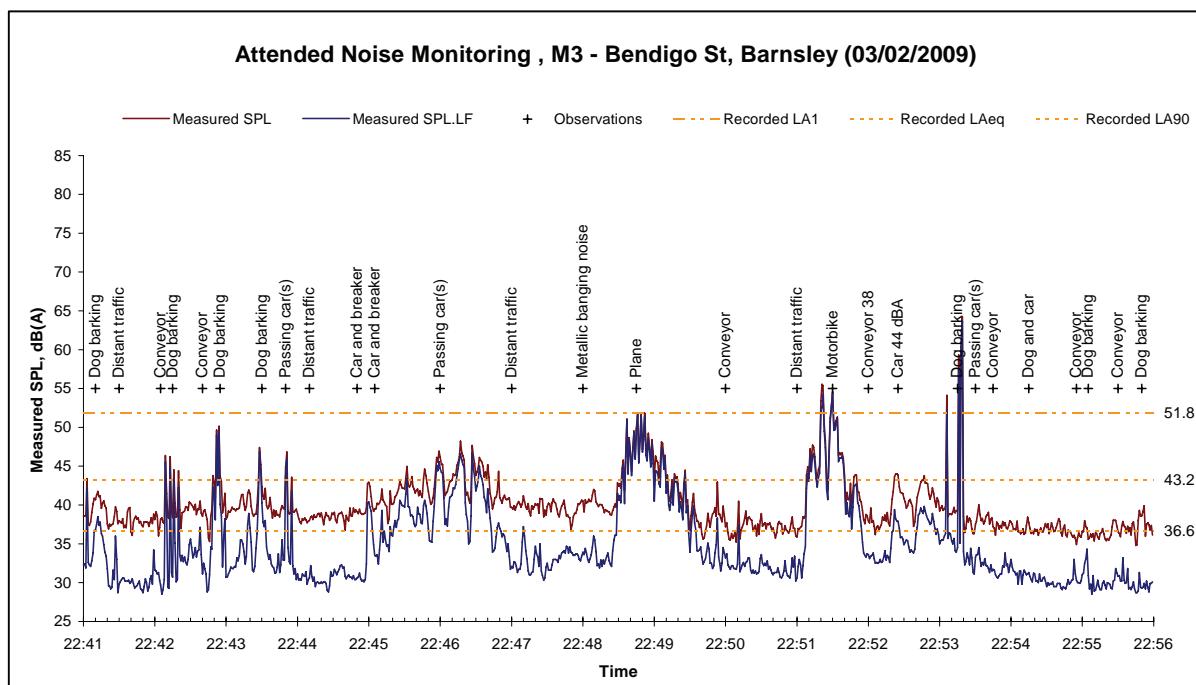
## Raw Data Charts – M1, The Trongate (South), Killingworth



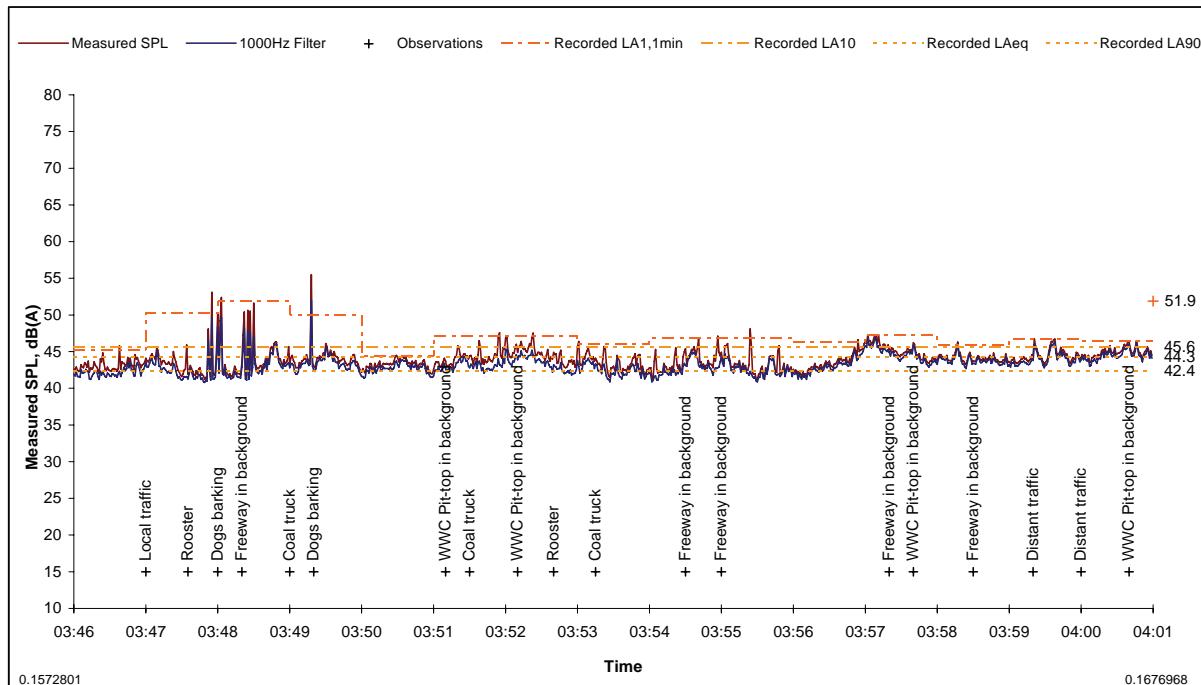
## Attended Noise Monitoring



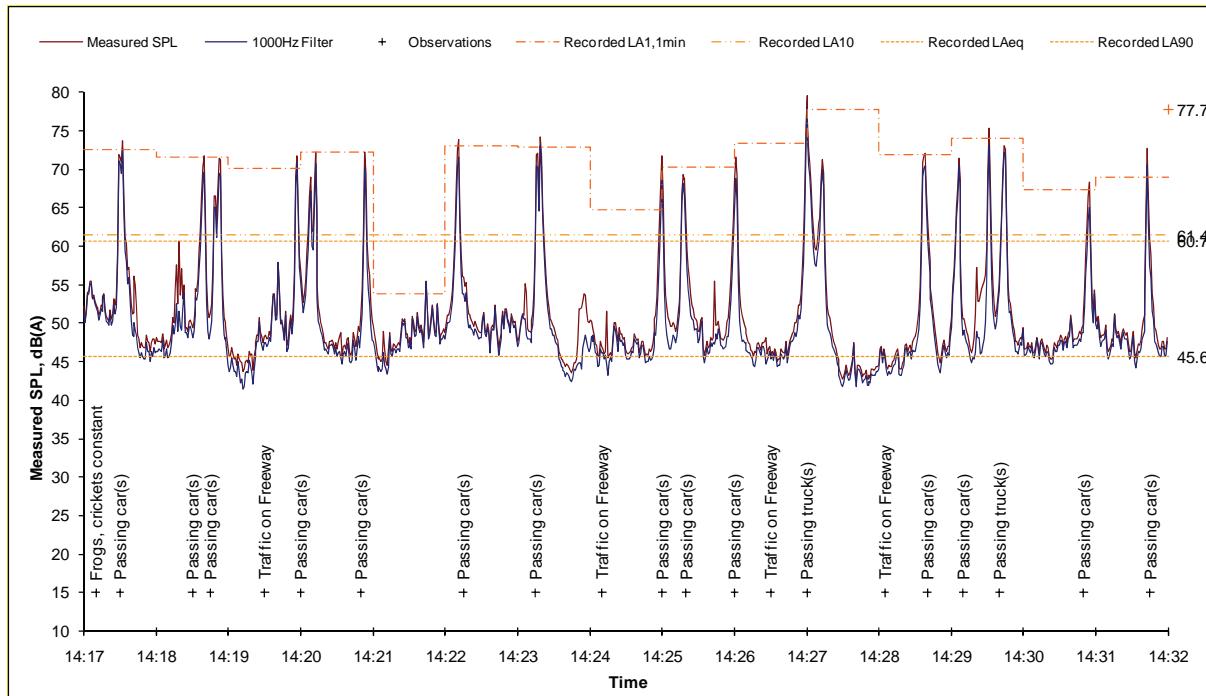


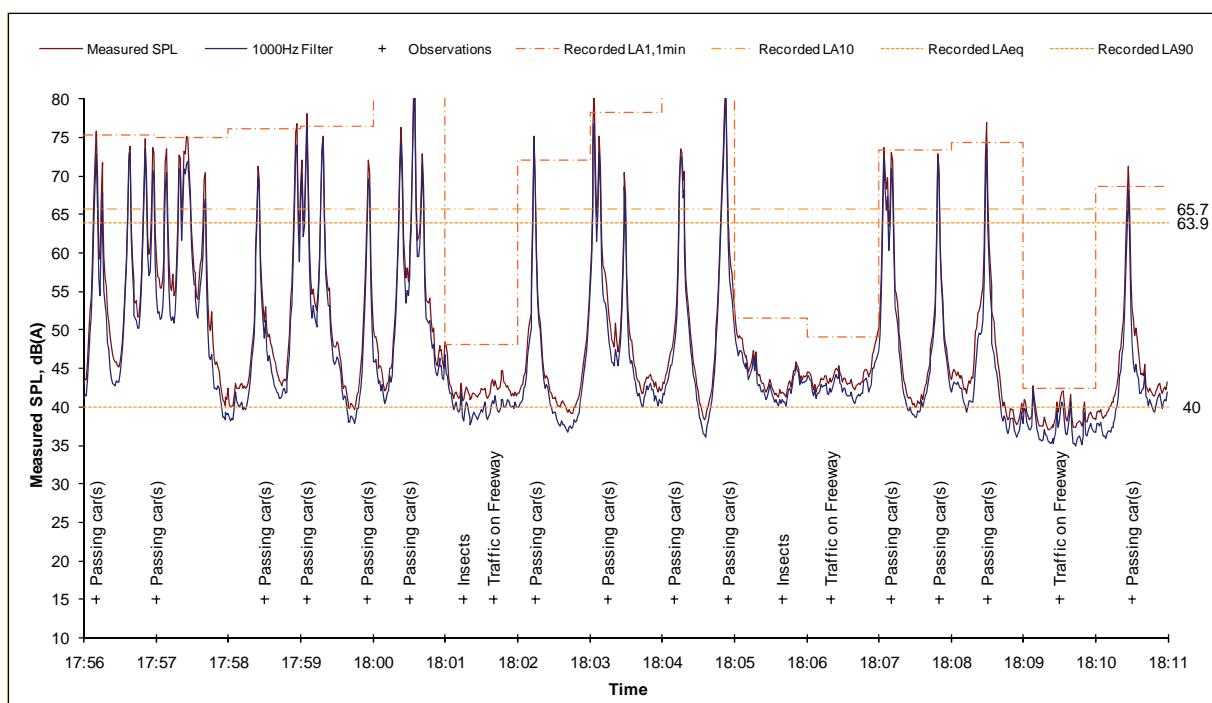
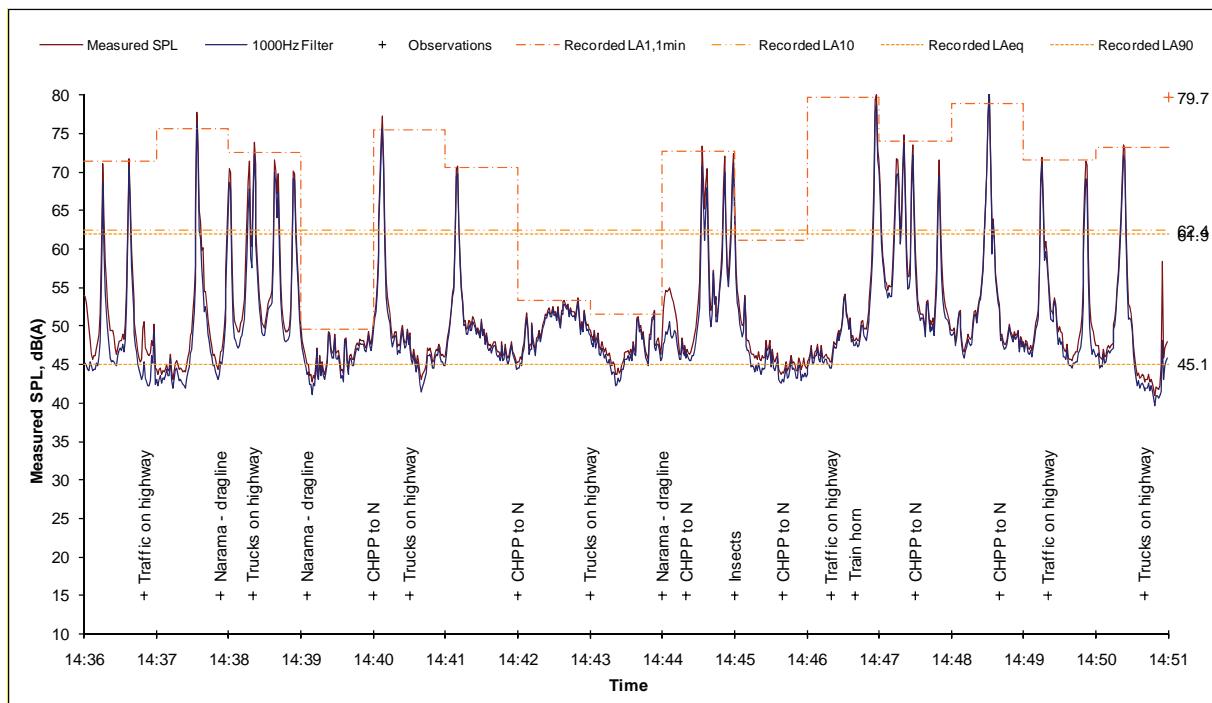


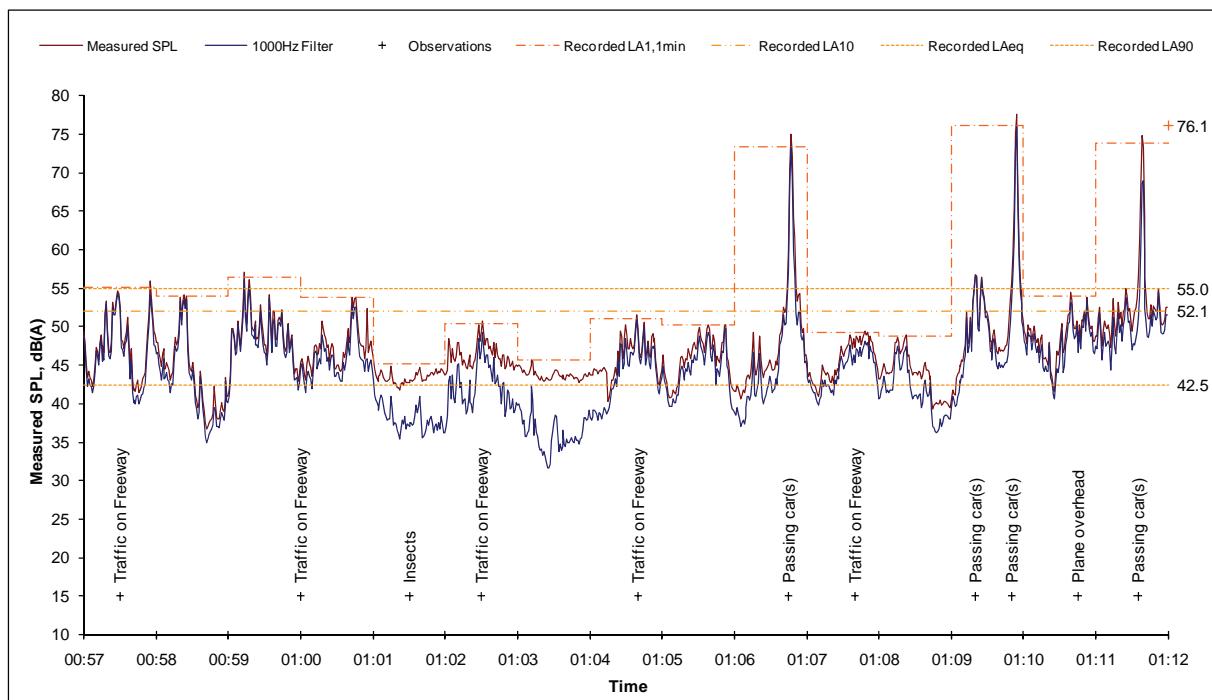
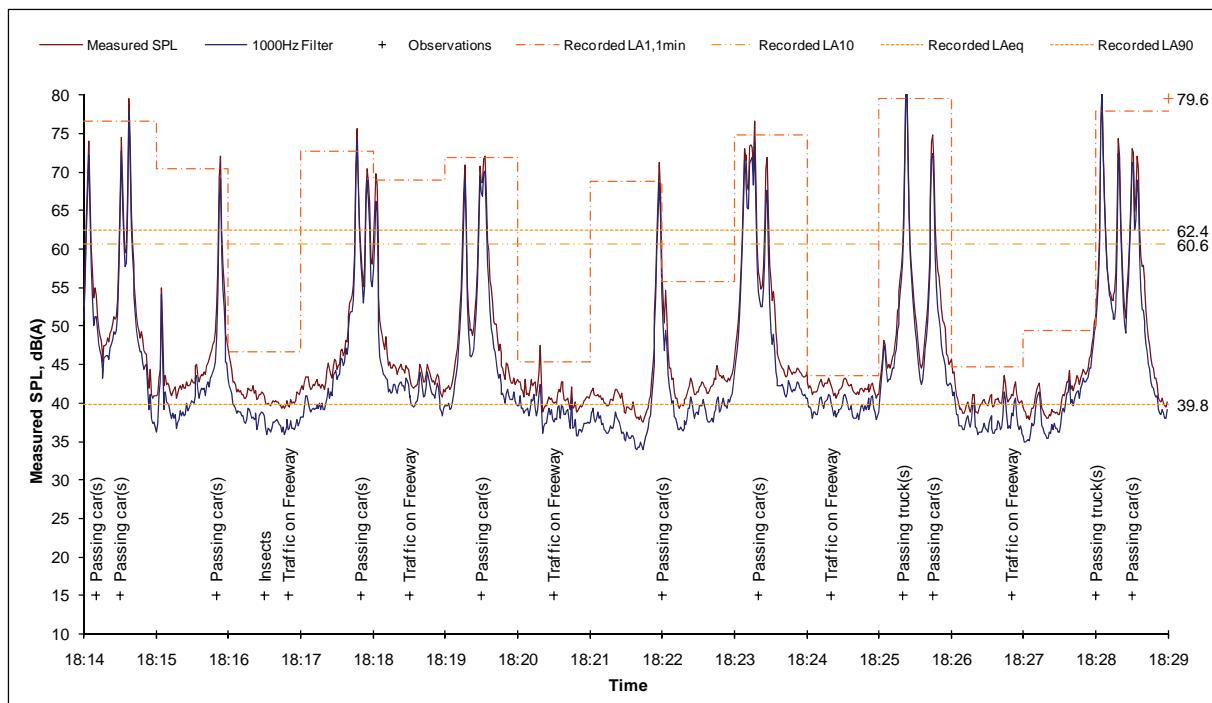
### Attended Noise Monitoring, M3 – Bendigo St Barnsley (04/12/2009)

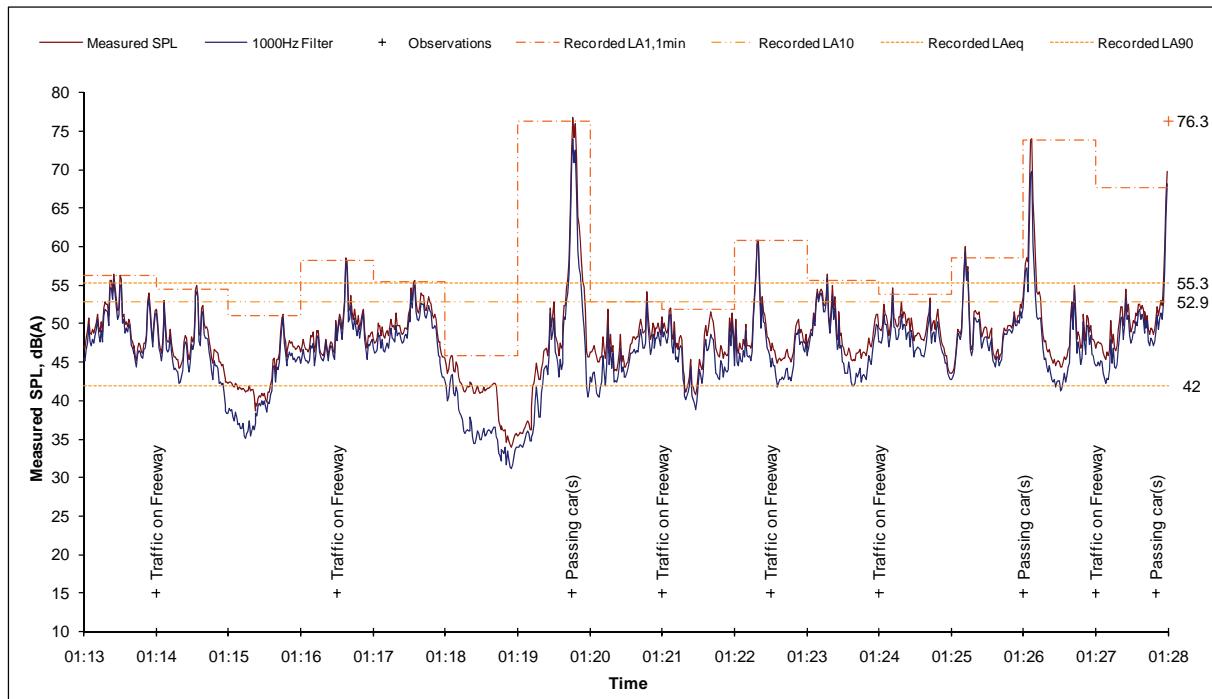


### Attended Noise Monitoring, M5 - Wakefield Rd Wakefield (20/01/2010)









## **APPENDIX D**

### **Noise Mitigation Control Strategies**

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## **Appendix D – Noise Mitigation and Control Strategies**

### **1.0 Controlling Noise at the Source**

#### **1.1 Source Elimination**

Where practical, a noise source could be replaced by an alternate process or item of equipment or machinery or even eliminated completely.

#### **2.1 Best Management Practice**

Best management practice (BMP) is the adoption of particular operational procedures that minimise noise while retaining productive efficiency. When an appropriate mitigation strategy that incorporates expensive engineering solutions is being considered, the extent to which cheaper, non engineering - oriented BMP can contribute to the required reduction of noise should be taken into account.

Application of BMP includes the following types of practice:

- siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise;
- where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently;
- keeping equipment well maintained;
- employing ‘quiet’ practices when operating equipment—for example, positioning idling trucks in appropriate areas; and/or
- running operator-education programs on the effects of noise and the use of quiet work practices.

#### **3.1 Best Available Technology Economically Achievable**

Allied with BMP is ‘best available technology economically achievable’ (BATEA). With BATEA, equipment, plant and machinery that produce noise incorporate the most advanced and affordable technology to minimise noise output. Affordability is not necessarily determined by the price of the technology alone. Increased productivity may also result from using more advanced equipment, offsetting the initial outlays - for example, ‘quieter’ equipment that can be operated over extended hours. Often old or badly designed equipment can be a major source of noise.

Where BMP fails to achieve the required noise reduction by itself, the BATEA approach should then be considered. Examples of uses of BATEA are:

- adjusting reversing alarms on heavy equipment to make them ‘smarter’, by limiting acoustic range to the immediate danger area;
- using equipment with efficient muffler design;

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- using quieter engines, such as electric instead of internal combustion;
- using efficient enclosures for noise sources;
- using high-pressure hydraulic systems to split rock, instead of hydraulic or pneumatic hammers; and/ or
- damping or lining metal trays or bins.

## **2.0 Controlling Noise in Transmission**

Barriers are more effective if they are near the source or the receiver. Their effectiveness is also determined by the height, the materials used (absorptive or reflective) and the density of the material used. The relationship of these design features to attenuation is well documented. Barriers can take a number of forms - including free-standing walls along roads, grass or earth mounds or bunds and trenches or cuttings within which noise sources are sited. Barriers are employed when source and receiver control is either impractical or too costly.

## **3.0 Controlling Noise at the Receiver**

Noise controls at the receiver are expensive when many receivers require treatment, but may be attractive and cost-effective where only a few receivers would be affected by noise and the alternatives are even more expensive source controls. Cost effectiveness is also determined by the increase in future potential receivers where residential land is being developed near the noise source.

The two major controls are insulation and double glazing of windows. For these to be effective, the residence needs air conditioning, or a sophisticated ventilation system that does not compromise the effect of the noise insulation.

Negotiations with landholder range from setting up mutually agreeable private agreement to the more extreme option of property acquisition.

## **4.0 Noise Mitigation Strategies**

Selecting an appropriate strategy for a proposed development or alterations to an existing development involves the following steps:

- Determining the noise reduction required to achieve the project-specific noise levels.
- Identifying the specific characteristics of the industry and the site that would indicate a preference for specified measures.
- Examining the mitigation strategy chosen by similar industries on similar sites with similar requirements for noise reduction; and considering that strategy's appropriateness for the subject development.
- Considering the range of noise-control measures available.
- Considering community preferences for particular strategies. This is especially important when the community has particular sensitivities to noise.

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The preference ranking (from most preferred to least preferred) for particular strategies is:

- **Land-use controls** - When such strategic planning land use decisions are available to the proponent or regulatory authority(s), this long-term strategy is preferable to other measures as it separates noise-producing industries from sensitive areas and avoids more expensive short-term measures.
- **Control at the source (BMP and BATEA)** - Used in conjunction with each other and other strategies, source control strategies are the best after land-use planning, as they serve to reduce the noise output of the source so that the surrounding environment is protected against noise.
- **Control in transmission** - This is the next best strategy to controlling noise at the source as it serves to reduce the noise level at the receiver but not necessarily the environment surrounding the source.
- **Receiver controls** – This is the least-preferred option, as it protects only the internal environment of the receiver and not the external noise environment. Proponents will take into account the cost-effectiveness of strategies in determining how much noise reduction is affordable. A proponent's choice of a particular strategy is likely to have unique features due to the economics of the industry and site specific technical considerations.

The above steps and the range of measures described in the chapter can be used as a guide in assessing the strength of the proponent's mitigation proposals.

Where a proposed mitigation strategy will not achieve the desired noise reduction and leaves a remaining noise impact, the problem needs to be solved by negotiation.