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Fimiston Operations

Noise and Vibration Monitoring and Management Programme

(August 2009 Revision)




Greening the Golden Mile

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1 INTRODUCTION

Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) manages the mining and ore processing operations at the Fimiston Open Pit, Mt Charlotte Underground Mine, Fimiston Mill and the Gidji Roaster on behalf of joint venture owners Barrick Gold of Australia Ltd and Newmont Asia Pacific Ltd. KCGM was formed in 1989 by the amalgamation of several small scale mining operations along Kalgoorlie's Golden Mile ore body. KCGM's mining operations are currently projected to continue until 2017.

Mining activities conducted at KCGM, such as blasting, crushing, exploration drilling, ore haulage and dumping of waste rock, can generate noise, vibration and airblast overpressure. Due to KCGM's close proximity to the City of Kalgoorlie-Boulder this can potentially impact upon nearby residents. This Noise and Vibration Monitoring and Management Programme was developed by KCGM to minimise the potential impacts of noise, blast vibration and airblast overpressure from mining operations on the residents of the City of Kalgoorlie-Boulder.

Operations at KCGM commenced prior to the development of the *Environmental Protection (Noise) Regulations 1997* and the site has operated in accordance with noise level standards set in Ministerial Statement 188 since the early 1990's. The Noise and Vibration Monitoring and Management Programme was first implemented as part of the approval for the Consultative Environmental Review for the Fimiston Mine and Waste Dumps (1990). The programme was developed by KCGM in January 1993 to meet the requirements of Condition 5 of Ministerial Statement 188 and was subsequently revised in June 2004.

In early 2006, KCGM applied to the Minister for the Environment for an Approval pursuant to Noise Regulation 17 to enable it to vary its noise levels from the prescribed standard in the noise regulations, which was triggered by the Environmental Impact Assessment of the proposed Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning Public Environmental Review (PER).

The basis of the application is that while KCGM is committed to operating the existing Fimiston Open Pit Operations and Fimiston Operations Extension using best technologies and procedures in terms of noise emissions, it cannot reasonably and practicably comply with the prescribed standard in the noise regulations, principally as a consequence of the effect of meteorological conditions on sound propagation.

The Minister for the Environment granted PER approval 29 January 2009 and approval of variation from the Noise Regulations on 14 July 2009. The Noise and Vibration Monitoring and Management Programme was revised in 2009 to meet the requirements of:

- Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning Public Environmental Review - Ministerial Statement Number 782; and
- Environmental Protection (Fimiston Gold Mine Noise Emissions) Approval 2009.

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KCGM believes this programme provides the best possible practices and procedures to enable mining at Kalgoorlie in a reasonable and practicable manner, while providing an acceptable noise environment for the residents of Kalgoorlie-Boulder. Through implementation of this programme, KCGM commits to undertake all reasonable, practicable and safe measures to meet the relevant standards for noise and vibration emissions from its operations.

This Noise and Vibration Monitoring and Management Programme covers:

- Noise Control Strategy;
- Ground Vibration and Airblast Overpressure Control Strategy;
- Recording and Reporting of Noise and Vibration;
- Community Consultation and Complaints; and
- Noise Modeling and Verification.

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2 NOISE CONTROL STRATEGY

KCGM has developed a noise control strategy to minimise the noise emissions from its mining and mineral processing activities. The strategy ensures compliance with environmental noise standards and is based on noise modelling and assessment conducted at KCGM.

KCGM has prioritised noise control from its operations over many years and has a focus on continual improvement. KCGM is committed to investigating and where practicable, using the best technologies and procedures in terms of noise control.

2.1 Environmental Noise Levels

Noise levels for KCGM are set in the Environmental Protection (Fimiston Gold Mine Noise Emissions) Approval 2009. These noise levels were set based on reference locations and prevailing weather conditions.

The $L_{A 10}$ and $L_{A max}$ levels for specific reference locations are determined by adding to the decibel values (Table 1), the Weather Influencing Factor (Table 2) for that location (according to the wind speed and direction at the time),

Table 1 KCGM Approved Noise Levels

Reference Location	Time of Day	Approved Level (dB)	
		$L_{A 10}$	$L_{A max}$
Kalgoorlie Technical School	Day ⁽¹⁾	50 + WIF ⁽⁴⁾	62 + WIF
	Evening ⁽²⁾	45 + WIF	52 + WIF
	Night ⁽³⁾	45 + WIF	52 + WIF
Boulder Primary School	Day	50 + WIF	62 + WIF
	Evening	45 + WIF	52 + WIF
	Night	45 + WIF	52 + WIF
Outram Street, Boulder	Day	52 + WIF	65 + WIF
	Evening	49 + WIF	60 + WIF
	Night	49 + WIF	60 + WIF
York Street, Boulder	Day	52 + WIF	65 + WIF
	Evening	49 + WIF	60 + WIF
	Night	49 + WIF	60 + WIF
Barton Street, Williamstown	Day	50 + WIF	65 + WIF
	Evening	45 + WIF	55 + WIF
	Night	45 + WIF	55 + WIF

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Notes to Table 1:

- (1) Day: 0700 to 1900 hours Monday to Saturday and 0900 to 1900 hours Sunday and Public Holidays
- (2) Evening: 1900 to 2200 hours all days
- (3) Night: 2200 on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays
- (4) WIF = Weather Influencing Factor

Table 2 Weather Influencing Factor

Wind Direction	Wind Speed (km/h)	Reference Location				
		Barton St, Williamstown	Kalgoorlie Technical School	York St, Boulder	Boulder Primary School	Outram St, Boulder
Calm	<2	3	6	4	6	5
Northerly	≥2	-2	6	5	6	5
North Easterly	≥2	2	6	5	6	4
Easterly	≥2	4	6	5	6	4
South Easterly	≥2	4	6	5	6	3
Southerly	≥2	4	6	5	4	2
South Westerly	≥2	3	5	4	2	2
Westerly	2-7	0	6	2	2	3
Westerly	>7	-4	-2	-3	-3	3
North Westerly	2-7	-4	3	2	4	4
North Westerly	>7	-6	-1	-1	3	3

2.2 Environmental Noise Bund

A key noise management feature at KCGM is the environmental noise bund that runs along the western edge of the open pit operation.

The noise bund was originally established in 1993/94 using waste rock. In 2000, a major project was undertaken at the former Croesus mill site to further extend the bund northwards and additional minor works were also undertaken. In 2004 a major southern extension of the noise bund was commenced and in 2006 an application for a realignment of the bund was approved. This will ensure that protection for the community from mine noise will continue. A history of the construction of the environmental noise bund is shown in Figure 1.

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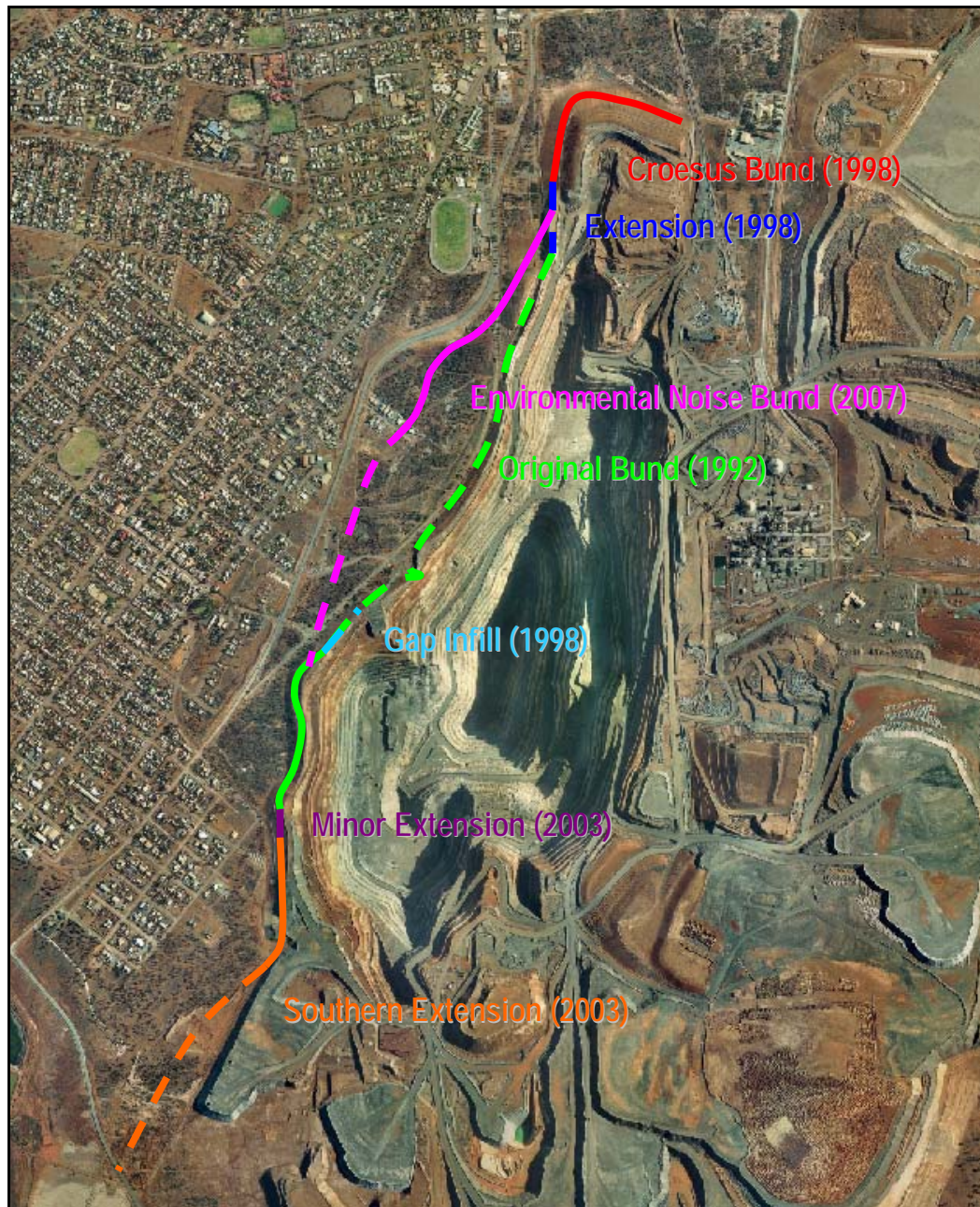


Figure 1 KCGM Environmental Noise Bund Construction History

The noise bund has significantly lowered noise levels in residential areas, as shown by the 50dB(A) contour lines shown in Figure 2.

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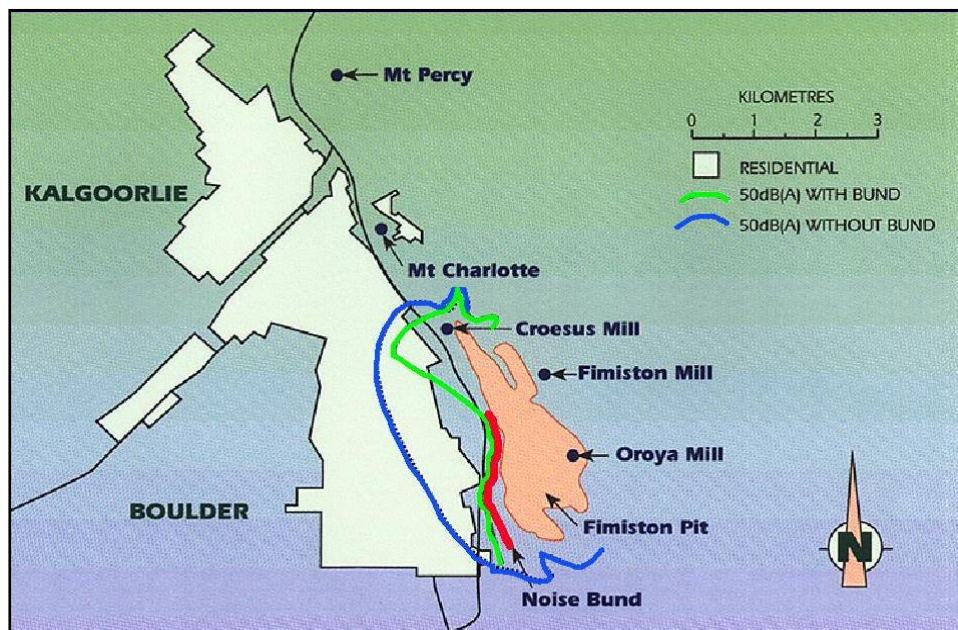


Figure 2 Impact of Environmental Noise Bund on the 50dB(A) Contour

Noise controls utilised during environmental noise bund construction at KCGM include:

- Ensuring the quietest equipment available is used;
- Restricting the use of equipment for the bund construction phase to the hours of 7am to 7pm Monday to Saturday and not on Sunday or public holidays;
- Ensuring that all contractors and staff involved with constructing the noise bund undertake a site-specific induction to raise awareness including the importance of noise control;
- Ensuring noise monitoring is undertaken;
- Ongoing consultation with stakeholders to determine the success of the noise management practices; and
- Undertaking modelling to determine predicted noise levels during construction.

2.3 Management of Operations

The KCGM operations are planned and managed so that due consideration is given to noise emission levels. KCGM has identified activities and equipment that are significant noise sources and developed methods for minimising their impact.

2.3.1 Surface Activities

Noisier activities, such as long hole percussion drilling and rock breaking (Figure 3), could result in high levels of residential noise when carried out at the surface. Where appropriate, these activities are restricted to the time period 7am to 7pm Monday to Saturday.

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Figure 3 Rock Breaking

When mining of the Golden Pike cutback commences there is the potential for increased noise levels when vehicle movement and loading occurs near the ground surface level. As the depth of mining increases the level of noise experienced at neighbouring premises will decrease as the pit wall effectively acts as a height extension to the environmental noise bund.

To minimise the potential impact of noise from surface mining, operations at the Golden Pike cutback will be limited to days only (0700 to 1900 hours Monday to Saturday and 0900 to 1900 hours Sunday and Public Holidays) until reaching a level that is 20 metres below the undisturbed ground surface level.

Construction of waste landforms to the north of the operations has the potential to impact on the residents of Williamstown. To minimise potential noise from the dumping of waste rock, KCGM will build a 20m high noise bund along the northern edge of the waste landform. This noise bund will be constructed during day shift only and in advance of the waste landform construction. The noise bund will be constructed prior to the dumping of waste rock occurring on each lift of the waste landform.

2.3.2 Open Pit Blasting

Primary blasting is only carried out during daylight (between the hours of 7am and 6pm) and, whenever possible, occurs at a publicised time each day (generally 1pm or 5pm). Where weather, safety or production requirements preclude blasting at the set time blasting may be undertaken at short notice. Whenever possible, explosives placed for surface blasts are fired when weather conditions are such that the impact of air-blast over pressure and dust emissions on residential areas of Kalgoorlie-Boulder are minimised.

KCGM will only blast outside of the hours 7am to 6pm if absolutely necessary for safety reasons. If blasting does occur outside of these hours it will be undertaken in accordance with Regulation 8.28(4) of the *Mines Safety and Inspection Regulations 1995*. When blasting occurs outside of the hours 7am to 6pm, KCGM will submit a report outlining the circumstances which led to such detonation being necessary to

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the Chief Executive Officer of the Department of Environment and Conservation within 36 hours.

2.3.3 Waste Rock Transportation to Mt Charlotte Glory Hole

Waste rock from Fimiston is transported to the Mt Charlotte Glory Hole for backfilling of underground voids. This backfilling was initially undertaken by haul trucks, however an alternative method was required to address residents concerns.

Decommissioned conveyor equipment, already located at Mt Charlotte was extended and modified for the backfilling job. The conveyor obviated the need to use haul trucks and it is significantly less noisy for nearby residents.

Part of the conveyor design included an elevated section to cross Williamstown Road (Figure 4). This section is fully enclosed and internally lined with insulation to reduce noise. The cover also eliminates any danger of rocks falling as a result of spillage or belt breakage.

Additional noise control measures included an enclosure constructed around the transfer chute on the western side of the conveyor. Where possible, KCGM endeavours to use the conveyor during dayshift only.

Some use of haul trucks may still be required to complete the backfilling operation after Mt Charlotte closes if other conveyor modifications cannot be made.



Figure 4 Fimiston to Mt Charlotte Overland Conveyor

2.3.4 Resource Definition Drilling

Due to the close proximity to residential properties, some form of noise control is applicable to many KCGM exploration drilling operations.

In June 2002 a detailed noise management plan was developed by Herring Storer Acoustics for a KCGM resource definition drilling programme on the western side of the Fimiston open pit that was in close proximity to residential areas. Due to the similarities between this drilling programme and other programmes conducted by

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KCGM (i.e. proximity to residential areas and equipment used) the noise control principles and practices developed are used to manage potential noise impacts.

Noise control measures may include administrative procedures (including restricting times of operation and procedures to be followed for certain potentially noisy operations) or engineered noise control.

As part of the 2002 drilling programme KCGM designed and constructed trailer mounted acoustic screens (Figure 5). One of the key design features (other than noise control) was that the screen was portable and easy for the operators to use. The acoustic screen is an integral part of KCGM’s resource definition drilling noise management programme.



Figure 5 Drill Rig Acoustic Screen

2.3.5 Mobile Equipment

Noise emissions from mobile equipment used for production (e.g. haul trucks, front end loaders, face shovels and drills) are measured and appropriate engineering noise controls applied to the extent that such techniques are reasonable, practicable and safe in a mining environment.

A mining noise investigation conducted in 2000 identified that additional improvements could be made in the area of haul truck noise. Based on these findings, during 2002 KCGM undertook an improvement program to retrofit existing trucks with quieter engines. New trucks purchased since this time have quieter engines and fans as a standard.

KCGM will continue to work with suppliers and manufacturers to investigate further opportunities to minimise tonality and noise characteristics of equipment where practicable through procurement specifications.

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Noise assessment and modeling work identifies haul trucks as the primary source of noise from KCGM's operations. Therefore the focus is on the haul trucks and ensuring that they do not deteriorate and become noisier over time.

KCGM undertakes six-monthly noise monitoring of individual haul trucks (Caterpillar 793C) to track noise performance and identify if additional maintenance is required. The noise monitoring is undertaken in accordance with AS2012.1-1990: Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise.

General methodology for this truck noise monitoring is as follows:

- Measurements are recorded on a flat, compacted surface with no reflective surfaces for at least 50 meters in any direction. Background noise levels are less than 60 dB(A).
- Six measurements are taken at a 16 meter radius from the centre of the equipment being tested.
- Two of these measurements are situated at approximately 11 meters above the horizontal plane. Noise level measurements are recorded with the machine at high idle.
- Calculations are then performed using the recorded noise levels to determine the sound power level of the machine in accordance with AS2012.1-1990.

A minimum of 75% of trucks are measured during sampling which allows for breakdown and maintenance.

Results of the six-monthly noise monitoring of trucks is reported in the Annual Environmental Report submitted to the Department of Environment and Conservation and Department of Mines and Petroleum.

2.3.6 Reversing Alarms

Reversing warning alarms are required for safety purposes on all mobile equipment operating on any mining or mineral processing site. The signals from audible alarms are by design intrusive in nature and are recognised as a significant environmental noise source.

KCGM endeavours to fit all mobile equipment with "smart alarms". Smart alarms adjust their output so that the signal is adjusted to 5dB_(A) above background noise levels. Thus the emitted signal reversing signal is reduced during quiet periods (e.g. at night).

In 2006 KCGM became aware of a new type of broad band reversing alarm. Testing of these alarms indicates that:

- They attenuate more with distance (such that the overall dB_(A) levels are lower); and
- The tonality of normal and smart alarms is not present as it is spread over several 1/3 octave centre frequencies.

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Broad band reversing alarms were successfully trialled on a loader and truck at the crusher area. The trial is now planned to be expanded to include all of the 777 truck fleet working in this area and equipment working on the construction of the environmental noise bund.

Pending the outcome of the trial with the 777 fleet it is envisaged that the larger open pit mining fleet (793's) will be progressively equipped with broad band reversing alarms.

KCGM will continue to research the feasibility of mechanisms other than audible signals that do not jeopardise safety standards and are approved by the Department of Mines and Petroleum (DMP). To date this research has identified the use of visual high intensity magenta strobe lights. KCGM now uses these strobe lights on night shift in a limited access and high elevation area.

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3 GROUND VIBRATION AND AIRBLAST OVERPRESSURE CONTROL STRATEGY

KCGM has developed a vibration and airblast overpressure control strategy to minimise the impacts from its mining activities. The strategy ensures compliance with relevant standards and is based on recommendations of specialist consultants and past experience.

3.1 Vibration and Airblast Overpressure Standards

Standards which KCGM must meet for vibrations from blasting and airblast overpressure were set during the approval of the Fimiston Gold Mine Operations Extension (Stage 3) and Mine Closure Planning Public Environmental Review (Ministerial Statement 782). The conditions imposed relating to airblast overpressure and vibration from blasting are summarised in Table 3.

Table 3 Ministerial Conditions Relating to Airblast Overpressure and Vibration

Number ⁽¹⁾	Condition
7-4	The proponent shall only detonate explosives at surface level on the premises when wind directions favour the carriage of dust away from the residential areas of Kalgoorlie-Boulder, unless undertaken in accordance with regulation 8.28 (4) of the <i>Mines Safety and Inspection Regulations 1995</i> .
9-1	The proponent shall only detonate explosives on the premises between the hours of 0700 hours and 1800 hours unless undertaken in accordance with regulation 8.28(4) of the <i>Mines Safety and Inspection Regulations 1995</i> .
9-2	Where explosives are detonated on the premises outside the requirements specified in conditions 7-4 and 9-1, the circumstances which led to such detonation being necessary shall be reported by the proponent to the CEO within 36 hours following the detonation.
9-3	The proponent shall ensure that all airblast overpressure levels due to blasting comply with Regulation 11 of the <i>Environmental Protection (Noise) Regulations 1997</i> .
9-4	The proponent shall make all reasonable effort to avoid blasting on Sundays.
9-5	For all blasting, the proponent shall comply with the following vibration limits, measured or calculated in accordance with section J4.2 of <i>Australian Standard 2187.2-2006</i> , for the protection of human comfort at any houses and low rise buildings, theatres, schools and other similar buildings occupied by people and not owned by the proponent: <ol style="list-style-type: none"> 1. the peak particle velocity shall not exceed 5 millimetres per second for 90% of blasts per year; 2. the peak particle velocity shall not exceed 10 millimetres per second for any blast; and 3. no more than one in ten consecutive blasts shall exceed 5 millimetres per second peak particle velocity.

Notes to Table 3:

(1) Ministerial Statement 782 Condition Number

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KCGM is required to comply with Regulation 11 of the *Environmental Protection (Noise) Regulations 1997*. Regulation 11 sets the following standards for airblast levels due to blasting:

Subregulation (3): No airblast level resulting from blasting on any premises or public place, when received at any other premises, may exceed –

- a) 125 dB $L_{\text{Linear peak}}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or
- b) 120 dB $L_{\text{Linear peak}}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

Subregulation (4): Notwithstanding subregulation (3) airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other premises, must not exceed –

- a) 120 dB $L_{\text{Linear peak}}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or
- b) 115 dB $L_{\text{Linear peak}}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

Subregulation (5): No airblast level resulting from blasting on any premises or public place, when received at any other premises, may exceed –

- a) 90 dB $L_{\text{Linear peak}}$ outside the periods between 0700 hours and 1800 hours on any day except where that blasting is carried out in accordance with regulations 8.28(4) of the Mines Safety and Inspection Regulations 1995; or
- b) The levels specified in subregulations (3) and (4) outside the periods between 0700 hours and 1800 hours, as appropriate for the time when it was intended that the blast be fired, if the exception in paragraph (a) applies.

3.2 Management of Operations

3.2.1 Blasting Times

During general activities KCGM undertakes blasting between 7am and 6pm.

Whenever possible blasting occurs at a publicised time each day (generally 1pm or 5pm). Where weather, safety or production requirements preclude blasting at the set time blasting may be undertaken at short notice.

3.2.2 Blasting Practices

To minimise noise and vibration created by blasting at the Fimiston Open Pit the following measures have been implemented:

- Bulk explosives are loaded to a set stemming height to minimise noise and vibration;
- Instantaneous charge weight is minimised using nonelectric or electronic detonator timing to offset each blast hole;
- Where possible blasts are not carried out under unfavourable weather conditions including heavy cloud cover (minimises noise); and
- Electronic detonators may be used (minimises vibration).

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4 RECORDING AND REPORTING

4.1 Noise Monitoring Programme

The noise monitoring programme conducted by KCGM involves recording of:

- Noise levels at reference locations; and
- Weather conditions.

Weather conditions are monitored as they can affect the noise levels received at neighbouring properties and because wind speed and direction are used to calculate the approved noise levels at the reference locations.

Monitoring is conducted in accordance with a standard operating procedure.

4.1.1 Noise Monitoring Locations

Noise monitoring occurs at five reference locations around the Kalgoorlie-Boulder area (Figure 6).

Continuous Monitoring

Continuous noise monitoring occurs at the Kalgoorlie Technical School (KTS) and Boulder Primary School (BPS). The data from KTS and BPS is not to be directly compared to the noise levels set in the *Environment Protection (Fimiston Gold Mine Noise Emissions) Approval 2009* (Table 1) as the data contains noise emissions from sources other than the Fimiston Gold Mine – such as those generated by traffic, dogs, airplanes, commercial activity and people. As a result the continuous noise monitoring data from KTS and BPS is not a reliable indicator for determining compliance with the assigned levels in Table 1.

KCGM will continue the continuous monitoring at BPS and KTS as we believe it will act a long term reference for the historical comparison of noise levels over time. The continuous monitoring has been undertaken since 1993.

Compliance Monitoring

Quarterly monitoring will be undertaken by specialist noise consultants 'Herring Storer Acoustics' at five monitoring locations (as shown in Figure 6) to determine compliance against the approved limits in Table 1. The measurement and assessment of noise at these locations will be undertaken in accordance *Environmental Protection (Noise) Regulations 1997*. This monitoring will be performed over a 5 day period in the evening or at night to minimise sources of contributing noise. Evening and/or night periods have also been selected as they represent the time of day at which the Kalgoorlie-Boulder residents would be most affected by noise from Fimiston Gold Mine and because they have the lowest approved levels.

The noise measurements will be undertaken using manned sound level meters and contributing noise will be excluded from the sound pressure level logs. Digital noise recordings will also be taken of the sampling period.

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If the noise assessments indicate further monitoring is required or should KCGM receive frequent complaints additional monitoring may be undertaken.



Figure 6 Noise Monitoring Network Location Plan

4.1.2 Noise Monitoring Equipment

Continuous noise monitoring is undertaken using a Class 2 type RTA Technology Environmental Noise Logger Model RTA02. The RTA02 is a self contained sound level measuring instrument with statistical processing capabilities. Sound levels are

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sampled at a rate of 10 samples per second and the L_{eq} , L_{max} , L_1 , L_{10} , L_{50} , L_{90} , L_{95} and L_{max} statistical levels are calculated.

Additionally, the logger incorporates a Sony ICD-ST10 tape recorder programmed to turn on for predefined conditions each day. This recording is used to establish the contribution of mining noise at the monitoring site.

The tape trigger is set to operate between 1900 hours and 0700 hours. This is the time when mining noise is most noticeable as traffic noise is at a minimum. A tape trigger event is recorded when the noise level exceeds 60 dB_(A) between 7:00 pm and 10:00 pm and 55 dB_(A) between 10:00 pm and 7:00 am for more than two minutes. The tape recorder date and time stamps all recordings.

Tape recordings are retrieved and the dominant noise identified, where possible, for each noise event. Where the noise monitoring results show that mining noise is causing an unusual increase in tape recorder trigger events these are investigated to determine the source of the noise. When the source is identified, reasonable, practicable and safe action is taken to reduce the noise where possible.

Noise data and noise triggers recorded are downloaded to a laptop each week and the data is then imported into the Noise Monitoring Database on the KCGM network.

4.1.3 Weather Monitoring Equipment

Weather monitoring equipment at the KCGM weather station MEX (Figure 6) is used to determine the WIF (Table 2) and the approved noise levels that KCGM must comply with (Table 2). MEX monitoring equipment continually measures the following parameters:

- Wind speed and
- Wind direction.

The equipment used at the KCGM weather station is summarised in Table 4.

Table 4 KCGM Weather Monitoring Equipment

Parameter	Equipment
MEX Wind speed	Met One 50.5 Sonic D2875
MEX Wind direction	Met One 50.5 Sonic D2875

Data recorded at the weather station is stored in a data historian (PI), where it can be viewed by operators.

Weather data can also be obtained from the Bureau of Meteorology site located at the Kalgoorlie-Boulder airport if required.

4.1.4 Calibration of Noise and Weather Monitoring Equipment

Maintenance and calibration of the RTA02 noise monitors is conducted on a weekly basis by KCGM Environmental personnel in accordance with the standard operating procedure. Maintenance of the noise monitor consists of:

- Checking the noise logger clock is correct;
- Checking the voltage of the noise logger battery;

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- Cleaning the solar power supply; and
- Checking the condition of the battery and connections.

The noise monitors are calibrated on a weekly basis by KCGM personnel using a 100Hz Rion NC-73 sound level calibrator. The calibrator is calibrated by a NATA authorised company every two years.

The noise monitor is calibrated every two years by a NATA accredited laboratory. The calibration meets the requirements of Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating" and Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging".

The weather monitoring equipment is calibrated on a two yearly basis, or as required by the manufacturer, Met One Instruments.

4.1.5 Reporting of Noise Monitoring

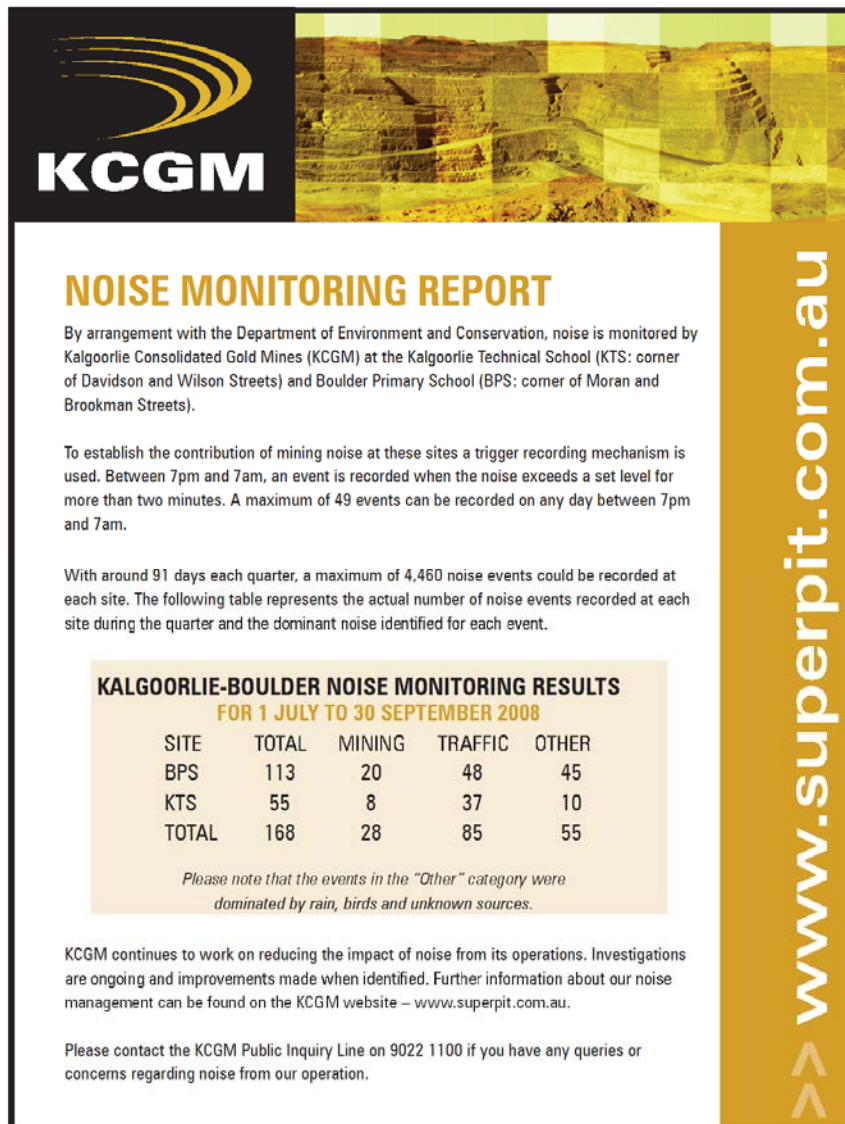
Quarterly Noise and Blast Monitoring Report

KCGM submits a noise and blast monitoring report to the Department of Environment and Conservation (DEC) on a quarterly basis. This report contains the following information in relation to noise monitoring:

- Compliance monitoring results;
- Number of noise events recorded for the quarter at the Kalgoorlie Technical School and Boulder Primary monitoring sites;
- Number of events dominated by mining, traffic or other sources;
- Number of mining dominated events caused by reversing alarms, trucks or other sources;
- Information on any data loss during the reporting period;
- Details of any public complaints relating to noise during the reporting period;
- General comments relating to noise management; and
- Graphs of continuous noise levels recorded at the KTS and BPS monitoring sites for the reporting period.

Results from the noise monitoring programme are provided to the public on a quarterly basis via an advertisement in the Kalgoorlie Miner (Figure 7) and on the KCGM website (www.superpit.com.au). The newspaper advertisement contains information on how many times the trigger levels were exceeded at the continuous noise monitoring sites and what the dominant noise was for each event recorded.

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NOISE MONITORING REPORT

By arrangement with the Department of Environment and Conservation, noise is monitored by Kalgoorlie Consolidated Gold Mines (KCGM) at the Kalgoorlie Technical School (KTS: corner of Davidson and Wilson Streets) and Boulder Primary School (BPS: corner of Moran and Brookman Streets).

To establish the contribution of mining noise at these sites a trigger recording mechanism is used. Between 7pm and 7am, an event is recorded when the noise exceeds a set level for more than two minutes. A maximum of 49 events can be recorded on any day between 7pm and 7am.

With around 91 days each quarter, a maximum of 4,460 noise events could be recorded at each site. The following table represents the actual number of noise events recorded at each site during the quarter and the dominant noise identified for each event.

SITE	TOTAL	MINING	TRAFFIC	OTHER
BPS	113	20	48	45
KTS	55	8	37	10
TOTAL	168	28	85	55

Please note that the events in the "Other" category were dominated by rain, birds and unknown sources.

KCGM continues to work on reducing the impact of noise from its operations. Investigations are ongoing and improvements made when identified. Further information about our noise management can be found on the KCGM website – www.superpit.com.au.

Please contact the KCGM Public Inquiry Line on 9022 1100 if you have any queries or concerns regarding noise from our operation.

www.superpit.com.au

Figure 7 Publication of Results from Noise Monitoring Programme in Kalgoorlie Miner

Annual Noise Monitoring and Management Report

Additional to the quarterly Noise and Blast Monitoring Reports KCGM submits an Annual Noise Monitoring and Management Report to the Department of Environment and Conservation by 14 August. The report covers the period 14 July previous year to 13 July current year.

The report contains the following:

- A summary of the levels of noise recorded at continuous monitoring locations KTS and BPS and compliance monitoring conducted at the five monitoring locations
- Particulars of actions taken by KCGM during the year to reduce the level of noise emitted from the Fimiston Gold Mine.

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4.2 Ground Vibration and Airblast Overpressure Monitoring Programme

The ground vibration and airblast overpressure monitoring programme conducted by KCGM involves recording of ground vibration and airblast overpressure at reference locations for each blast undertaken. Recording of a blast is triggered by ground vibration exceeding the set trigger level of 0.20mm/sec.

KCGM uses a combination of methods for recording blast monitoring data:

- Texcel Easylink software;
- KCGM's Operational Management Database (MMRS);
- Geographical Information System (GIS) database;
- Daily blast notices;
- Air Quality Control monitoring; and
- Bureau of Meteorology.

These methods meet the requirements of Section J3.4 of Australian Standard 2187.2-2006.

The following information is stored in MMRS database for each blast undertaken at KCGM:

- Blast size (m³);
- Number of blast holes;
- Planned explosive weight per hole;
- Design timing sequence;
- Method of initiation;
- The date and time of the blast;
- Location of the blast in relation to mine leases;
- Peak particle vibration and peak airblast level; and
- Design blast hole locations.

The MMRS system contains a full history of ground vibration and airblast responses since 1999.

The location of the blast monitors does not change and is recorded in the KCGM Geographical Information System (GIS) database.

The trigger level for the blast monitoring equipment does not change. The trigger level is recorded in several locations, including the Quarterly Noise and Blast Monitoring Report, Texcel Easylink software and this management programme.


The measurement equipment used by KCGM does not change and the type of equipment used is recorded in this programme. Operation of the measurement equipment is an automated process controlled by the Texcel Easylink software and does not require an operator. Downloading of data into the MMRS database is conducted on a daily basis by KCGM Drill and Blast personnel.

The location of the blast in relation to the mine leases and any structures and/or person who may be affected by the blast is recorded graphically in the KCGM Blast

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Notice (Figure 8) which is prepared for each blast. The Blast Notice is distributed electronically around the KCGM site and is put up on noticeboards. The Blast Notice contains information on where the blast is located and an action plan for managing access to the blast area and personnel exclusion zone. The location of the blast can also be recorded in the GIS database if required.

BLAST AREA MUST BE EVACUATED WITHIN 30 MINUTES OF BLAST TIME.



Today's Blast

KALGOORLIE CONSOLIDATED GOLD MINES
FIMISTON OPEN PIT'S

Tuesday 11th August 2009

Pit	Shot	Time
Trafalgar	320-1915/17	1pm
Chaffers	400-1308	1pm

Blast Guards

#	Position	Who
1	320r1 Trafalgar floor	
2	"O" ramp below Trog-a-bout	
3	"X" ramp below "A" ramp intersection	
4		
5		
6	Dispatch	

NOTE: Chaffers out, south Trafalgar out, north Trafalgar in

Tourist Lookout: Open
Wind dependant: No

Blast location
Wind dependant Shot
200m Minimum personnel and equipment exclusion zone

Figure 8 KCGM Blast Notice

The peak particle velocity values for each of the triaxial components is recorded by the measuring equipment and automatically downloaded each day. This data is not currently stored in MMRS but can be retrieved if required.

To date analysis of face survey information of the blast design has not been required as no issues have arisen in relation to face blasts. All possible shots are buffered to minimise ore dilution which eliminates non pit edge face burst. Should KCGM ever either move away from buffering shots, or have face burst incidents, analysing face hole survey information may become a requirement.

Weather conditions are measured through Air Quality Control monitoring and stored in a data historian (PI). Weather data can also be obtained from the Bureau of Meteorology if required.

Video footage is taken of each blast and is available for review if required.

Subjective information from the shotfirer is recorded in the Accident Incident Reporting System (AIRS) if a problem occurred during blasting. Any feedback

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received via the PIL from any persons affected by the blast is recorded in the PIL database.

4.2.1 Vibration and Airblast Overpressure Monitoring Locations

There are six ground vibration and air blast overpressure monitors permanently installed at sites between the Fimiston Open Pit and the City of Kalgoorlie-Boulder (Figure 8).



Figure 9 Blast Monitoring Network Location Plan

Ground vibration and air blast overpressure is monitored using Advanced Texcel Monitors (ATM) monitors which meet the requirements of Regulation 21 of the Environmental Protection (Noise) Regulations 1997 and Section J3.2.2 of Australian Standard 2187.2-2006.

Monitors are permanently installed at outdoor sites at least 5 meters away from any substantial sound reflecting surfaces. The positions of the monitoring locations were

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established in 1993. A blast monitoring and modelling review has since been completed as part of the PER process by Terrock Consulting Engineers in 2005.

Monitoring of vibration and airblast overpressure is undertaken by KCGM Drill and Blast personnel, who have acquired through training and experience the knowledge and skills required to carry out the task.

The ATM monitors include concrete mounted external triaxial geophones and linear weighted microphones (elevated approximately 1.6m) to measure the ground vibration and overpressure associated with blast events. The microphones have a frequency response between 2.0 - 500Hz.

The ATM is triggered when a preset level is exceeded, and captures detailed waveform data. The trigger levels are 0.200 mm/sec for geophone vibration. Trigger levels have been set based on more than fifteen years of monitoring data.

Based on past experience, the microphone trigger for overpressure is not used due to excessive wind noise, however a blast of any magnitude will trigger by vibration.

The orientation of each of the transducers is fixed and documented and can be placed in the same global coordinate system used for the blastholes within a blast.

4.2.2 Vibration and Airblast Overpressure Monitoring Equipment

Ground vibration and airblast overpressure are monitored using Advanced Texcel Monitors. The trigger levels for the blast monitors are set at 0.2mm/sec for geophone vibration. Based on past experience, the microphone trigger for overpressure is not used due to excessive wind noise. However, a blast of any magnitude will always trigger the monitors by vibration.

The Advanced Texcel Monitors comply with Schedule 4 of the *Environmental Protection (Noise) Regulations 1997* and Section J3.2.1 of Australian Standard 2187.2-2006.

The ATM monitors include linear weighted microphones and the microphone bandwidth is 2.0 – 500 Hz (-3dB).

Particle velocity is recorded in mm/s and stored in the MMRS database.

The vibration transducer records signals from three mutually orthogonal axes. This data is automatically downloaded and can be reviewed if required. The Peak Component Particle Velocity is recorded by the measuring equipment and automatically downloaded each day. This data can be retrieved if required. The geophone will record a vertical, radial and transverse vibration signal, using these three signals to calculate a peak particle velocity.

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The monitors record continuously and will report a trigger above 0.2mm/sec for a period spanning 0.5 seconds prior to triggering, 0.8 seconds post triggering. Blasts at Fimiston Open Pit Operations average approximately 3 seconds with long blasts averaging 5 – 6 seconds. No blasts have ever been detonated that lasted longer than 8 seconds.

The ViewW software will display waveform data and peak readings for each component channel for every trigger event.

The monitor will report peak component readings for the vertical, radial and transverse channels, and will calculate a peak particle velocity using $\sqrt{\sum 2}$ method.

Instrument calibration testing performed annually restricts instrumentation background interference to $\pm 2.0\%$ of maximum PPV.

Geophones used for monitoring are within the range 2Hz to 250Hz.

The sampling frequency for monitoring is 1KHz.

4.2.3 Calibration of Vibration and Airblast Overpressure Monitoring Equipment

The vibration and airblast overpressure monitoring equipment are returned to Texcel (manufacturer and supplier) on an annual basis for calibration. Texcel calibrations are undertaken in accordance with ISEE Performance Requirements and the calibration process is traceable to the Australian National Measurements Institute.

Calibration of the equipment meets the requirements of Schedule 4 of the *Environmental Protection (Noise) Regulations 1997*, the manufacturers specifications and section J3.1.2 of *Australian Standard 2187.2-2006*.

4.2.4 Reporting of Vibration and Airblast Overpressure Monitoring

Since 1993 a Quarterly Noise and Blast Monitoring Report has been submitted to the DEC. This report contains the following information in relation to vibration and airblast overpressure monitoring:

- Number of shots fired during the quarter;
- Number of trigger events (vibration of greater than 0.2mm/sec or overpressure of greater than 114dB(L));
- Details of each blast which triggered an event; and
- General comments on any events over 125dB or numerous events over 120dB.

A summary of blast monitoring results is also included in the Annual Environmental Report.

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COMMUNITY CONSULTATION AND COMPLAINT MANAGEMENT

KCGM has an established community consultation network and utilises a range of mechanisms to facilitate consultation and to capture community feedback on an ongoing basis. The most significant mechanisms include the:

- Community Reference Group (CRG);
- Public Interaction Line (PIL); and
- KCGM Super Pit Shop.

KCGM also uses its noise monitoring results as an indicator for potential concern for residential areas (even if no complaints are received). Where the noise monitoring results show that mining noise is causing significant tape recorder trigger events these are investigated to determine the source of the noise. When the source is identified, reasonable, practicable and safe action is taken to reduce the noise where possible.

KCGM is committed to ongoing consultation with our key stakeholders to determine the success of the noise and vibration management practices and where required investigate and implement additional control measures to address any community concerns.

4.3 Community Reference Group

The CRG is a (self-selected) group of local community members and invited guests from the Department of Environment and Conservation, Department of Consumer and Employee Protection, Department of Health, Department of Mines and Petroleum and Department of Indigenous Affairs. The group meets monthly to discuss current KCGM planning, operational activities and feedback from the community.

4.4 Public Interaction Line

KCGM has a 24-hour Public Interaction Line that can be contacted for a wide range of issues including emergencies, complaints, inquiries and feedback. Both the public and employees (including contractors) are encouraged to use the PIL for any matter relating to the operations. It is a particularly important avenue for capturing those issues which require follow up and action.

Feedback from the PIL system is very effective in helping to make KCGM aware of issues that are of concern to the community such as noise, dust or blasting. Being aware of the problems allows KCGM to investigate and implement control measures to address any community concerns.

KCGM has a procedure for dealing with all calls to the PIL. This procedure is followed for any complaints received regarding noise, vibration or air blast over pressure.

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During business hours enquiries are forwarded immediately to the relevant department supervisor to take the required action. Incoming calls received outside office business hours may be forwarded to the shift supervisor for immediate action or where appropriate will be followed up the next work day.

Contact is also made with any member of the community, employee or contractor who calls the PIL either by phone or in writing. Direct personal contact follows, depending on the nature of some inquiries.

All calls to the PIL are recorded in a database, along with actions taken to resolve complaints.

4.5 KCGM Super Pit Shop

The KCGM Super Pit Shop is situated in Burt Street, Boulder and provides easy access from the community to review approval and planning documentation, and to discuss issues with a range of KCGM staff.

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5 NOISE MODELLING AND VERIFICATION

Since September 1991 KCGM has been guided by Herring Storer Acoustics through its undertaking of extensive modeling and assessment of KCGM operations and plans.

5.1 Modelling

Modelling is carried out primarily to quantify the noise environment and establish a model for planning purposes.

The modeling is primarily undertaken using the SoundPlan software programme to predict, assess and map noise. KCGM understands this programme is recognised by the Department of Environment and Conservation as a reliable tool in the forward planning, applications assessment and operation of sites which contain noise sources as part of their operations.

The noise sources used in the modelling have been taken from actual measurements of equipment used at KCGM.

5.2 Model Validation and Direct Noise Measurements

Noise measurements have also been taken at fixed sites in residential areas. These direct measurements were carried out during the middle of the night in order to minimise the effects of other noise sources in the city.

The measurements served two main purposes:

- Validation of the predictions of the model.
- Assessment of background noise levels in the absence of mining. In order to achieve this goal, a complete shut down of the mining operation was undertaken.

5.3 Blast Vibration Modelling

When blasting near surface blasts on the western side of the pit, KCGM have the blast vibration modelled to predict maximum Peak Particle Velocity (PPV) at the blast monitoring stations. The model inputs are kg of explosives at each hole, X,Y,Z position of the hole and firing sequence. With these inputs a Monte Carlo simulation is run, predicting the Maximum PPV with certain probability.

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6 KCGM'S COMMITMENTS

1. Continuous environmental noise monitoring at long-term sites (Boulder Primary School and Kalgoorlie Technical School) including assessment of noise triggers. When mining noise triggers occur, these are investigated to determine the source of the noise and when the source is identified, action is taken to reduce the noise where possible.
2. Quarterly noise monitoring reports to the Department of Environment and Conservation including summary report advertisements in the local Kalgoorlie Miner newspaper and on the KCGM website www.superpit.com.au .
3. Revision and implementation of the KCGM Noise and Vibration Monitoring and Management Programme.
4. Investigate the replacement of reversing alarms with broad band reversing alarms that attenuate more with distance. Pending the trial outcome, the aim is to have all mobile equipment reversing alarms upgraded by the time the Golden Pike Cutback commences.
5. Undertake 6 monthly noise monitoring of individual haul trucks (75% to be covered during sampling allowing for breakdown and maintenance) to track noise performance and identify if additional maintenance is required. Results will be reported in the Annual Environmental Report.
6. Work with suppliers and manufactures to investigate further opportunities to minimise tonality and noise characteristics of equipment where practicable through procurement specifications.
7. Limit Golden Pike cutback operations for the second bench (-20m) to day and evening time periods (07:00 to 22:00) and not commence the North West waste rock dump until Golden Pike mining operations have completed two benches (-20m).
8. Employees and contractors will receive formal induction and training covering procedures for noise control.

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9. The KCGM “Public Interaction Line” will be used to register and respond to complaints, concerns and inquiries in accordance with the KCGM procedure.
10. KCGM will take all reasonable measures to reduce noise emitted from the Fimiston Gold Mine with the aim of reducing noise emissions by 3dB within 5 years of the *Environmental Protection (Fimiston Gold Mine Noise Emissions) Approval 2009*.

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GLOSSARY OF TERMS

Airblast level: A noise level resulting from blasting.

Airblast overpressure: The sudden increase in air pressure, generated by a shock wave, produced when an explosive is detonated.

A-weighting: A frequency-dependent scaling of a sound wave that mimics the response of human hearing.

Annual: A twelve (12) month period.

Blasthole: A hole that has been drilled or prepared for the purpose of being charged with explosives, or has been charged with explosives.

Blasting: The use of explosive material to fracture:

- a) rock, coal and other minerals for later recovery; or
- b) structural components or other items to facilitate removal from a site or for reuse.

Competent person: A person who has acquired through training, qualification or experience, or a combination of these, the knowledge and skills to carry out the required task.

Component velocity: One of the orthogonal particle velocities; typically one of radial, transverse, or vertical velocity.

Ground vibration: Mechanical energy (vibration) produced by a blast and transmitted through the ground.

DEC: Department of Environment and Conservation.

$L_{A\ 10}$ approved level: An assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded to more than 10% of any period of one hour.

$L_{A\ max}$ approved level: An assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

$L_{A\ slow}$: The reading in decibels (dB) obtained using the "A" frequency-weighting characteristic and the "S" time-weighting characteristic as specified in AS 1259.1-1990 with sound level monitoring equipment that complies with the requirements of Schedule 4 of the *Environmental Protection (Noise) Regulations 1997*.

$L_{Linear\ peak}$: The maximum reading in decibels (dB) obtained using the "P" time-weighting characteristic as specified in AS 1259.1-1990 with all frequency-weighting networks

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inoperative and with sound level measuring equipment that complies with the requirements of Schedule 4 of the *Environmental Protection (Noise) Regulations 1997*.

Measured: In relation to the measurement of a noise emission, means measured and adjusted in accordance with the *Environmental Protection (Noise) Regulations 1997*.

Monitoring: Is the process of sampling and measuring certain parameters.

NATA: National Association of Testing Authorities.

Particle velocity: The time history of the velocity of particles within the ground.

Peak component particle velocity: The peak level of the particle velocity for an individual component.

Quarterly: A three (3) month period.

Reference location: A location specified in the terms in Environmental Protection (Fimiston Gold Mine Noise Emissions Approval) 2009 for the assessment of noise emissions.

Significantly contribute to: A noise emission is taken to “significantly contribute to” a level of noise if the noise emission exceeds a value which is 5dB below the assigned level at the point of reception. As defined in the *Environmental Protection (Noise) Regulations 1997*, Regulation 7(2).

Sound level meter: A measuring device that measures the level of sound, and may provide dBL, dBA or dBC values.

Sound pressure level (dB): A logarithmic scale of pressure with a reference pressure of 20µPa.

Vector peak particle velocity: The peak level of the particle velocity calculated from the vector formed by the magnitude of the three orthogonal components of the particle velocity over their measured time history.

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