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West Belconnen
Existing Industrial Land Uses
Preliminary Noise Impact Assessment

Report Number 670.10602-R1

13 June 2014

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Version: Revision 2

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Preliminary Noise Impact Assessment

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
670.10602-R1	Revision 2	12 June 2014	John Sleeman	Jamie Hladky	Jamie Hladky
670.10602-R1	Revision 1	04 June 2014	John Sleeman	Jamie Hladky	Jamie Hladky
670.10602-R1	Revision 0	22 May 2014	John Sleeman	Jamie Hladky	Jamie Hladky

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EXECUTIVE SUMMARY

SLR Consulting Australia (SLR) has been engaged by Riverview Projects (ACT) Pty Ltd to assess the impact of noise from existing ACT industrial land uses close to the area proposed for development as part of the West Belconnen project.

The existing commercial and industrial facilities considered in this study are:

- The Canberra Substation, located at 105 Parkwood Road (registered rural Block number 1559);
- The West Belconnen Resource Management Centre (WBRMC), on Parkwood Road; and
- Lower Molonglo Water Quality Control Centre (LMWQCC), on Stockdill Drive.

The scope of this report is to:

- Document the current understanding in the project team of the noise generated by these sources.
- Provide a high-level preliminary noise impact assessment of these three sites, to give early identification of potential development risks associated with the noise from these sources.
- Provide indicative guidance on typical noise mitigation measures and/or setbacks that may be required to enable residential development in the vicinity of these noise sources.
- Where required, recommend further activities that would allow more detailed assessment of noise from these sources. Outline further information required for the detailed assessments.

Design criteria have been proposed in accordance with the *ACT Environment Protection Regulation, The Territory Plan and National Capital Plan*, and the *ACT EPA Noise Measurement Manual*. Reference is also made to relevant NSW Policy. The findings of this preliminary assessment can be summarised as follows:

- **Canberra Substation** – Using a computer noise prediction model based on preliminary noise measurements at the site and no mitigation, an indicative setback distance of approximately 200 to 250 m from the substation boundary was determined to comply with the residential noise limits.

Noise control measures proposed to reduce this setback distance include the construction of a noise wall at the substation boundary. From the initial study, it appears that a barrier formed of a combination of earth bund and wall would be required to provide a useful increase to the area of land that is suitable for residential development (ie that meets the relevant ACT Zone Noise Limits) in this vicinity.

These distances and indicative mitigation should be confirmed in a detailed assessment of noise sources at the substation, in particular the operation of transformers and circuit breakers.

- **WBRMC** – Based on initial assumptions for equipment on this site, an indicative setback distance in the region of 300 m was determined to be required to comply with the Zone Noise Criteria. This assumes operation during the daytime (7am to 10pm) only. This is less than the 500 m emergency landfill buffer already in place. The future operation of this site is the subject of future studies, and existing uses may be phased out over time.

It may therefore be the case that setbacks are not necessary, depending on the relationship between development progress and reduction in operation over time.

- **LMWQCC** – Noise levels are expected to comply with the residential Zone Noise Criteria at the boundary of the project development area.

1 INTRODUCTION

SLR Consulting Australia (SLR) has been engaged by Riverview Projects (ACT) Pty Ltd to assess the impact of noise from existing ACT commercial and industrial land uses within the proposed development area of the West Belconnen project.

The scope of this report is to:

- Document the current understanding in the project team of the noise generated by significant existing noise sources close to the development area.
- Provide a high-level preliminary noise impact assessment of these sites, to give early identification of potential development risks associated with the noise from these sources.
- Provide indicative guidance on typical noise mitigation measures and/or setbacks that may be required to enable residential development in the vicinity of these noise sources.
- Where required, recommend further activities that would allow more detailed assessment of noise from these sources. Outline further information required for the detailed assessments.

This report provides a high level assessment for initial planning purposes, taking in account the ACT Zone Noise Criteria as developed from the *ACT Environment Protection Regulation, The Territory Plan and National Capital Plan*, and the ACT EPA *Noise Measurement Manual*.

Noise levels expected from the three land uses have been estimated, enabling setback distances for residential developments to be determined, for assessment against the Zone Noise Criteria.

A glossary of acoustic terminology used in this report is given in **Appendix A**.

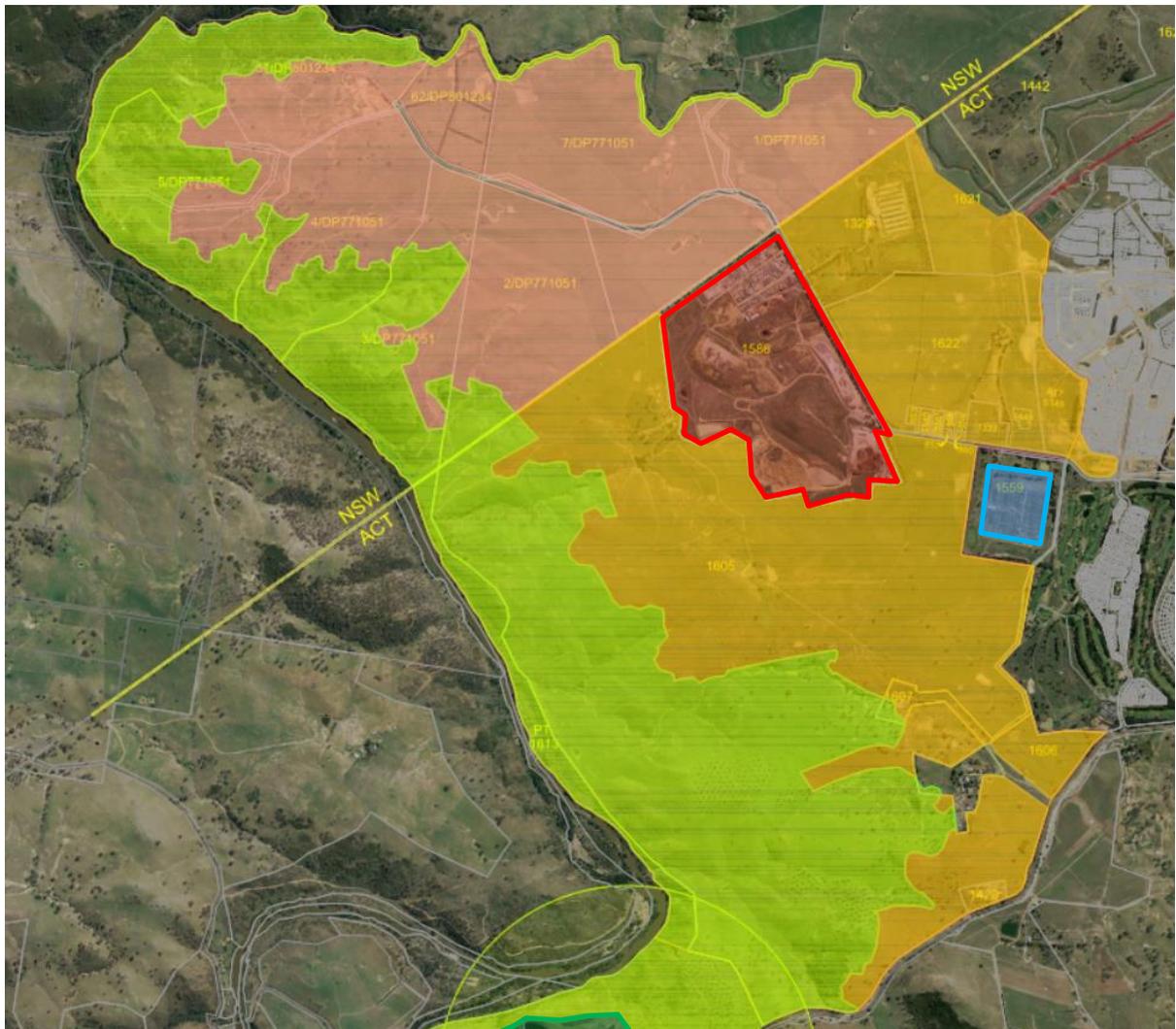
1.1 Site Description

The proposed West Belconnen residential project is located west of Holt, ACT, and south-east of and adjacent to the NSW/ACT border. The currently rural project area is shown indicatively in **Figure 1**.

There are three existing significant noise generating commercial and industrial land close to the development area, as also highlighted in **Figure 1**:

- The **Canberra Substation** is located at 105 Parkwood Road (registered rural Block number 1559) and is currently the main bulk electrical supply point for the ACT. The substation adjoins the north-eastern corner of the project site.
- The **West Belconnen Resource Management Centre (WBRMC)** is located midway along the northern boundary of the project site, for a distance of typically 1 km along, and extending around 1.3 km to the north.
- The **Lower Molonglo Water Quality Control Centre (LMWQCC)** is located south east of the project site on Stockdill Drive, with the nearest building/plant item typically at least 1 km from the nearest part of the development area that is currently proposed for residential land uses.

Figure 1 Aerial Photograph Indicating the West Belconnen ACT Development Area (orange highlight), Canberra Substation (blue), WBRMC (red) and LMWQCC (green)



Source: Knight Frank / Riverview Projects

2 NOISE CRITERIA

Steady noise from the day to day operations of the three sites needs to be assessed in accordance with Zone Noise Criteria defined in the ACT *Environment Protection Regulation, 2005* (the Regulation) and the ACT *Territory Plan*. Additional criteria for short-term noise events or noise with annoying or attention-drawing characteristics are described in the ACT *Environment Protection Noise Measurement Manual 2009* (the Manual).

2.1 ACT Zone Noise Criteria

Noise zones, noise standards and conditions contained in the Regulation are made under the *Environment Protection Act 1997*. Schedule 2 of the Regulation provides noise criteria based on ACT *Territory Plan* zonings.

There are different zone noise standards depending upon the proposed land usage. These criteria will apply to impacts from noise generated by existing and future fixed noise sources to the future residential land parcels in West Belconnen. The noise limits referred to make use of the LA10(t) index, as specified in Section 31 of the Regulation.

Future residential land parcels are expected to be defined as being within Noise Zone G. The relevant noise goals for residential development are presented in **Table 1**.

In the case that mitigation or setbacks prove impractical and limit the potential for residential development in some areas, it may be appropriate that land parcels close to the existing industrial noise sources described in **Section 1.1** could be developed for uses that have less onerous noise requirements. Criteria for sample non-residential uses are also presented in **Table 1**. Detail on other uses is given in **Appendix B** to this report.

Table 1 Noise Level Goals – Residential Development

ACT land use type	Noise goal L10 (dBA)			
	Mon-Sat 7am-10pm	Mon-Sat 10pm-7am	Sun & Public Holidays 8am-10pm	Sun & Public Holidays 10pm-8am
Residential	45	35	45	35
Land in group centres and office sites	55	45	55	45
land in a restricted access recreation zone, or a broadacre zone	50	40	50	40

The noise goals are taken to apply at the 'compliance location', which is the property boundary, or is the property boundary on the other side of the street if there is an intervening road.

2.2 Criteria for Noise with Attention-Drawing Characteristics

Table 1 of the Noise Measurement Manual provides modifying factors to be applied to noise which has attention-drawing characteristics. According to the Manual:

- Penalties apply to noise sources with tonal, intermittent, impulsive or significant low frequency characteristics.
- Single noise events are allowed to exceed the zone noise limit by an amount relative to their duration.

This information is reproduced in detail in **Appendix B**.

2.3 Other Criteria for Short-Term Noise Events

International research indicates that the amount of disturbance from short term noise events is mainly due to the following characteristics:

- The time of day at which they occur;
- The duration of each event;
- Emergence above ambient noise level (amount by which the noise level exceeds the ambient noise level); and
- The frequency with which these events occur.

Clearly, short term noise events which may not affect the LA10 zone noise limit are not as significant in impact as those of longer duration. This is reflected in the single event table in the Manual (see **Appendix B**).

Noise events of short term duration (less than 1 minute) may not statistically affect the LA10 within a measurement period and therefore not affect the zone noise limit, however a number of such events, at sufficient noise levels could cause disturbance. This disturbance would be most likely during the night time period (10pm to 7am), since for a given type of event the emergence is likely to be higher.

The Noise Measurement Manual does not directly provide guidance for a small number of very short term noise events, as we understand is the case for the circuit breakers at the Canberra Substation. It is therefore appropriate to make reference to other standards.

2.3.1 NSW Policy

This lack of specific assessment criteria for short-term noise events is also reflected in the NSW EPA *Industrial Noise Policy*, 2000 (INP), from which the ACT Noise Measurement Manual criteria were drawn. The deficiency was addressed in later NSW policy documents including the NSW Road Noise Policy 2011 (RNP), in Section 5.4 – Sleep Disturbance. The RNP summarises the status of current research as follows:

From the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*

It is noted that this guidance is based on a threshold approach, meaning that the assessment level is independent of the exact number of events, on the basis that sleep can be disturbed by any one noise event.

2.3.2 World Health Organization - Guidelines for Community Noise

The World Health Organization (WHO) *Guidelines for Community Noise*, 1999, proposes more conservative criteria than the NSW EPA INP:

- Table 1 of the guidelines recommends L_{Amax} 60 dB as an **external** noise level, outside a window.
- Assuming a worst-case façade sound insulation performance of an open bedroom window, this equates to an **internal** noise assessment level of between around L_{Amax} 45 to 50 dB.

3 THE CANBERRA SUBSTATION

The substation is currently the main bulk electrical supply point for the ACT. The substation contains 4 transformers, circuit breakers and switch gear. Associated with the facility are a number of 60 m-wide transmission corridors (easements) with 330 kV lines that cross the development area, connecting to:

- Wollongong/Sydney (to the north)
- Yass (to the north-west)
- Tumut (to the west)
- Williamsdale (to the south)

Section 3.1 describes our current understanding of the noise sources associated with the substation site, their location, and frequency of operation.

Section 3.2 provides preliminary assessment based on this available data.

Section 3.3 describes further information that would be required in order to complete a more detailed study, and outlines how this may be achieved.

3.1 Operational Noise Sources

Figure 2 gives an aerial photograph of the substation site, indicating the currently understood locations of transformers and circuit breakers. This is based on information provided by BES (Aust) Pty Ltd (memo of 6 April 2014).

Figure 2 Canberra Substation – Known Locations of Transformers and Circuit Breakers

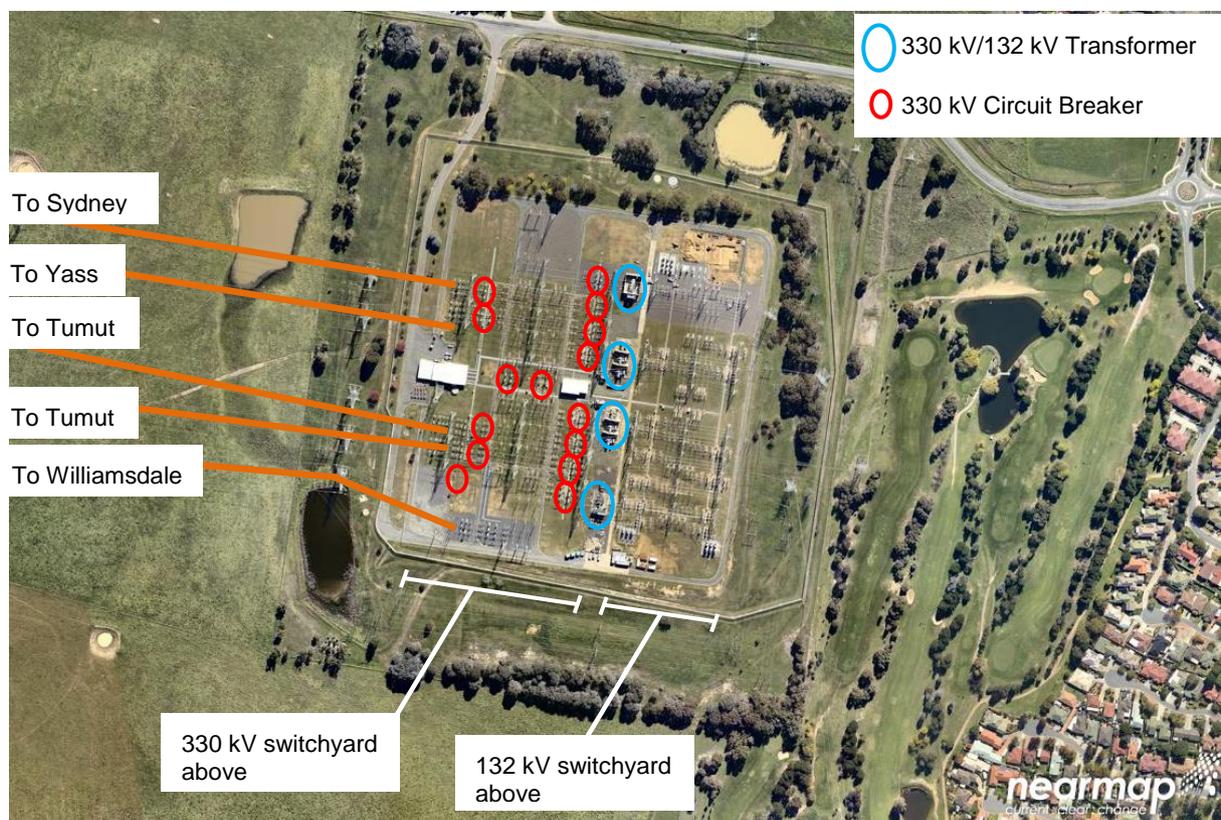


Image: Nearmap

3.1.1 Transformers

The main continuous steady state noise from the site is caused by the operation of transformers. Noise results from vibration of the transformer, and is usually at the second, third and fourth harmonic of the 50 Hz mains frequency.

In addition, cooling fans are often used to blow air through oil-filled radiators. The noise generated is usually a function of how many transformers are operating, which is generally determined by electrical load demand. We understand that peak electrical load occurs during mid-summer (when daily maximum temperatures exceed around 40°C) and mid-winter (when daily maximum temperatures are less than around 12°C).

Following discussions with Transgrid, we can make the following notes:

- No 1 and No 4 transformers were more recently installed and these include enclosures which act as blast walls, fire walls and sound barriers.
- Transgrid expect to replace the existing No 2 and No 3 transformers in the mid-term future (due to the available transformer capacity at Williamsdale) with a single transformer.
- The replacement is likely to result in the new transformer also being enclosed, which would reduce noise levels from this equipment item.

As relatively little information was forthcoming on the current operation of the substation transformers, and it was not possible to gain access to the interior of the substation site, it was necessary to undertake noise measurements beyond the substation site perimeter, at or around the time the abovementioned work was completed by Transgrid, or base our work on the newer No 1 and No 4 transformers only, to assess long term impact after the proposed replacement.

Whilst it was not possible to take direct measurements of the noise from individual sources without site access, the survey results from the current site configuration enable broad correlation with previous measurements at similar substations, allowing indicative predictions of the reduction of noise over distance away from the substation to be made.

The survey is described in **Appendix D** to this report, and the resulting assessment is described in **Section 3.2** below.

3.1.2 Transmission Lines and Corona Noise

In addition to noise from transformer operation, Corona noise is the most common noise associated with the transmission lines and is heard as a crackling or hissing sound.

Corona is the breakdown of air into charged particles caused by the electrical field at the surface of conductors. This type of noise varies with both weather and voltage of the line, and most often occurs in conditions of heavy rain and high humidity (typically >80%). An electric field surrounds power lines and causes implosion of ionized water droplets in the air, which produces the sound.

Figure 3 shows a plan of the ACT West Belconnen development area indicating the existing transmission line easements.

Figure 3 Site Plan Indicating Electrical Transmission Corridor Easements

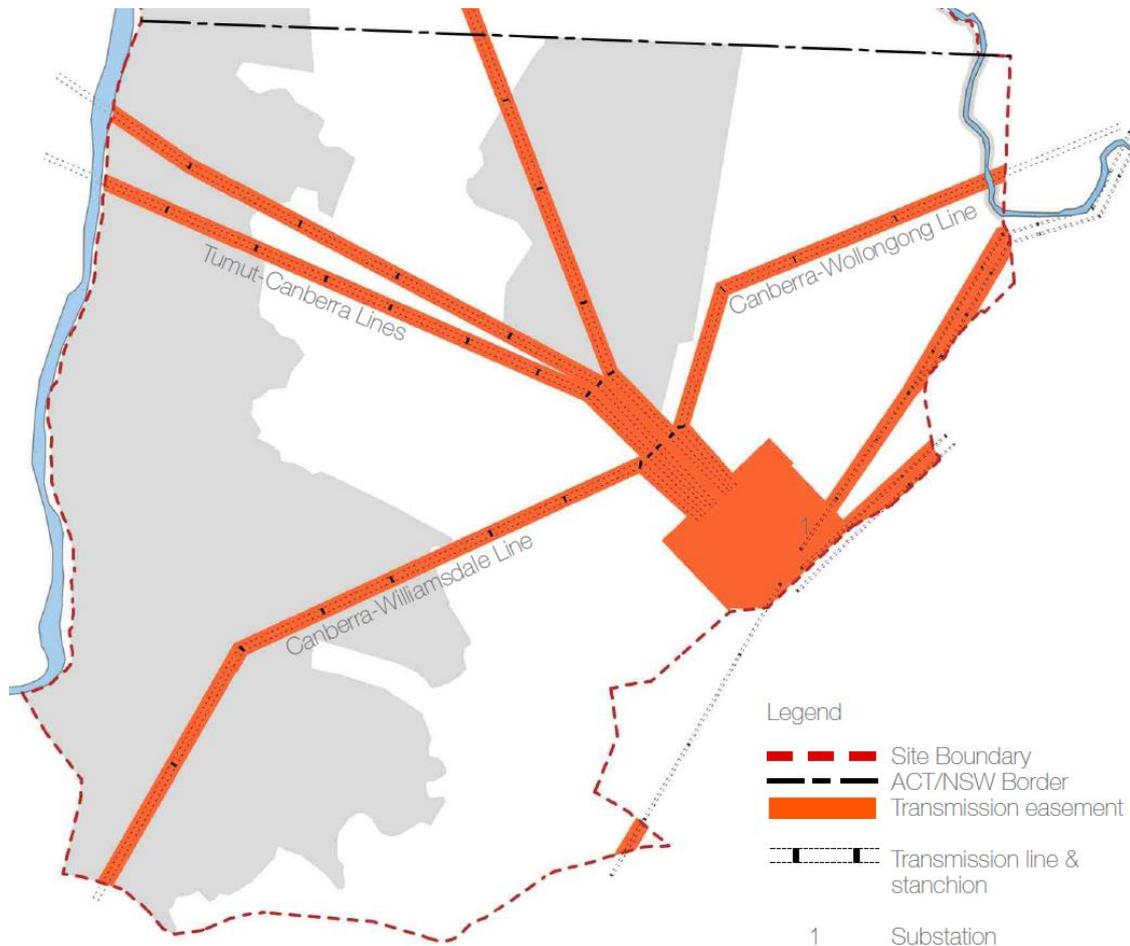


Image: MacGregor Coxhall

3.1.3 Circuit Breakers

Additional short-term (impulsive) noise is generated at a number of locations across the substation site when circuit breakers operate. These would be assessed as short-term noise events, as discussed in **Section 2.3** above. It has been possible to obtain a limited amount of information about the operation of these devices. We understand that:

- The noise source is an impulse sound of very short duration (circa 50 to 200 milliseconds).
- There are at least fifteen (15) 330 kV circuit breakers at the site, located to the west of the transformers.
- There are no Air Blast Circuit Breakers (ACB's) at the Canberra Substation site.
- The circuit breakers at the Canberra Substation are understood to be either bulk oil, Sulphur Hexafluoride (sF6), small oil, or vacuum-type. Whilst these circuit breaker types are known to generate significantly lower noise levels than the ACB's, there is currently no further understanding on the number, location or height of the different types of circuit breakers in use. This makes detailed noise assessment difficult at this stage, and further work is required.
- These operations cannot be triggered deliberately, and only occur in the case of line faults, or as part of reactive support. Because the timing of operation is not known, it was not possible at this stage to take attended measurements of noise from the operation of circuit breakers.
- Future work will involve taking long-term noise measurements at or around the site in attempt to capture noise levels generated during operation of circuit breakers. See **Section 3.3** below.

Information from Transgrid suggest that 2666 circuit breaker operations were recorded over 4 years. This comprises 1975 operations at 1325 kV and 691 operations at 330 kV. The timings are not known. However operations typically relate to:

- Maintenance (generally during business hours in the spring and autumn);
- Reactive plant (during summer and winter peak periods);
- Faults (anytime).

This averages at around 1.8 operations per day, but in reality it is likely that higher numbers of events occur on less frequent days. It has not been possible to obtain more detailed records on the daily frequency of operation, but we understand that:

- Given that maintenance and fault operations are likely to be a relatively small proportion of overall operations, most of the switching is expected to occur during the summer or winter periods, to provide reactive support.
- At these times, operations may be on the order of approximately an average of 4 per day (say ON + 2 OFF) on around 140-150 days during the summer winter period.
- The number of operations on any day would vary and is dependent on network conditions, as to when reactive plant (that is capacitor installed at Canberra Substation) need to be switched on and off. The determining factor is therefore likely to be summer / winter temperature.
- No noise complaints have been registered by Transgrid in relation to circuit breakers.

Further work will be required in our next phase of work in order to assess circuit breaker noise. See **Section 3.3**.

3.2 Preliminary Assessment

3.2.1 Transformers

3D noise emission modelling was undertaken using SoundPLAN noise prediction software, based on the CONCAWE industrial noise algorithm. The noise modelling algorithms account for the one-third octave and octave band sound power levels of the sources, their heights, the distances to the receivers, the natural topography, buildings, air absorption and ground effects.

As described in **Appendix C**, attended noise measurements were conducted at locations across the development area, beginning at the western boundary of the Canberra Substation. These were used to validate previous noise measurements of 330 kV equipment in NSW. This allowed sound power levels (SWLs) of the Canberra Substation transformers to be estimated for the purpose of this preliminary assessment.

In accordance with the ACT Noise Measurement Manual (see **Section 2.2** above), the estimated SWLs have been incorporated in to the noise model **including** a 5 dB tonal penalty. This accounts for a combination of low frequency noise and tonality that was observed during the site measurements.

As the noise levels from the substation transformers will be broadly similar between day and night, it is appropriate that the night time residential noise goal of 35dBA is taken to apply when assessing the need for setbacks and/or mitigation.

The closest existing residences are approximately 200m from the inner substation site perimeter, approximately 380m from the nearest transformer (inside the substation site).

The predicted noise contours are presented in **Appendix D**. These contours show that without further mitigation, the 35 dBA night-time criterion contour extends typically around 200 to 250 m out from the boundary of the substation.

It is noted that a number of existing residences to the east of the substation (on Slight Place and Allen Place, Holt) are closer than the predicted 35 dBA contour, by around 50 to 65m. This means that based on our current understanding of these noise sources, these residences may currently experience higher noise than the ACT zone noise standard. This in turn means that there could be a precedent for accepting marginal exceedances of the noise limits due to the operation of this facility.

The computer noise predictions have been repeated assuming the introduction of the most likely noise mitigation control; the construction of a solid noise wall at the substation perimeter. Such a measure would be expected to provide a reduction in noise of 5 dB to 8 dB to single storey receivers.

Provided in **Appendix D** are figures that indicate predicted noise levels following the introduction of a 5m, 8m and 10m barrier wall. It appears that some form of barrier would need to be constructed above the existing topography in order to provide a reduction in noise that is useful in terms of maximising the land area suitable to receive residential development. Further work (see **Section 3.3**) will be undertaken to establish the total barrier height and this is likely to be formed by combination of earth bunding and wall construction.

The need for such a construction is driven by the following points:

- The large distances between the noise sources and the site perimeter mean that a high barrier is required to provide the attenuation required.
- In the existing topography of the development area around the site, the land rises in height with increasing distance from the substation, meaning that the noise shadow zone provided by the barrier wall is less effective for potential receivers in the middle-distance from the site.
- A solid masonry or concrete barrier is needed to provide sufficient mass as to be efficient in attenuating the low frequency tonal harmonic noise generated by the transformers.

In acoustic terms, noise mitigation measures located much closer to the noise sources would be much more effective, and much smaller. It is not possible to identify opportunities for local mitigation close to the noise sources without access to site and/or more detailed information about the equipment items.

Section 3.3 indicates future work that would need to be undertaken to provide a more detailed assessment of noise from this source.

3.2.2 Transmission Lines Corona Noise

A detailed assessment of corona noise has not been undertaken at this stage. At this time, it can be noted that the electrical transmission lines are already subject to 60m wide easements (ie +/-30m to both sides of the transmission centreline) beneath which, residential development would not be permitted in any case.

On a note of precedent, in nearby locations (such as Macgregor and Dunlop to the north), large numbers of existing residences are located at 30m from electrical transmission line. This noise source would therefore appear to be a low risk, but it is recommended that a study on corona noise is undertaken during the detailed assessment of noise related to the substation, such that this risk is better understood.

3.2.3 Circuit Breakers

A more detailed understanding of circuit breaker noise will be required to allow a more detailed assessment.

Noting that sound power information is not available from the substation operator, a comprehensive survey designed to capture a representative number of events will be required as part of the next project phase, to assess the potential for sleep disturbance and likely mitigation measures.

3.3 Further Work

The following activities are recommended, in order to provide a detailed assessment of the risks and possible mitigation associated with noise from the Canberra Substation:

- Further liaison with Transgrid to gain detailed understanding of every noise source at the site.
- Ideally, this would include the location, dimensions, height, specifications, frequency and duration of each source. We would visit site to undertake sample attended noise measurements at the substation, at a time of day where particularly high noise levels, or noise of specific interest is known to be generated. Ideally we make specific measurements close to certain items of interest, in order to provide a more robust basis of assessment.

However, in the event that access to the required information is not be forthcoming, and that physical access to the site may not be possible, it is proposed that the following would be a suitable alternative:

- Deploy unattended noise monitoring equipment at suitable secure locations close to the site perimeter. The monitoring period will be around one month, during the upcoming (high load) cold winter period.
- This longer-term monitoring is intended capture a robust representative proportion of all noise events at the site, including transformers, circuit breakers and corona noise. Where possible this monitoring would be correlated against logs or records of events provided by Transgrid.
- Determine sound power levels for individual transformers, associated cooling fans and all other equipment.
- Conduct measurements of noise from the 132 kV and 330 kV transmission lines, at the nominal easement boundary. Where possible conduct these measurements for a range of meteorological conditions, including light rain or high humidity.
- Assess the characteristics of the noise, such as tonality, impulsiveness, irregularity or low/high frequency content. Make adjustments in accordance with the ACT Environment Protection (Noise Measurement Manual) 2009.
- Using site topography data already provided, construct a 3D computer noise model for the land around the industrial site. Include maintenance noise sources where these are known.
- Using SLR industrial noise source databases and the results of validated measurements as above, undertake calculations to provide a residential development setback distance.
- Where possible, provide a second indicative residential development setback distance assuming that the most typical form of noise mitigation for each source (e.g. noise barriers, acoustic attenuators, operating time limits) will be implemented. Mitigation information would include barrier heights, locations and typical selections as suitable for costing purposes.

4 WEST BELCONNEN RESOURCE MANAGEMENT CENTRE

The West Belconnen Resource Management Centre (WBRMC) operated as a landfill site accepting a range of materials (predominantly putrescible wastes) between approximately 1974 and 2002. From that time, landfilling of 'special wastes' (such as asbestos) has occurred when required.

In addition to these and the historical landfill area, several resource recovery operations currently occur at the site. The WBRMC currently acts as the ACT's emergency landfill (See **Figure 4**), and provides a location for contracted commercial resource recovery operations.

Figure 4 Site Plan Indicating Landfill Site, Emergency Landfill Area and 500m Landfill Buffer

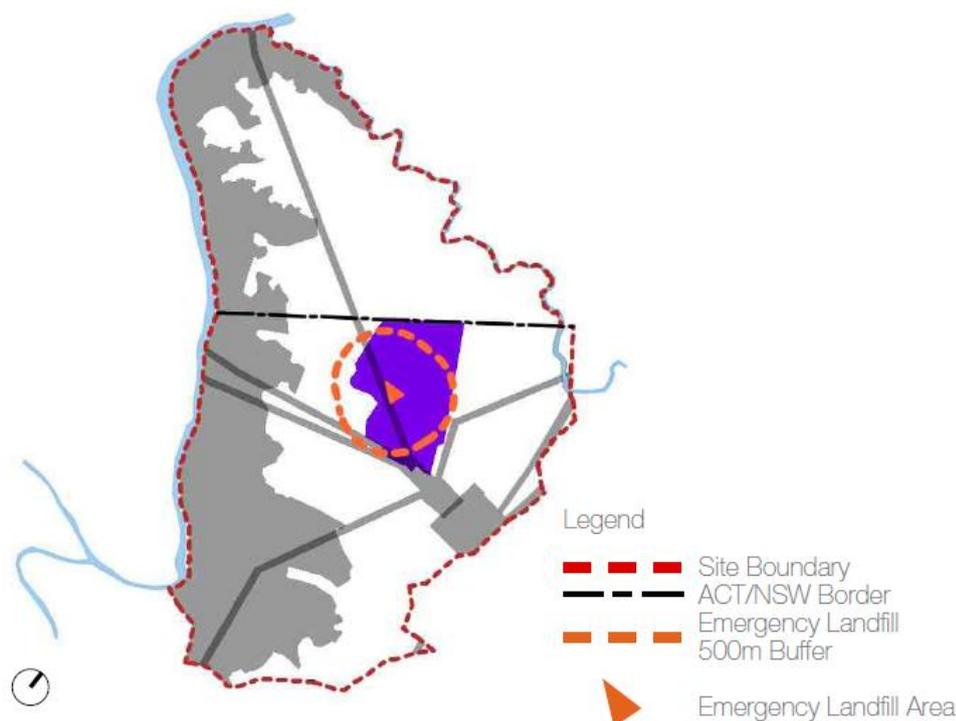


Image: MacGregor Coxhall

The resource management centre is located midway along the northern boundary of the proposed residential development, occupying an area of typically 1 km along the boundary and extending 1.3 km to the north.

4.1 Operational Noise Sources

Parkwood Road Recycling Estate, at the north eastern corner of the site, is a facility which recycles paper and cardboard, glass and plastic containers, aluminium and car batteries. Within the site boundary, along the eastern side is a tyre trench and an area leased by Canberra Sand and Gravel.

To the north of the site is an asbestos pit, which is slowly being restored by filling with imported asbestos contaminated materials. Likewise, to the south of the historical landfill area lies a borrow pit which is also being restored by filling with asbestos contaminated materials.

Resource recovery operations currently operating at the site include:

- A public drop off facility for paper and cardboard, glass jars and bottles, rigid plastic containers, milk and juice cartons, aluminium and steel cans, car batteries and waste oils; and
- A green waste processing facility operated by Canberra Sand and Gravel (CSG).

4.2 Preliminary Assessment

The computer noise model was used to determine typical noise levels due to the operation of typical earth moving equipment of the southern side of the site. Equipment noise levels have been based on measurements at typical resource management centres for previous projects, and we have assumed the operation of 2 compactors, a bulldozer and dump truck delivering waste, operational on the southern side of the centre.

Assuming that the centre operates during the daytime (7am to 10pm) only, the less onerous daytime residential noise goal of 45dBA is taken to apply when assessing the need for setbacks and/or mitigation from this site.

The predicted noise contours are presented in **Appendix E**, which shows the 45 dBA daytime criterion contour extending typically around 300 m out from the boundary of the management centre.

This sits within the existing 500m landfill buffer zone and as such, based on current operation the noise buffer is expected to be significantly less than that already in place for the landfill buffer.

The future of the operation of this site is not well understood, and will be the subject of future studies. It is likely to be the case that certain current activities are phased out over time. It may therefore be the case that noise setbacks or mitigation will not be necessary, depending on the relationship between residential development progress and reduction in operation over time.

This will be assessed in more detail once the progressive operation of the site is better understood.

4.3 Further Work

It may be the case that further noise assessment is not required here, as the operation of this site may be gradually reduced. If the site remains in operation, and the existing landfill buffer is removed, it may be appropriate to undertake a more detailed study of expected noise impact. In that case, the following activities are likely to be necessary:

- Liaise with TAMS in order to gain a detailed understanding of the noise sources, and the frequency and duration of activities at the site. It is likely that we would have complete noise source data from previous work on similar facilities. If required we would visit site to take sample noise measurements of particular items of interest, to provide a more robust basis of assessment.
- Assess the characteristics of the noise, such as tonality, impulsiveness, irregularity or low/high frequency content. Make adjustments in accordance with the ACT Environment Protection (Noise Measurement Manual) 2009.
- Using site topography data already provided, construct a 3D computer noise model for the land around the industrial site. Include maintenance noise sources where these are known. Undertake calculations to provide a confirmed residential development setback distance.
- Where possible, provide a second indicative residential development setback distance assuming that the most typical form of noise mitigation for each source (e.g. noise barriers, acoustic attenuators, operating time limits) will be implemented. Describe indicative barrier heights, locations and typical selections as suitable for costing purposes.
- Work with the project team to gain an understanding of the likely future operations of this site. We could then provide separate assessments for development around this site at certain intervals (say at five-year intervals, to be agreed), to assess the reduction in need for noise setbacks or mitigation over time.
- In order to do this, we will need a clear scheduled understanding of which activities will continue, and in which locations, over the time intervals agreed.

5 LOWER MOLONGLO WATER QUALITY CONTROL CENTRE

The Lower Molonglo Water Quality Control Centre (LMWQCC) is the main treatment facility for Canberra. The process includes physical, chemical, and biological treatment processes before the water is discharged into the Molonglo River.

5.1 Operational Noise Sources

Noise sources associated with the operational process of the LMWQCC will include pumps, odour fans, discharge stacks, screens, filters, grit classifiers, chutes, centrifuges, and electrical generators.

5.2 Preliminary Assessment

Assuming that the LMWQCC will operate similarly during the day and night, the more onerous night time residential noise goal of 35dBA is taken to apply when assessing the need for setbacks and/or mitigation from this site.

A detailed assessment has not been undertaken for this site. Based on an internal review of past and current similar projects in ACT and NSW, the typical residential setback distance for the LMWQCC is expected to be in the order of 200 to 300 m.

The nearest part of the West Belconnen development area is over 1 km from the LMWQCC to the east (the southernmost tip of the area, see **Figure 1**). As such, it is expected that it will be appropriate for residential development to extend to the full southern extent of the proposed development area.

5.3 Further Work

The noise impact of the LMQCC is not currently anticipated to cause a significant impact on residential development (ie at the southern extent of the development area). As such, further detailed assessment is not expected to be required.

If a more detailed assessment is required as part of the rezoning of this land, then a great deal more information would need to be gathered on the operation of the LMWQCC. Activities in the case that further assessment is required would include:

- Liaise with ActewAGL to gain a detailed understanding of the noise sources, and the frequency and duration of activities at the site. It is likely that we would have complete noise source data from previous work on similar facilities. If required we would visit site to take sample noise measurements of particular items of interest, to provide a more robust basis of assessment.
- Assess the characteristics of the noise, such as tonality, impulsiveness, irregularity or low/high frequency content. Make adjustments in accordance with the ACT Environment Protection (Noise Measurement Manual) 2009.
- Using site topography data already provided, construct a 3D computer noise model for the land around the industrial site. Include maintenance noise sources where these are known. Undertake calculations to provide a residential development setback distance.
- Discuss possible approaches to mitigation, if necessary.

6 CONCLUSION

SLR Consulting Australia (SLR) has been engaged by Riverview Projects (ACT) Pty Ltd to assess the impact of noise from existing ACT commercial and industrial land uses within the proposed development area of the West Belconnen project.

The current understanding in the project team of the noise generated by existing commercial and industrial noise sources close to the development area has been documented. A high-level preliminary noise impact assessment has been provided for three sites, to give early identification of potential development risks associated with the noise from these sources.

The existing commercial and industrial facilities considered in this study are:

- The Canberra Substation, located at 105 Parkwood Road (registered rural Block number 1559);
- The West Belconnen Resource Management Centre (WBRMC), on Parkwood Road; and
- Lower Molonglo Water Quality Control Centre (LMWQCC), on Stockdill Drive.

Design criteria have been set, in accordance with the *ACT Environment Protection Regulation, The Territory Plan and National Capital Plan*, and the *ACT EPA Noise Measurement Manual*. Reference is also made to relevant NSW Policy.

Where required to allow more detailed assessment of noise from these sources, further activities and additional information required have been recommended.

6.1 Preliminary Assessment Findings

The findings of this preliminary assessment can be summarised are as follows:

- **Canberra Substation** – Using a computer noise prediction model based on preliminary noise measurements at the site, an indicative setback distance of approximately 200 to 250 m from the substation boundary was determined to comply with the residential Zone Noise Criteria. It is noted that some existing residential premises are located around 200 m from the substation.

Noise control measures proposed to reduce this setback distance include the construction of a noise wall at the substation boundary. From the initial study, it appears that a barrier formed of a combination of earth bund and wall would be required to provide a useful increase to the area of land that is suitable for residential development in this vicinity.

These distances and indicative mitigation should be confirmed in a detailed assessment of noise sources at the substation, in particular the operation of transformers and circuit breakers.

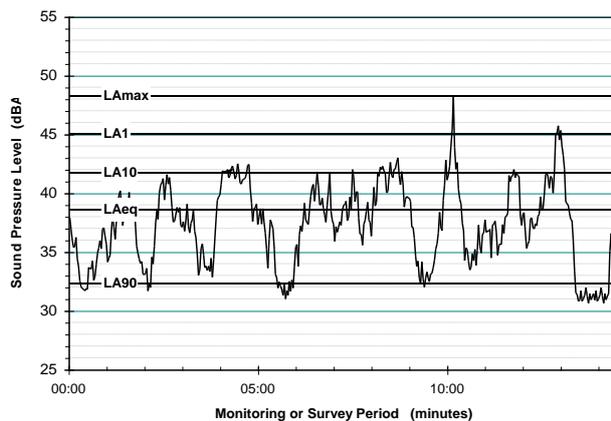
- **WBRMC** – Based on initial assumptions for equipment on this site, an indicative setback distance in the region of 300 m was determined to be required to comply with the Zone Noise Criteria. This assumes operation during the daytime (7am to 10pm) only. The future operation of this site is not well understood, and is likely to be phased out over time. As such, it may be the case that setbacks are not necessary for this site, depending on the relationship between residential development progress and reduction in operation over time.
- **LMWQCC** – Noise levels are expected to comply with the residential Zone Noise Criteria at the boundary of the project development area.

Typical Noise Indices

This Report makes repeated reference to certain noise level descriptors, in particular the LA10, LA90 and LAeq and LAmax noise levels.

- The LA10 is the A-weighted sound pressure level exceeded 10% of a given measurement period and is utilised normally to characterise typical maximum noise levels.
- The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period. The LAeq(period) is the measurement parameter used to describe the average sound level over the period. For daytime the period is 7 am to 6 pm, for evening 6 pm to 10 pm, and for night-time 10 pm to 7 am.
- The LA90 noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the “background” level.
- The LAmax is simply the maximum noise level and is often represented by the LA1(1min), being the level exceeded 1% of 1 minute, ie the noise level exceeded for 0.6 of a second.

Graphical Display of Typical Noise Indices



Typical Noise Levels

The following table presents examples of typical noise levels.

Typical Noise Levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerb side of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to Quiet
50	General Office	
40	Inside private office	Quiet to Very quiet
30	Inside bedroom	
20	Unoccupied recording studio	Almost silent

A-Weighting or dBA Noise Levels

The overall level of a sound is usually expressed in terms of dBA, which is measured using the “A-weighting” filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the “loudness” of that sound. Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.

ACT ZONE NOISE CRITERIA

Table B1 summarises the ACT Zone Noise Criteria with reference to the ACT Land Use Zones.

Table B1 Zone Noise Standards

Land Use Zone ¹	Land Use Description	Zone Noise Standard, LA10(15 minutes) dB			
		Mon-Sat 7am-10pm	Mon-Sat 10pm-7am	Sun & Public Hols 8am-10pm	Sun & Public Hols 10pm-8pm
IZ1/IZ2	Land in an industrial zone	65	55	65	55
CZ1-CZ3	Land in the city centre and town centres	60	50	60	50
CZ1-CZ3	Land in the Central National Area (City)				
CZ1-CZ3	Land in group centres and office sites	55	45	55	45
CZ4	Land in a commercial CZ4 zone	50	35	50	35
PRZ2 NUZ1	Land in: -a restricted access recreation zone -a broadacre zone	50	40	50	40
RZ1-RZ5 NUZ2-NUZ5	All other land, except land in the Central National Area (Fairbairn)	45	35	45	35
CZ5 TSZ2 CF CZ6	Land in: -a commercial CZ5 zone -a TSZ2 services zone -a community facility zone -a leisure/accommodation zone	The Zone Noise Standard is the same as the Zone Noise standard for the adjoining noise zone that has the highest noise zone standard for that period			

NOTE: 1. ACT Land Use Zones are as follows:

Residential zones

- RZ1 Suburban Zone
- RZ2 Suburban Core Zone
- RZ3 Urban Residential Zone
- RZ4 Medium Density Residential Zone
- RZ5 High Density Residential Zone

Commercial zones

- CZ1 Core Zone
- CZ2 Business Zone
- CZ3 Services Zone
- CZ4 Local Centres Zone
- CZ5 Mixed Use Zone
- CZ6 Leisure and Accommodation Zone

Industrial zones

- IZ1 General Industrial Zone
- IZ2 Mixed Use Industrial Zone

Community facility zones

- CFZ Community Facility Zone

Parks and recreation zones

- PRZ1 Urban Open Space Zone
- PRZ2 Restricted Access Recreation Zone

Transport and services zones

- TSZ1 Transport Zone
- TSZ2 Services Zone

Non-urban zones

- NUZ1 Broadacre Zone
- NUZ2 Rural Zone
- NUZ3 Hills, Ridges and Buffer Zone
- NUZ4 River Corridor Zone
- NUZ5 Mountains and Bushland Zone

ACT EPA NOISE MEASUREMENT MANUAL 2009

The ACT *Environment Protection Noise Measurement Manual* (2009) provides modifying factor corrections that are to be applied if the noise source has particular attention-drawing characteristics, or for single events of short duration. These are summarised in **Table B2**.

Table B2 ACT EPA Noise Measurement Manual – Modifying Factor Corrections

Factor	Assessment / Measurement	When to Apply	Correction (added to the measured / predicted level)¹	
Tonal Noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: - 5dB or more if the centre frequency of the band containing the tone is above 400Hz. - 8dB or more if the centre frequency of the band containing the tone is 160 to 400Hz inclusive. - 15dB or more if the centre frequency of the band containing the tone is below 160Hz.	+5dB ²	
Low-frequency noise	Measurement of C-weighted and A-weighted level	Measure to assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15dB or more.	+5dB ²	
Impulsive noise	A-weighted fast response and impulse response	If a difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2dB.	Apply difference in measured levels as the correction, up to a maximum of +5dB.	
Intermittent Noise	Subjectively assessed	Level varies by more than 5dB.	+5dB	
Duration	Single-event noise duration	One event in any 24-hour period, with duration as below.	Night (10pm to 7am)	Day (7am to 10pm)
		1 to 2.5 hours	0	-2
		15 min to 1 hour	0	-5
		6 min to 15 min	-2	-7
		1.5 min to 6 min	-5	-15
		Less than 1.5min	-10	-20

NOTES: 1. Where two or more modifying factors are present, the maximum correction is limited to 10dB.
 2. Where a source emits noise which has both tonal and low-frequency components, only one 5dB correction should be applied.

Summary of Relevant Noise Criteria

NSW EPA SLEEP DISTURBANCE CRITERIA

The NSW EPA considers sleep disturbance as the 'emergence' of the maximum or LA1(1minute) noise level above the LA90(15minute) background level at the time.

An appropriate screening criteria for sleep disturbance is therefore an LA1(1minute) level 15 dB(A) above the Rating Background Level (RBL) for the night-time period (10.00 pm to 7.00 am).

When the screening level is not met, a more detailed analysis may be required which should cover the maximum noise level or LA1(1minute), the extent that the maximum noise level exceeds the background level and the number of times this occurs during the night-time period.

Some guidance on possible impacts is contained in the review of research results in the NSW EPA *Road Noise Policy, 2011* (RNP).

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 10.00 pm and 7.00 am); and
- Whether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

It is noteworthy that there are no specific criteria for sleep disturbance nominated in the Industrial Noise Policy, in the INP Application Notes, the RNP or in the Interim Construction Noise Guideline.

This is consistent with the statements in the RNP that *"Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied."*, and that *"There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise"*.

However, the RNP concludes from the research on sleep disturbance that:

- Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions; and
- One or two noise events per night with maximum internal noise levels 65-70 dBA are not likely to significantly affect health and wellbeing.

Based on the ACT Zone Noise Criteria residential night time noise level goal of LA10 35dB, this would be consistent with an RBL or LA90(15minute) level of around 30 dBA. Therefore the initial screening level proposed for the assessment of sleep disturbance within a residential property is LAmax 45 dB (ie 15 dBA above the background level).

However Based on the typical worst-case façade sound insulation scenario of an open bedroom window, with outside to inside sound level differences in the region of 10 dBA, external levels of LAmax 60 to 65 dBA are unlikely to cause awakening reactions.

CANBERRA SUBSTATION – PRELIMINARY NOISE SURVEY

Methodology

A preliminary environmental noise survey was undertaken close to the Canberra Substation. As it had not been possible to arrange access to the interior of the substation site, measurements were made at locations beyond the site perimeter.

Measurements were made at increasing distances from the substation perimeter to the west, with a view to establishing typical noise level losses due to distance from the site. The westerly direction was chosen because:

- The land in this direction has relatively even topography, meaning that it was possible to make measurements at increasing distance without the interference of local screening effects from natural mounds and rises in the landscape.
- At the time of the survey, no information had been obtained about the operation of circuit breakers or other intermittent noise sources. As such, transformer noise was the focus of the assessment. It was not known which transformers would be operating on the day of the visit. The 330 kV to 132 kV transformers are orientated north to south across the site. Making noise measurements in an increasingly westerly direction meant that the transformers were all approximately equidistant from all of the measurement locations.

At the time of the visit, the weather was warm and dry, no appreciable wind. Measurements were made between approximately 7 and 9 pm on Wednesday 19 March 2014. All measurements were made with a Brüel & Kjær type 2260 integrating sound level analyser.

As noise from the substation transformers was very consistent and steady-state, it was appropriate to make relatively short measurements. All measurements were 1 minute in duration. Noise from extraneous sources (such as vehicles on Parkwood Road) was omitted from measurements.

Figure C1 shows an aerial photograph of site indicating approximate measurement locations, to demonstrate methodology only.

Figure C1 Aerial Photograph of Substation indicating approximate measurement locations



Image: Nearmap

Observations

Overall, the subjective impression is that noise from the substation is very quiet at all locations, beyond the site perimeter. The noise during the survey was subjectively dominated by the low frequency harmonic ‘hum’ from the transformers.

Noise from circuit breaker operations or corona discharge was not observed during the survey.

From post-analysis of the measured one-third octave band noise levels, it is expected that the 5dB penalty for ‘tonal noise’ given in the ACT EPA Noise Measurement Manual (**Appendix B, Table B2**) would be applied. It is possible that the ‘Low frequency noise’ penalty would also be applicable, but according to the Manual *“Where a source emits noise which has both tonal and low-frequency components, only one 5dB correction should be applied”*.

The dominant substation noise source at all locations was low frequency tones generated by the transformers at harmonics of the 50 Hz mains frequency. This causes at least two issues for measurement:

- The wavelengths of sound at these frequencies are very large; between around 1 and 7m. This means that local acoustic minima and maxima can be generated, and these are of the order of metres apart.
- At low frequencies, interference effects are caused due to the coincidence of noise emitted by the separate transformers. This also causes local acoustic minima and maxima that are difficult to quantify.

Canberra Substation – Noise Survey

As such, measurements further from these sources in combination can be louder than those at slightly closer distances. This makes physical measurement of these sources difficult on site, and adds a layer of complexity to assessment. Detailed analysis has been undertaken to avoid these issues in post-processing. The measured results presented below should be taken as for reference only

Results Summary

Detailed measurements were made in one-third octave bands across the full audio range. A large amount of survey data was gathered, and these are summarised by presenting the single figure A-weighted values in **Table C1**.

According to the ACT EPA Environment Protection (Noise Measurement Manual), noise from industrial sources would be assessed using the L₁₀ index in the event of a noise-related complaint. The values presented in **Table C1** summary use the L_{eq} index in order to reduce the influence that other environmental noise sources not associated with the substation had on measurements (distant road traffic etc). This is acoustically appropriate for a steady-state noise source such as a group of transformers.

The A-weighted values presented have been calculated in post-processing after omitting sound pressure level data recorded in frequency bands above 400Hz. Observations made during measurements to confirm that the substation was not generating appreciable noise in the mid- and high-frequencies at the time of the visit.

Noise at higher frequencies was associated with other environmental noise sources only

Table C1 Substation Transformer Noise Summary of Measured Results

Meas. Ref.	Measurement start time (dd/mm/yy hh:mm:ss)	Approximate distance of measurement location from western substation site boundary (see Figure C1)	Measured sound pressure level, L _{eq 1min} , dBA
1	19/13/14 19:42:40	0m	37
2	19/13/14 19:46:39	1m	30
3	19/13/14 19:49:46	2m	32
4	19/13/14 19:51:59	10m	33
5	19/13/14 19:55:31	20m	34
6	19/13/14 19:57:56	30m	33
7	19/13/14 20:00:04	40m	34
8	19/13/14 20:01:54	50m	31
9	19/13/14 20:03:47	60m	30
10	19/13/14 20:09:14	70m	31
11	19/13/14 20:12:23	80m	32
12	19/13/14 20:15:20	90m	30
13	19/13/14 20:17:04	100m	30
14	19/13/14 20:21:53	150m	31
15	19/13/14 20:27:25	200m	29
16	19/13/14 20:45:17	250m	25
17	19/13/14 20:46:42	251m	24
18	19/13/14 20:49:44	300m	25

Appendix D

Report Number 670.10602-R1

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Canberra Substation – Noise Predictions

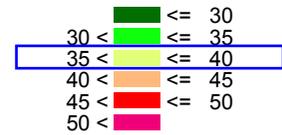


PROJECT:
WEST BELCONNEN
RESIDENTIAL PROJECT
INDUSTRIAL NOISE STUDY

TITLE:
PREDICTED NOISE LEVELS
CANBERRA SUBSTATION

MAP NO: 1

Predicted Noise
Level at 1.5 m
dBA, L10



Daytime Criterion 45 dBA
Night-time Criterion 35 dBA

Scale 1:25027



Prediction Algorithm: Concawe

Meteorological Category: N/A

Wind: N/A Stability Class: N/A

PROJECT NO.: 670.10602.00000

REPORT NO.: 670.10602-R2

APPENDIX: D

DATE: 20-05-2014

PREPARED: JS

SLR Consulting Australia

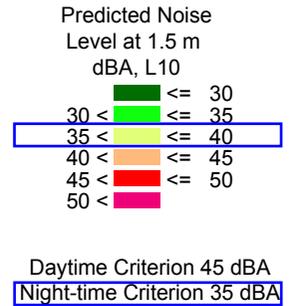
ABN 29 001 584 612
Suite 3, Level 4, 11 London Circuit
Canberra ACT 2600
Tel: 61 2 6287 0800 Fax: 61 2 6287 0801



PROJECT:
WEST BELCONNEN
RESIDENTIAL PROJECT
INDUSTRIAL NOISE STUDY

TITLE:
PREDICTED NOISE LEVELS
CANBERRA SUBSTATION
5 M PERIMETER WALL

MAP NO: 1



Prediction Algorithm: Concawe

Meteorological Category: N/A

Wind: N/A Stability Class: N/A

PROJECT NO.: 670.10602.00000

REPORT NO.: 670.10602-R2

APPENDIX: D

DATE: 20-05-2014

PREPARED: JS

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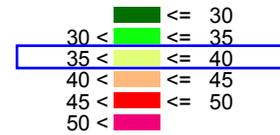


PROJECT:
WEST BELCONNEN
RESIDENTIAL PROJECT
INDUSTRIAL NOISE STUDY

TITLE:
PREDICTED NOISE LEVELS
CANNBERRA SUBSTATION
8 M PERIMETER WALL

MAP NO: 1

Predicted Noise
Level at 1.5 m
dBA, L10



Daytime Criterion 45 dBA
Night-time Criterion 35 dBA

Scale 1:25027



Prediction Algorithm: Concawe

Meteorological Category: N/A

Wind: N/A Stability Class: N/A

PROJECT NO.: 670.10602.00000

REPORT NO.: 670.10602-R2

APPENDIX: D

DATE: 20-05-2014

PREPARED: JS

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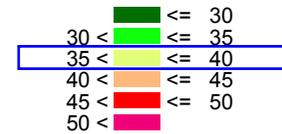


PROJECT:
WEST BELCONNEN
RESIDENTIAL PROJECT
INDUSTRIAL NOISE STUDY

TITLE:
PREDICTED NOISE LEVELS
CANNBERRA SUBSTATION
10 M PERIMETER WALL

MAP NO: 1

Predicted Noise
Level at 1.5 m
dBA, L10



Daytime Criterion 45 dBA
Night-time Criterion 35 dBA

Scale 1:25027



Prediction Algorithm: Concawe

Meteorological Category: N/A

Wind: N/A Stability Class: N/A

PROJECT NO.: 670.10602.00000

REPORT NO.: 670.10602-R2

APPENDIX: D

DATE: 20-05-2014

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Appendix E

Report Number 670.10602-R1

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West Belconnen Resource Management Centre – Noise Predictions

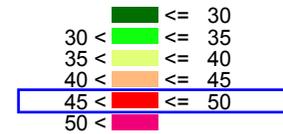


PROJECT:
WEST BELCONNEN
RESIDENTIAL PROJECT
INDUSTRIAL NOISE STUDY

TITLE:
PREDICTED NOISE LEVELS
WEST BELCONNEN RESOURCE
MANAGEMENT CENTRE

MAP NO: 1

Predicted Noise
Level at 1.5 m
dBA, L10



Daytime Criterion 45 dBA
Night-time Criterion 35 dBA

Scale 1:25027



Prediction Algorithm: Concawe

Meteorological Category: N/A

Wind: N/A Stability Class: N/A

PROJECT NO.: 670.10602.00000

REPORT NO.: 670.10602-R2

APPENDIX: E

DATE: 20-05-2014

PREPARED: JS

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