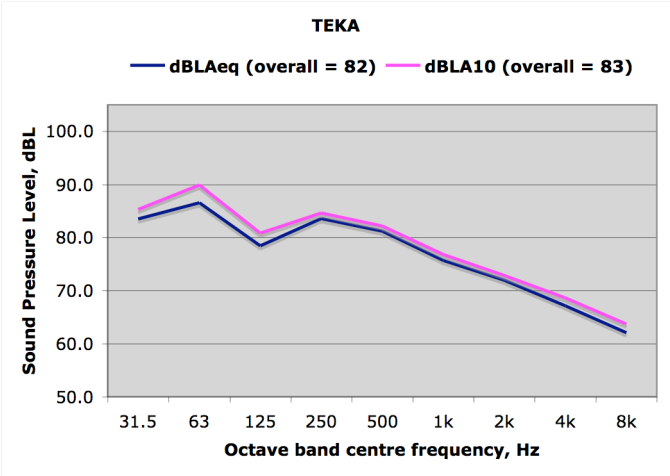
Figure 10 : TEKA

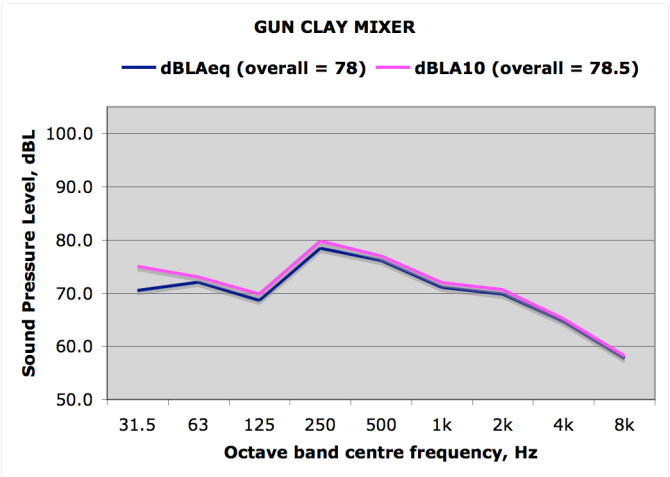
Image indicates typical equipment and process. It does not necessarily represent the exact equipment and process at the proposed facility.



Duration	Tonal noise	Low frequency noise
Batching and exhaust fans are continuous, vibrating skip 1 min every 10 minutes	*No*	*No*

Figure 11 : GUN CLAY MIXER

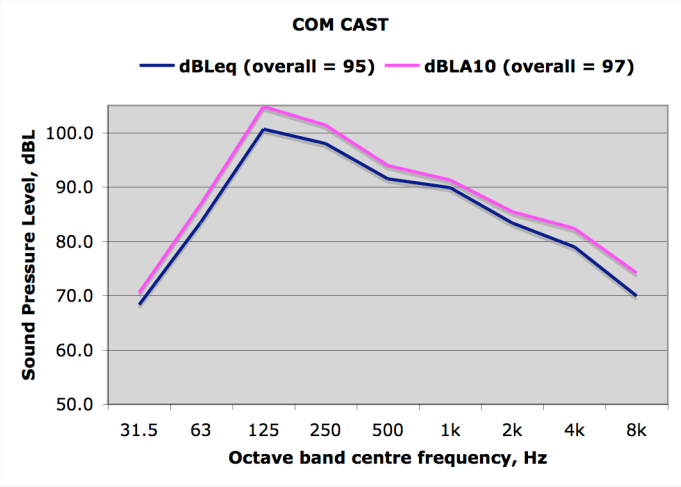
Image indicates typical equipment and process. It does not necessarily represent the exact equipment and process at the proposed facility.



Duration	Tonal noise	Low frequency noise
Varies – assumed continuous for the assessment	*No*	*No*

Figure 12 : VIBRO TABLE – COM CAST

Image indicates typical equipment and process. It does not necessarily represent the exact equipment and process at the proposed facility.

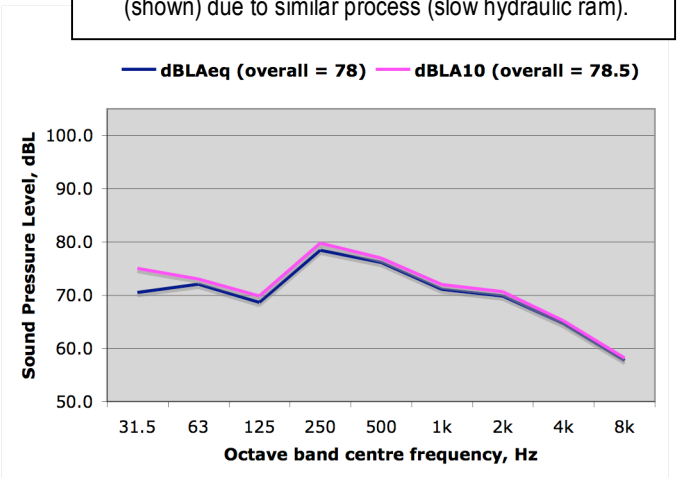


Duration	Tonal noise	Low frequency noise
Once per hour for 8 minutes, high noise output (measured) for first 3 minutes	*No*	*No*

Figure 13 : RAM EXTRUDER

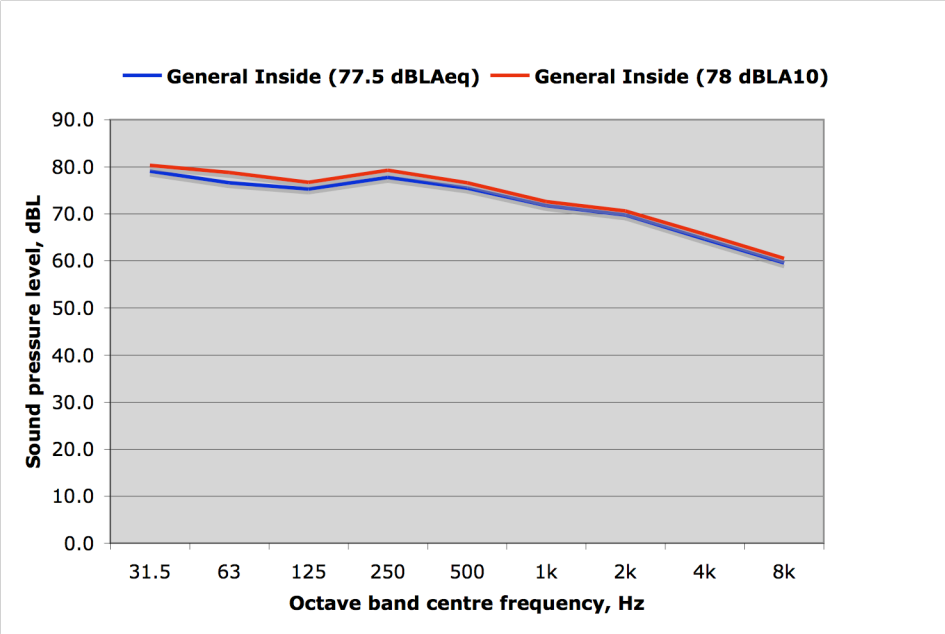
Image indicates typical equipment and process. It does not necessarily represent the exact equipment and process at the proposed facility.

Ram extruder was being serviced at the time of the measurements. Noise output is similar to Gun Clay Mixer (shown) due to similar process (slow hydraulic ram).



Duration	Tonal noise	Low frequency noise
Varies – assumed continuous for the assessment	*No*	*No*

Figure 14 : GENERAL CONTINUOUS INTERNAL NOISE LEVEL



8.1 Summary of existing equipment noise levels

The noisiest items of equipment are (highest noise output first):

Com Cast Vibro Table : 95 dBL_{Aeq}

Ball Mill : 87.5 dBL_{Aeq}

Crusher : 85.5 dBL_{Aeq}

For the purposes of the assessment, the Ball Mill and Crusher are assumed to operate continuously (since there are days when these items will operate continuously). The Ball Mill, along with the TEKA and many ventilation fans / dust collection fans, was operating during the measurements of the general continuous internal noise level of 77.5 $dBL_{Aeq,\ 15\ min}$ (shown in Figure 14).

For the purpose of the assessment, the general continuous internal noise level of 77.5 $dBL_{Aeq,\ 15\ min}$ is considered to represent the 'typical' operating scenario for the proposed facility.

The Com Cast Vibro Table operates approximately once per hour for a period of 8 minutes. For the first 3 minutes of the operating cycle the noise level generated is 95 $dBL_{Aeq,\ 3\ min}$ at 5 to 10 m. This is significantly higher than the noise level generated by all other items of equipment. For the remaining 5 minutes, the noise level drops to below 85 dBL_{Aeq} at 5 to 10 m.

For the purpose of the assessment, the Com Cast noise level of 95 $dBL_{Aeq,\ 3\ min}$ at 5 to 10 m is considered to represent the 'worst-case' operating scenario for the proposed facility.

9 Predicted Operational Noise Levels

9.1 Proposed equipment layout

Figure 15 indicates one possible layout for the machinery and equipment within the proposed building.

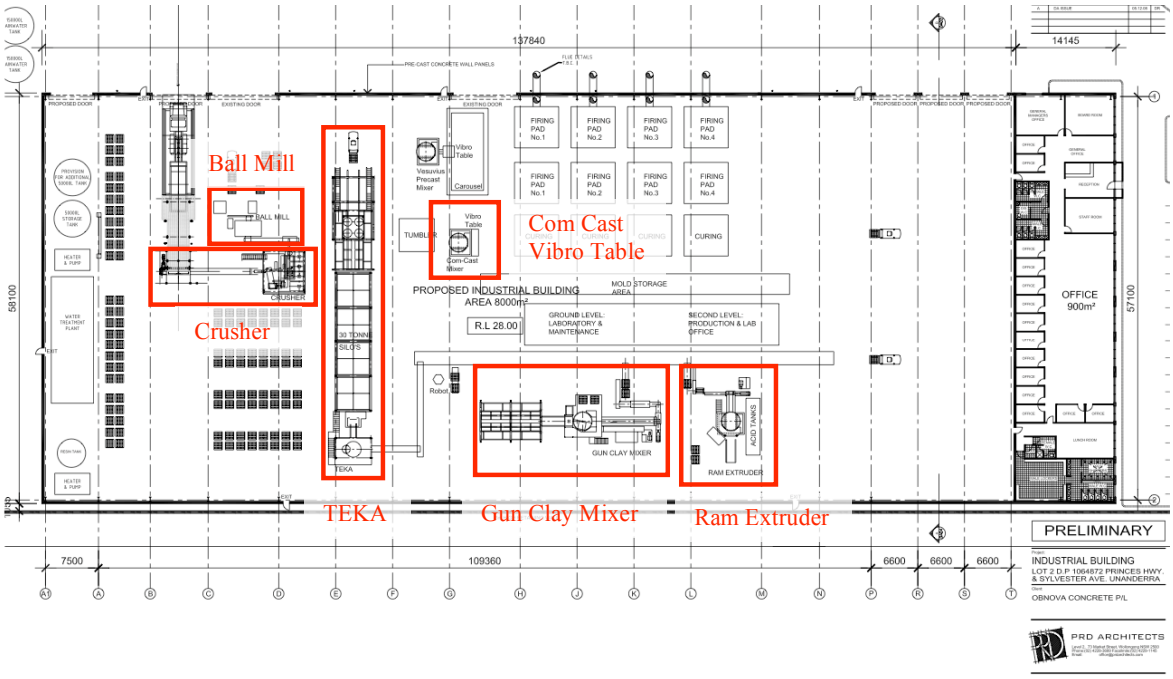


Figure 15 : Indicative layout of primary noise-generating equipment in proposed building

9.2 Equipment operating scenarios

During the measurements of operational noise levels at the existing facility, the facility managers described in detail the operating scenarios for all plant and processes. From these descriptions we have been able to determine that there are two key operating scenarios which require a noise impact assessment:

Scenario 1 : Typical Operating Scenario

The Com Cast Vibro Table is not operating. The noise level inside the building is 77.5 $dBL_{Aeq,\ 15\ min}$. This noise level is assumed to apply equally over all areas of the external envelope of the proposed building.

Scenario 2 : Worst Case Operating Scenario

The Com Cast Vibro Table is operating for a 3-minute period. The noise level inside the building increases to 95.0 $dBL_{Aeq,\ 3\ min}$ local to the Com Cast equipment. This is equivalent to a 15-minute L_{eq} of 85.5 $dBL_{Aeq,\ 15\ min}$. This noise level is assumed to apply over a localised area of the external envelope of the proposed building.

9.3 Predicted operational noise levels at the nearest residential areas

Operational noise levels have been predicted at the Orama Parade residential receivers. The calculation methodology is as follows:

- Determine the noise level generated by the equipment.
- Make allowance for the attenuation provided by the envelope of the proposed building – assuming the sound reduction provided by the weakest sound transmission paths (colorbond roof and roller shutters).
- Make allowance for distance attenuation from the building to the receiver location.
- Make allowance for barrier attenuation / screening between the proposed building and the residential receiver location. We note that we have included no allowance for barrier attenuation / screening since there is direct line of sight between the proposed building and the Orama Parade receiver location.

Once the operational noise level is calculated, determine whether any modifying factors apply to account for any annoying characteristics of the operational noise, plus consider the impact of meteorological conditions.

Calculation of the operational noise levels

A summary of the prediction of the operational noise levels at the Orama Parade assessment location is given in Table 4.

	Internal reverberant noise level, $L_{Aeq,15min}$	Building attenuation, dB(A)	Façade area, m^2	Façade area factor	Distance to receiver, m	Distance attenuation, dB(A)	Constant	Resultant receiver level, $L_{Aeq,15min}$
Scenario 1 Typical	77.5	-15	8000	+39	350	-50	-14	37.5
Scenario 2 Worst-case	85.5	-15	800	+29	350	-50	-14	35.5

Table 4: Summary calculation of operational noise levels at receiver location

"Modifying factor" adjustments

It is necessary to adjust the predicted noise level if it contains any of the following characteristics:

- Tonality
- Impulsiveness
- Intermittency
- Irregularity
- Dominant low-frequency content.

In the case of operational noise from the proposed facility, none of these characteristics apply.

The noise produced by the equipment is considered to be broadband with no tonal components, no impulsive characteristics nor dominated by low frequency content.

Some of the equipment may be considered to be intermittent. The intermittent modifying factor applies to the Night time period only (2200 – 0700).

Therefore, for the Morning period used in the assessment (0600 to 0700), we have assumed a correction to the predicted operational noise levels of + 5 dB to account for intermittent noise.

For the Day and Evening time periods no adjustments to the predicted operational noise levels are considered necessary.

Meteorological conditions

Temperature inversions and gradient wind can increase noise levels in certain conditions. The NSW Industrial Noise Policy includes a procedure for assessing the impacts of these conditions. Any increase in receiver noise levels must be added to the predicted receiver level before assessment.

Temperature inversions

There are two important characteristics of temperature inversions:

- They usually occur at nighttime.
- They focus noise at relatively large distances from the noise source.

The first step in assessing noise level increases due to temperature inversions is to carry out an initial screening test to determine whether there is a likely impact. This test (as detailed in the NSW Industrial Noise Policy) considers:

- Whether the development operates at nighttime.

- Whether, by using a default set of values, it can be shown that there would be no significant additional noise impacts during inversion conditions (such as areas that experience only slight increases, or areas where the most affected residences are located close to the development). No significant additional noise impact is defined as a less than 3 dB increase.

If the initial screening test shows there is little or no impact, no further analysis is required.

Initial screening test

- Nighttime operation

  The development operates for a small night time period – between 0600 and 0700.

- Test for maximum possible level of impact

  Using the parameters for non-arid areas (temperature inversion strength of 3°C/100m, source to receiver drainage wind speed of 2m/s at 10m height), Table D1 in the NSW Industrial Noise Policy shows that the maximum increase in noise level would be approximately 3 dB (for a source to receiver distance of 350m).

From this initial screening test it is evident that there will be little or no impact, and no further analysis is required.

Wind effects

Wind effects need to be assessed where wind is a feature of the area, such as where source to receiver wind speeds (at 10m height) of 3m/s or below occur for 30% of the time in any season.

To determine whether or not these conditions apply, wind speed and direction data provided by the Australian Government Bureau of Meteorology for Wollongong Airport has been considered. This data is an average of all data collected from the airport between 1970 and 2008.

A summary of the data is provided in Figure 16.

The summary indicates that the prevailing wind is south-westerly in the mornings and north-easterly in the afternoons.

Considering this data, a conservative scenario has been assumed for the assessment. Worst-case modifying factors have been applied to the predicted operational noise levels to account for wind effects. Refer to Section 10.

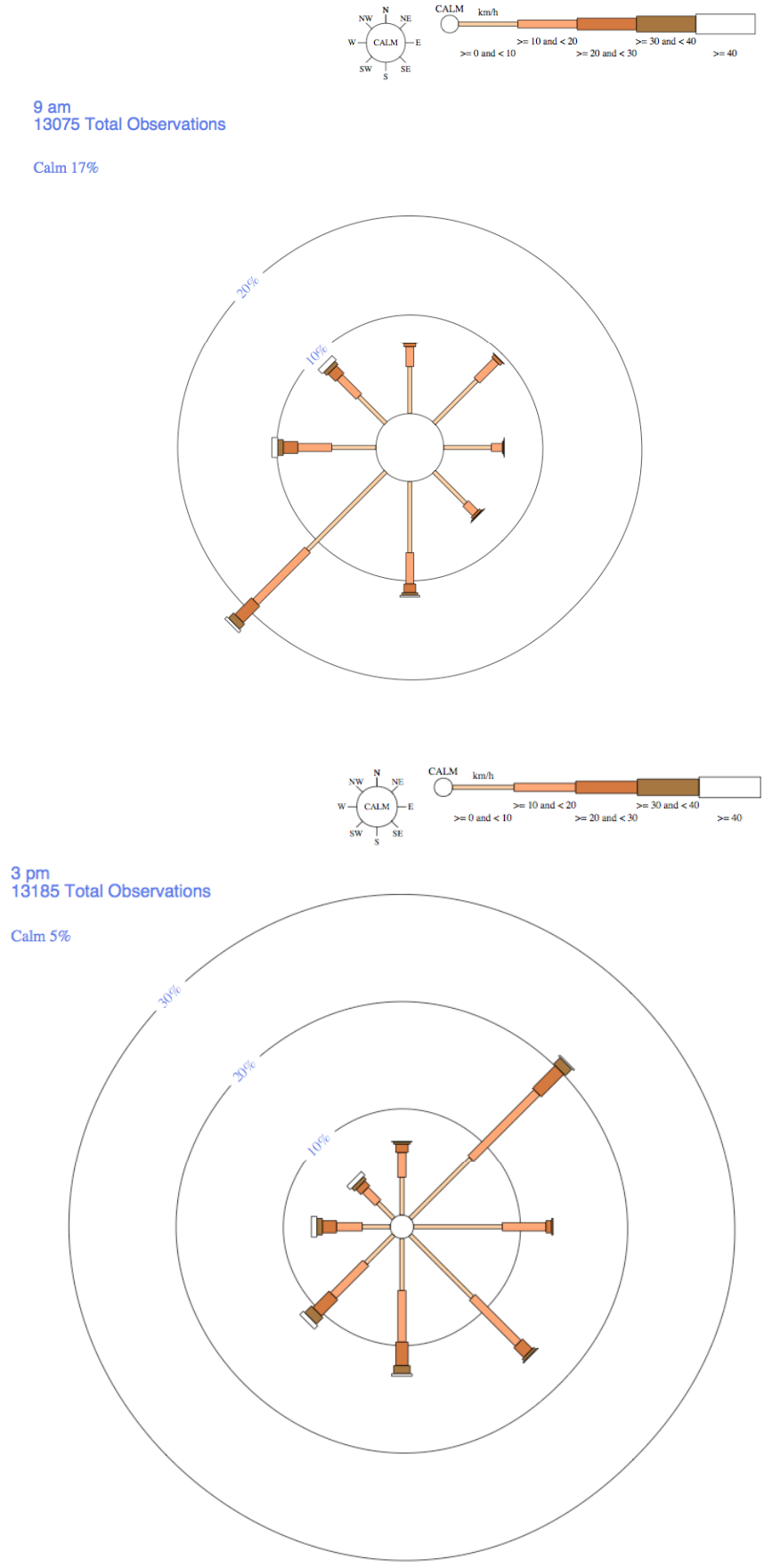


Figure 16 : Annual wind rose at Wollongong Airport - Morning (9am) and Afternoon (3pm), 1970 to 2008
http://www.bom.gov.au/climate/averages/tables/cw_068188_All.shtml

10 Noise Impact Assessment

The noise impact of the development has been determined by comparing the predicted operational noise level at the nearest residential receiver locations with the project-specific noise criteria derived for the particular receiver location.

10.1 Without wind effect and temperature inversion

The predicted operational noise level, before modifying factors for meteorological conditions are applied, is compared with the Project Specific Noise Level for each assessment time period in Table 5.

	Assessment Period	Operational Noise Level, $L_{Aeq15min}$	Project Specific Level, $L_{Aeq,15min}$	Complies ?
Scenario 1 Typical	Morning 0600 - 0700	37.5 + 5 (intermittent)	43.1	✓
	Day 0700 - 1800	37.5	54.5	✓
	Evening 1800 - 2200	37.5	47.6	✓
Scenario 2 Worst-case	Morning 0600 - 0700	35.5 + 5 (intermittent)	43.1	✓
	Day 0700 - 1800	35.5	54.5	✓
	Evening 1800 - 2200	35.5	47.6	✓

Table 5: Comparison of predicted operational noise levels and Project Specific Noise Level – before corrections for meteorological conditions

10.2With wind effect and temperature inversion

A detailed assessment has been carried out to determine the predicted operational noise levels once modifying factors for meteorological conditions are applied.

Predicted *octave band* operational noise levels for each scenario (Scenario 1 and Scenario 2) are compared with the lowest measured existing background noise levels at the Orana Parade residences.

A summary of the predicted noise levels is provided in Tables 6 and 7.

	dB re 20µPa								
	Overall	**Octave band centre frequencies, Hz**							
		31	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Scenario 1: Typical (no Com Cast)	77.5 dBL_{Aeq}	79	76	75	77	75.5	71	70	64.5	59.5
Building Attenuation		-8	-8	-9	-11	-14	-15	-17	-18	-21
Area Correction Factor (8000m^2)		+39	+39	+39	+39	+39	+39	+39	+39	+39
Distance attenuation (350m)		-50	-50	-50	-50	-50	-50	-50	-50	-50
Constant		-14	-14	-14	-14	-14	-14	-14	-14	-14
Ground reflection		+3	+3	+2	+2	+1	+1	+1	+1	+1
Temperature inversion correction		+3	+3	+3	+3	+3	+3	+3	+3	+3
Wind correction		+4	+4	+5	+6	+11	+5	+6	+6	+6
Receiver Sound Pressure Level, dBL_{eq}	50.5 dBL_{Aeq}	56	53	51	52	51.5	40	38	31.5	23.5
Existing Background Noise at 6am, dBL_{90}	55.5 dBL_{A90}	63.0	59.1	64.6	52.4	46.3	50.7	47.5	38.2	30.4
Compliance at 6am	Yes	✓	✓	✓	✓	X	✓	✓	✓	✓
Existing Background Noise at 10pm, dBL_{90}	52.5 dBL_{A90}	65.2	59.7	60.1	52.1	48.2	47.0	43.1	38.1	34.1
Compliance at 10pm	Yes	✓	✓	✓	✓	X	✓	✓	✓	✓

Table 6: Octave band assessment of predicted operational noise levels and existing background noise levels – including corrections for meteorological conditions : SCENARIO 1 – Typical, No Com Cast

Considering the predicted octave band noise levels under worst-case meteorological conditions, there is only 1 predicted exceedance of the existing background noise level at the Orama Parade Residences – between 3 and 5 dB at 500 Hz assuming Scenario 1.

We note that this prediction assumes a worst-case scenario as follows;

- worst-case corrections for wind effects, combined with
- worst-case corrections for temperature inversions, combined with
- lowest measured background noise levels - under calm weather conditions.

Given these conservative assumptions we do not consider the exceedance under these circumstances to be significant.

	dB re 20µPa								
	Overall	**Octave band centre frequencies, Hz**							
		31	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Scenario 2: Worst-case (Com Cast)	95 dBL_{Aeq}	68.5	83.5	100.5	98	91.5	90	83.5	79	70
Building Attenuation		-8	-8	-9	-11	-14	-15	-17	-18	-21
Area Correction Factor (800m^2)		+29	+29	+29	+29	+29	+29	+29	+29	+29
Distance attenuation (350m)		-50	-50	-50	-50	-50	-50	-50	-50	-50
Constant		-14	-14	-14	-14	-14	-14	-14	-14	-14
Ground reflection		+3	+3	+2	+2	+1	+1	+1	+1	+1
Temperature inversion correction		+3	+3	+3	+3	+3	+3	+3	+3	+3
Wind correction		+4	+4	+5	+6	+11	+5	+6	+6	+6
Receiver Sound Pressure Level	59 dBL_{Aeq}	35.5	50.5	67.5	63	57.5	49	41.5	36	24
Existing Background Noise at 6am, dBL_{90}	55.5 dBL_{A90}	63.0	59.1	64.6	52.4	46.3	50.7	47.5	38.2	30.4
Compliance at 6am	Yes	✓	✓	X	X	X	✓	✓	✓	✓
Existing Background Noise at 10pm, dBL_{90}	52.5 dBL_{A90}	65.2	59.7	60.1	52.1	48.2	47.0	43.1	38.1	34.1
Compliance at 10pm	Yes	✓	✓	X	X	X	X	✓	✓	✓

Table 7: Octave band assessment of predicted operational noise levels and existing background noise levels – including corrections for meteorological conditions : SCENARIO 2 – Worst-case, with Com Cast

Considering the predicted octave band noise levels under worst-case meteorological conditions, there is a predicted exceedance of the existing background noise level at the Orama Parade Residences by 2 to 11 dB at 125 Hz to 1 kHz with the Com Cast Vibro Table operating.

We note that this prediction assumes a worst-case scenario as follows;

- worst-case corrections for wind effects, combined with
- worst-case corrections for temperature inversions, combined with
- lowest measured background noise levels - under calm weather conditions.

11 Proposed Noise Mitigation to Control Operational Noise Levels

No additional noise controls are required to control operational noise levels during typical operating scenario for the facility. The proposed construction of the envelope of the building (precast concrete wall panels plus colorbond roof) will be sufficient to control operational noise levels at the nearest affected residential receiver locations.

With the Com Cast Vibro Table operating before 7am or after 6pm there is a predicted exceedance of the existing background noise level at the Orama Parade Residences by 2 to 11 dB at 125 Hz to 1 kHz.

We do note that this prediction assumes a worst-case allowance for wind effects, combined with worst-case corrections for temperature inversions, combined with the lowest measured background noise levels - under calm weather conditions. However, to ensure that adverse noise impacts on the Orama Parade Residences are avoided, we recommend that the Com Cast Vibro Table is not operated before 7am or after 6pm.

We also note that there are a large number of ventilation fans and dust collector fans associated with the proposal. Some of these will be re-used from the existing facility (along with associated in-duct silencers) and some will be new.

Whilst these are relatively low-noise items of equipment, by comparison with the process equipment, the noise output of each of these does need to be assessed to ensure that the environmental noise limits are met.

If the existing fans and silencers are proposed for re-use in the new facility, the performance of each will need to be reviewed in detail during the detailed design process.

Similarly, for all new fans or replacement fans, we recommend that the following is resolved as part of the design development process:

- Select plant to operate at lowest noise output.
- Provide in-duct attenuation, including silencers and absorptive duct linings as required.
- Provide fan enclosures and duct linings as required.

In this way, the noise output of each fan can be assessed in the context of the overall noise levels generated by the facility to ensure that the environmental noise limits are met.

12 Compliance

In order to establish compliance with the noise limits set in this assessment report, or in any subsequent development consent conditions, we recommend that some ongoing noise monitoring is carried out soon after the completion of the relocation of the facility to the proposed site.

This will allow the actual resultant operational noise levels at the residential receivers to be determined, and any necessary amelioration works to be considered and implemented as required.

13 Traffic Noise

The relocation of the facility will generate additional traffic as follows:

- Car movements as staff arrive and depart the site at shift changeover times
- Truck movements associated with the delivery and distribution of materials

13.1 Traffic noise criterion

The Environmental Criteria for Road Traffic Noise 1999 of the NSW Department of Environment and Conservation sets a number of traffic noise criteria, depending on the type of development. In the case of this project, the appropriate criterion is that which applies to "Land use developments with potential to create additional traffic on existing freeways/arterials". For this category, the traffic noise criteria are:

- Day (0700 – 2200) $L_{Aeq(15hr)}$ 60 dB
- Night (2200 – 0700) $L_{Aeq(9hr)}$ 55 dB

The following note is also quoted from the document:

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 (traffic) noise levels of more than 2 dB.

13.2 Increased traffic flows

A traffic study for the project has been carried out. This report details the following increases in traffic flow.

Materials will be delivered in bulk on a daily basis using heavy load capacity trucks.

Similarly, the dispatch of the finished product from the site is also undertaken in trucks that have heavy load capacity.

Estimates suggest that the new facility implantation could result in an additional 40 truck trips to the site per week, or 12 truck trips per day. This projected additional level of truck activity is equivalent to less than 1 truck trip per hour.

In summary, it is expected that the proposed extensions will generate a small number of additional truck movements to/from the site.

13.3 Assessment

The additional vehicles expected to be generated by the relocation are not considered to be significant compared with the existing traffic flows along the Princes Highway.

Any increase to the existing traffic noise levels will be less than 2 dB.

Therefore, we consider there to be no impact on existing traffic noise levels from the small increase in traffic resulting from the relocation of the facility.

14 Construction Noise

14.1 Construction noise level limits

The Environmental Protection Agency in its 'Environmental Noise Control Manual, Chapter 171', suggests construction noise conditions that may minimise the likelihood of annoyance being caused to noise sensitive receptors. These are as follows:

- Construction period of 4 weeks and under.

  The L_{10} level (due to construction activities) measured over a period of not less than 15 minutes must not exceed the background level (when the construction site is not in operation) by more than 20 dB(A).

- Construction period greater than 4 weeks and not exceeding 26 weeks.

  The L_{10} level (due to construction activities) measured over a period of not less than 15 minutes must not exceed the background level (when the construction site is not in operation) by more than 10 dB(A).

- Construction period greater than 26 weeks.

  The L_{10} (due to construction activities) measured over a period of not less than 15 minutes must not exceed the background level (when the construction site is not in operation) by more than 5 dB(A).

These levels are for guidance only and do not form part of any legal obligation on the part of the project proponent. However, to follow them can be considered best practice.

14.2 Construction hours of operation

Construction operations should be limited to the following hours:

- Monday to Friday 07:00 - 19:00
- Saturday 07:00 – 17:00

Construction should not take place on Sundays and public holidays.

14.3 Construction program

A detailed construction program for the project will be prepared during the design development stage of the project. The programme will indicate the period over which construction will occur and identify the key stages of excavation and construction activity.

14.4Construction noise criteria

On the basis of the above program, construction noise should be limited to 5 dB above the background noise level at the nearest residential receivers. For the purposes of this assessment, the relevant background noise level is assumed to be the lowest daytime Rating Background Level established in this Report (49 dB(A)). This gives a construction noise limit of:

- Daytime maximum $L_{A10(15min)}$ of 54 dB(A) at Orama Parade residences

14.5 Discussion

Typically construction noise varies, depending on the activity and the number of pieces of plant operating at any given time. In most cases the period of greatest noise output is the early stages during earth moving, when heavy equipment is located on site such as excavators, bulldozers and trucks. Based on typical sound power outputs of such pieces of equipment (typically in the order of 110 dB(A)), and the distances between the site and the nearest residences (350 m), it is anticipated that the construction noise limits will be met most of the time. Consequently, construction noise impact is not anticipated to be significant for this project.

14.6 Construction noise management

Control Elements

Construction noise will be managed by:

- Limiting the operating noise of machinery brought on to the site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the site.
- Measuring the background noise level at the site boundary and at two specified noise sensitive receivers prior to any construction work taking place.

- Subsequent monitoring of noise by an acoustic consultant at noise sensitive receivers and other selected locations around the site, as required by the project construction activities.
- Implement non-compliance and corrective action procedure when required.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours. Where this is not possible and Best Practicable Means are being employed the activity will continue and affected stakeholders will be notified.
- Records of all results will be held on site and will be reviewed by the Project Manager weekly.
- Informing interested parties, as far as practicable, of impending or current events that may cause high levels of noise.
- All activities relating to the construction works will be carried out in line with current best practice.

Communication and Complaints

Where noisy activities are expected, noise sensitive receivers in the vicinity will be notified of impending activities.

Upon receipt of a complaint in relation to noise the project team will:

- Ascertain from the complaint what appliance / activity is causing the problem i.e., inside or outside the site and in what position.
- Establish, by way of monitoring, if the allowable noise level has been exceeded for both plant and general site noise.
- Establish if the appliance positioning has previously been highlighted as a problem area. If not and the noise levels are above the allowable noise level then the equipment and its position will be noted.
- Terminate activity or offending item of plant / machinery if the allowable levels have been exceeded, or take other acoustic remedial action to reduce noise levels to within allowable limits.
- If the activity is occurring outside agreed working hours, the General Foreman will immediately stop the activity. Where stopping the activity would create a safety issue the General Foreman will permit the activity to continue only as long as is necessary to make the area safe; The activity will then be directed to cease.

- Any activity that is directed to cease due to excessive noise may not recommence until the Project Manager is satisfied that the requirements of this plan can be met and has given permission to recommence the activity.
- The Project Manager will ensure that a report of any incident is included in the site records provided to any relevant stakeholders.
- Should it not be possible to adequately attenuate the noise of an activity and it cannot be rescheduled to less sensitive hours, providing Best Practicable Means are being employed the activity will be allowed to continue. The relevant stakeholders and the Council will be notified.