Appendix E

Noise Assessment of Horn Testing Options

HEGGIES

REPORT 10-6055-R4

Revision 2

South West Rail Link

Noise Assessment of Horn Testing Options

Leppington Train Stabling Facility

PREPARED FOR

Transport Construction Authority
Locked Bag 6501
ST LEONARDS NSW 2065

6 AUGUST 2010

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South West Rail Link
Noise Assessment of Horn Testing Options
Leppington Train Stabling Facility

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
10-6055-R4	Revision 2	6 August 2010	Briony Croft	Briony Croft	Briony Croft
10-6055-R4	Revision 1	28 July 2010	Robert Hall	Briony Croft	Briony Croft
10-6055-R4	Revision 0	5 July 2010	Briony Croft	Andrew Parker	Andrew Parker

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1 INTRODUCTION

The South West Rail Link (SWRL) is a major infrastructure project that will assist the NSW Government in providing a modern, integrated and efficient transport system to cater for Sydney's growth as a major global city.

The SWRL will consist of a dual track, electrified passenger railway line, approximately 11 km long, from Glenfield out to Leppington. The SWRL will also incorporate new stations at Edmondson Park and Leppington, and a train stabling facility (TSF) west of the planned Leppington town centre at Rossmore.

A noise and vibration assessment of the project has been completed as part of the Environmental Assessment (EA) and is reported in Heggies Report 10-6055-R3, dated 11 May 2010. The EA identified that horn noise resulting from horn testing within the TSF has the potential to cause sleep disturbance at surrounding residential receivers (existing and future).

The Transport Construction Authority (TCA) and RailCorp are investigating options for reducing the impacts of horn noise at the proposed TSF, including an alternative location for horn testing outside of the TSF and an alternative means of providing an audible warning signal prior to (and during) train movements within the TSF. This report examines the potential noise impacts of the alternative options.

2 HORN NOISE MITIGATION OPTIONS

2.1 Background

Horn sounding at stabling facilities near residential areas has been the subject of a large number of studies. In particular, the development of the stabling facility at MacDonaldtown initiated studies into mitigation of horn noise. Some of the options that have been considered previously are summarised in **Table 1** (see also Heggies Report 10-4369R1 *Train Horn Testing Noise Mitigation Options Study* for a more complete list). Various combinations of options have been considered. Train horns are considered a safety-critical device and testing of the horns is considered essential for the safe operation of the rail network. Horns are also used prior to train movement, as a warning that a train is about to move.

Table 1 Horn Noise Mitigation Options

Option	Comments
Dispense with horn testing prior to entering service	Instead, horns would be assumed to be functional if they operated normally at their last use, or are tested as part of routine maintenance.
Relocate horn testing to less sensitive sites	At MacDonaldtown, horn testing is carried out en-route to the first station in a less noise-sensitive area. An alternative to horns is required within the stabling facility to warn of imminent vehicle movements (eg whistles, beepers, or non-tonal warning signals).
Short horn soundings only	There is a difference of around 30 dB between a short 'toot' and a full 'blast', but only for some types of rolling stock.
Limiting horn use to the least sensitive part of a stabling yard	An alternative to horns is required elsewhere in the yard to warn of imminent vehicle movements.
Low-volume yard horn test	At present, there is no means to test a horn in controlled fashion at low volume. An engineered solution would need to be developed.
Shielding – barriers or enclosure	Does not eliminate all noise, it is likely that horns will still be audible and result in the potential for sleep disturbance at nearby receivers.

2.2 Current TSF Horn Sounding Procedure

The current standard procedure requires that train horns be tested prior to trains entering service. This typically occurs up to an hour before departure of a train from a stabling location. Since trains from the Leppington TSF will be used in the morning peak, horn test noise can be expected to occur from an early hour, peaking in the early morning as trains leave the TSF.

The current procedure also requires that train horns are sounded within the TSF prior to train movement, as a warning that a train is about to move.

2.3 Alternative Horn Sounding Procedure

The alternative option under investigation is for the current standard procedure to be altered as follows:

1. The use of non-tonal 'quacker' style audible warning signals in place of horns to provide a safety warning that a train is about to move within the TSF.

2. The testing of train horns at 'Town' levels in a deep cutting en-route to Leppington Station, in place of testing within the TSF.

It is assumed that the quacker style warning signals would be those that have been specified for the new Waratah trains.

The aim of this assessment is to determine:

1. The noise levels emitted by the non-tonal 'quacker' style audible warning signal within the stabling facility, and to assess compliance with the relevant noise goals outside the TSF boundary.

2. The maximum noise levels that would occur at existing and potential future residential receivers between the TSF and Leppington Station as a result of horn testing en-route to Leppington Station.

3 ASSESSMENT CRITERIA

3.1 Noise Criteria Applicable to Use of Warning Signals Within the TSF

The TSF is a fixed facility and is assessed in accordance with the DECCW's *Industrial Noise Policy* (INP). All noise emissions emanating from within the stabling facility, including that from train movements, need to be assessed in accordance with the INP.

The INP sets two separate noise criteria in order to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. In addition, the DECCW normally requires the risk of sleep disturbance to be assessed.

Guidance on sleep disturbance is provided in the DECCW's *Environmental Criteria for Road Traffic Noise* (ECRTN) and also in the Application Notes to the INP. Based on the Application Notes to the INP, an initial sleep disturbance screening criterion for L_{Amax} of 15 dBA above the background noise levels applies. A review of research on sleep disturbance in the ECRTN indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the ECRTN concludes "Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions." Based on a worst case minimum attenuation (with windows open) of 10 dBA, the ECRTN review suggests that short term external noises of 60-65 dBA are unlikely to cause awakening reactions.

The project specific noise criteria applicable to the TSF are described in Heggies Report 10-6055R3 (the noise and vibration technical report of the EA). For the proposed horn testing and audible warning procedure, the intrusive, amenity and sleep disturbance noise goals apply. These criteria are summarised in **Table 2**.

Table 2 Summary of Project Specific Noise Criteria

Period[1]	Intrusiveness LAeq(15minute) (dBA)	Amenity LAeq(period) (dBA)	Sleep Disturbance INP Screening Criterion[2] LAmax (dBA)	Sleep Disturbance ECTRN[3] LAmax (dBA)
Daytime	50	55	n/a	n/a
Night-time	40	40	50	65

Note 1: Evening period used in the INP not assessed since evening levels are between day and night levels. Night levels are the controlling criteria.

Note 2: The initial sleep disturbance screening criterion is 15 dBA above background as described in the Application Notes to the INP.

Note 3: Sleep disturbance criterion of 65 dBA is based on ECRTN "Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions" with an allowance of 10 dBA for attenuation in going from outdoors to indoors with open windows on a residential building.

3.2 Noise Goals Applicable to Horn Testing En-Route

3.2.1 Sleep Disturbance Criteria

Horn testing activities at train stabling facilities are assessed as industrial noise in accordance with the requirements of the NSW INP. Outside the stabling facility, the INP no longer applies. However, an assessment of sleep disturbance is still warranted. The sleep disturbance criteria are the same as those listed in **Table 2**.

3.2.2 IGANRIP Trigger Levels

Guidance in relation to operational noise is provided in DECCW's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (IGANRIP). The main purpose of the guideline is to assist the ongoing expansion of rail transport by ensuring that potential noise impacts associated with rail developments are assessed in a consistent and transparent manner. The guidelines are not mandatory and are intended to encourage the best outcomes for the community as a whole, given the application of feasible and reasonable means to control noise and vibration generated by rail traffic. IGANRIP provides "noise trigger" levels that flag the need for an assessment of the potential noise and vibration impacts from a project.

Train horns are used during general train operations as part of standard safety procedures to signal impending train movement when departing stations and at other times to provide a warning of an approaching train. These warning horn blasts are normally considered to be exempt from noise impact assessments given their importance to rail safety. However, the impacts of horn testing outside the TSF en-route to Leppington (in place of the current proposal presented in the EA to test horns within the TSF) represents an additional source of noise for the project and should therefore be assessed.

The noise trigger levels for residential receiver locations for a new railway line are provided in **Table 3**. IGANRIP also details trigger levels for other sensitive receivers, but for horn testing the L_{Amax} trigger level is of interest and this is only defined for residential receivers.

Table 3 Airborne Noise Trigger Levels for Surface Track - Residential

Type of Development	Residential Noise Trigger Levels (dBA)		
	Day (7 am to 10 pm)	Night (10 pm to 7 am)	Commentary
New rail line development	Development increases existing rail noise levels AND Resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for a rail infrastructure project to conduct an assessment of its potential noise impacts.
	60 LAeq(15hour) 80 LAmax	55 LAeq(9hour) 80 LAmax	An increase in existing rail noise levels is taken to be an increase of 2.0 dB or more in LAeq in any hour or an increase of 3.0 dB or more in LAmax.

In assessing noise levels at residential receiver locations, the outdoor noise level to be addressed is that prevailing at a location 1 m in front of the most affected building facade. For new rail projects, the noise trigger levels apply both immediately after operations commence and for projected traffic volumes at an indicative period into the future to represent the expected typical level of rail traffic usage (ten years or similar period into the future). The Year 2026 is taken as a representative period into the future.

3.2.3 RailCorp's Environmental Protection Licence

RailCorp's current Environmental Protection Licence (EPL) stipulates LAeq noise goals that are different to those provided in IGANRIP, but the LAmax criteria for new works are the same in IGANRIP and in the EPL. EPL12208 states that "*In the development of new works the licencee is required to work towards the planning goals of 55dBA LAeq(24hour) and 80 dBA LAmax pass by noise at one metre from the facade of the nearest affected residential property*."

4 NOISE ASSESSMENT AT THE TSF

Modelling of the noise from non-tonal 'quacker' style signals within the TSF has been carried out assuming neutral meteorological conditions, using the CONCAWE algorithm in SoundPLAN v6.5.

The TSF has been modelled with the 6 m high noise walls proposed in the EA in order to provide appropriate mitigation for other stabling facility noise sources.

4.1 Computer Noise Modelling

A noise goal based on the LAmax is applicable to horn noise that has the potential to cause sleep disturbance at the nearest receiver locations. However, this criterion alone is not considered to be appropriate for a non tonal, 'quacker' style signal due to its longer duration (or duty cycle). The appropriate assessment is the LAeq(15minute) intrusiveness criterion of 40 dBA during the night-time, along with the LAmax.

International Standard ISO 7731 *Ergonomics – Danger signals for public and work areas – Auditory danger signals* describes the criteria applicable to auditory danger signals. The signal is required to be clearly audible, sufficiently different from other sounds in the environment and have an unambiguous meaning. For a broadband (non-tonal) danger signal, the A-weighted sound pressure level shall not be lower than 65 dBA at any position in the signal reception area. In addition, the difference between the A-weighted sound pressure levels of the signal and the ambient levels shall be greater than 15 dBA.

The SoundPLAN noise model has been used to predict the $L_{Aeq(15minute)}$ and L_{Amax} noise levels adjacent to the TSF for trains fitted with BBS Tek BBS-102 broadband devices as measured during the studies carried out for the MacDonaldtown stabling facility. It has been assumed that the devices to be fitted to the new Waratah trains would be equivalent to this these. It is noted that devices with a range of source levels are available, and it is possible that the actual device fitted may be different to that modelled here. The intention is to evaluate the noise level emitted by this non-tonal warning signal against the INP intrusiveness and sleep disturbance criteria at the boundary of the TSF.

It has been assumed that the warning signal may sound for up to two minutes at a time, with an intermittent characteristic: on for one second then off for one second (I.e. the warning signal from one train would sound for a total of one minute during one complete vehicle movement).

4.2 Number of Train Movements

A summary of train movements within the TSF as modelled is provided in **Table 4** for the daytime and night-time periods. It can be seen from the values in **Table 4** that the worst case 15 minute event values are the same for the daytime and night-time periods.

These movements correspond to a worst-case future scenario with full usage of the capacity of the TSF, with twenty 8-car sets stabled overnight. Note that at opening, the capacity of the stabling facility will be less, with up to twelve 8-car sets using the stabling facility.

Table 4 Worst Case TSF Operations

TSF Operation	Night Time		Day Time	
	10.00 pm - 7.00 am	Worst Case 15 Minute Period	7.00 am - 10.00 pm	Worst Case 15 Minute Period
Train Arrival	4	1	14	1
Train Departure	8	4	10	4

NOTE It is assumed that the warning signal would only be sounded when trains are departing the TSF and not during arrival at the TSF.

4.3 Source Noise Levels

The BBS Tek BBS-102 device was modelled for this assessment. Measured noise levels from this device were reported in Heggies report 10-6392 Beeper Review dated February 2008 as part of the MacDonaldtown stabling facility study and are presented below in **Table 5**. This particular device was the loudest broadband warning signal tested in the MacDonaldtown study, and is therefore considered to be the likely worst case.

Table 5 BBS-102 Train Warning Signal Noise Measurement Results and Calculated Sound Power Level.

Train Warning Signal	$L_{Aeq(15minute)}$ Noise Levels at 7 m (dBA)			L_{Amax} Noise Level at 60 m[1] (dBA)	Maximum Sound Power Level (dBA)
	0 degrees	45 degrees	90 degrees		
BBS Tek BBS-102	85	82	76	70	117

Note 1: The L_{Amax} noise level at 60m has been calculated based on the measured L_{Amax} noise level at 7 m and standard distance attenuation of 20*log(7/60).

4.4 Noise Modelling Results

$L_{Aeq(15minute)}$ and L_{Amax} noise contours in the vicinity of the Leppington TSF are presented in **Appendix A** and **Appendix B** respectively. It should be noted that the predicted $L_{Aeq(15minute)}$ noise contours represent the overall background noise associated with the operation of the TSF including the operation of the BBS-102 broadband warning signal.

Overall $L_{Aeq(15minute)}$ noise levels are predicted to exceed the night-time INP Intrusiveness criterion of $L_{Aeq(15minute)}$ 40 dBA at sections of all boundaries of the TSF (the boundaries as identified on the acquisition plans), however, $L_{Aeq(15minute)}$ noise levels along most of the southern boundary are predicted to comply. Overall L_{Amax} noise levels are also predicted to exceed the sleep disturbance initial screening criterion of 50 dBA at the northern and the southern boundaries, but the higher sleep disturbance criterion of 65 dBA is exceeded only for a small section of the boundary to the north of the TSF. These noise levels are presented in **Table 6**.

Table 6 Predicted Noise Levels at the TSF Boundary

Boundary Location	$L_{Aeq(15minute)}$ Noise Level (dBA)	L_{Amax} Noise Level (dBA)
North of TSF	up to 58	up to 72
West of TSF	up to 47	< 50
South of TSF	up to 53	up to 63

The modelling results also indicate that the predicted $L_{Aeq(15minute)}$ noise levels comply with the $L_{Aeq(15minute)}$ intrusiveness criterion of 40 dBA at all existing residential receivers except at one (1) location (properties acquired for the project have been excluded). The predicted L_{Amax} noise levels are predicted to exceed the INP Application Notes sleep disturbance screening criterion of 50 dBA at two (2) locations. However, the predicted L_{Amax} noise levels at both of these existing residences are below the 65 dBA level discussed in the ECRTN as being 'unlikely to cause awakening reactions'. **Table 7** and **Table 8** provide a list of existing residences with predicted noise criteria exceedances.

Table 7 Existing Residential Property with Exceedances of the 40 dBA $L_{Aeq(15minute)}$ Intrusiveness Criterion

Address	Predicted $L_{Aeq(15minute)}$ (dBA)	Exceedance (dBA)
215 McCann Road Rossmore	49	9

Table 8 Existing Residential Properties with Exceedances of the L_{Amax} Sleep Disturbance Criteria

Address	Predicted L_{Amax} (dBA)	Exceedance of 50 dBA Criterion	Exceedance of 65 dBA Criterion
215 McCann Road Rossmore	58	8	-
467 Bringelly Road Rossmore	51	1	-

4.5 Compliance with Criteria

4.5.1 Intrusiveness

The more stringent night-time Intrusiveness noise criterion (40 dBA $L_{Aeq(15minute)}$) is the limiting criterion due to the worst-case vehicle movements in a 15 minute period being the same for both daytime and night-time periods.

A review of the information contained in **Table 7** and the $L_{Aeq(15minute)}$ noise contours provided in **Appendix A** indicates the following:

- The Intrusiveness criterion of 40 dBA $L_{Aeq(15minute)}$ is exceeded at one (1) existing property.
- The predicted exceedance is 9 dBA at 215 McCann Road Rossmore.

4.5.2 Sleep Disturbance

A review of the information contained in **Table 8** and the L_{Amax} noise contours provided in **Appendix B** indicates the following:

- The sleep disturbance screening criterion of 50 dBA L_{Amax} is exceeded at two (2) existing properties.
- The maximum predicted exceedance is 8 dBA at 215 McCann Road Rossmore.
- At all existing receivers, the predicted L_{Amax} noise levels are below the 65 dBA level that according to the ECTRN review is unlikely to cause awakening reactions.

4.5.3 Signal Recognition

A review of the source levels measured as part of the MacDonaldtown Stabling Facility study and listed in **Table 5** indicates that the L_{Amax} sound pressure level at 60m from the warning signal has been measured to be 70 dBA. This signal therefore complies with the requirements of ISO7731 that stated that the A-weighted sound pressure level shall not be lower than 65 dBA at any position in the signal reception area. It has been assumed that the signal only needs to achieve these levels ahead of the train, and that there is no reason for any signal to be audible along the full length of the train.

It is assumed that the warning signal provided by the BBS-Tek BBS-102 is sufficiently different from other sounds in the environment to have an unambiguous meaning.

5 NOISE ASSESSMENT OF HORN TESTING EN-ROUTE TO LEPPINGTON

As a possible alternative to testing of horns at the TSF, an alternative testing location situated within a cutting en-route to Leppington Station has been investigated.

For this assessment, all sources other than train horns have been omitted as they have been addressed in the EA. This analysis considers only L_{Amax} levels from horn testing of Town horns. SoundPLAN Version 6.5 has been used to calculate L_{Amax} horn noise emission levels for this project.

5.1 Source Noise Levels

The current RailCorp horn specification is RSU650 with horn noise levels for all train types as listed in **Table 9**. The directivity of the train horns is based on measurements undertaken as part of the review of noise modelling accuracy assessment for the MacDonaldtown stabling facility (Heggies Letter Report *10-4075 Horn Noise Modelling 20061129*), and is detailed in **Table 10**.

Table 9 Horn Specifications

Horn Type	Level and Distance[1]
Town	85 to 90 dBA at 100 m
Country	> 88 dBA at 200 m

Note 1: Sound Pressure Level at distance directly in front of train

It is recognised that horn noise is highly variable, depending on the duration of the event. A full horn blast is louder than a short 'toot'. For the purpose of this assessment it is assumed that the maximum levels in **Table 9** are representative of a typical full-blast horn test and that the results represent a worst case for horn noise testing.

Table 10 Horn Directivity

Angle (degrees) [1]	Directivity Adjustment (dBA)
0	0.0
45	-4.5
90	-8.0
135	-10.0
180	-11.0

Note 1: The 0 degrees position is directly in front of the train. The 90 degrees position is to the side of the train.

The noise modelling has been carried out assuming horn testing occurs at the front of trains travelling in the Up direction only. That is, the predicted L_{Amax} horn noise contours have been calculated for horns pointing only along the track towards Leppington Station. The location of the horn tests is assumed to be between approximate chainage 52.00 km and 52.10 km, within a cutting approximately 9 m deep.

5.2 Noise Modelling Results

5.2.1 Sleep Disturbance

L_{Amax} horn noise contours are presented in **Appendix C**. **Table 11** summarises the properties in the vicinity of the proposed horn test location where the L_{Amax} noise levels are predicted to exceed the sleep disturbance criteria (excluding properties acquired for the project).

Table 11 Existing Properties with Exceedances of the L_{Amax} Sleep Disturbance Criteria for a Town Horn Test

Address	Predicted L_{Amax} (dBA)[1]	Exceedance of 50 dBA Criterion	Exceedance of 65 dBA Criterion
17 Eastwood Road	54	4	-
40 Eastwood Road	55	5	-
62 Eastwood Road	55	5	-
133 Dickson Road	53	3	-
134 Dickson Road	58	8	-
140-146 Dickson Road	70	20	5
234 Ingleburn Road	53	3	-

Note 1: Predicted levels at these locations include a façade correction of 2.5 dBA to give the Predicted LAmax levels at 1m from the facade.

A review of the information contained in **Table 11** indicates that the sleep disturbance screening criterion of 50 dBA L_{Amax} is predicted to be exceeded at 7 existing residences due to horn noise (the maximum predicted exceedance was 20 dBA at 146 Dickson Road). The 65 dBA L_{Amax} sleep disturbance criterion is predicted to be exceeded at 1 residence.

Compliance with the sleep disturbance screening criterion of 50 dBA is expected at distances beyond 210 m from the rail corridor at 90 degrees to the track. The 65 dBA contour extends approximately 50 m from the rail corridor adjacent to the test location.

5.2.2 IGANRIP Trigger Levels

The noise modelling results indicate that the predicted L_{Amax} noise levels at all existing residential receivers would comply with the IGANRIP trigger level of L_{Amax} 80 dBA. It is predicted that the L_{Amax} trigger level would be exceeded at distances of up to 30 m from the rail corridor at 90 degrees to the track.

6 CONCLUSIONS

Train horns are considered a safety-critical device and testing of the horns is considered essential for the safe operation of the rail network. TCA and RailCorp are investigating alternative options for reducing the impacts of horn noise at the proposed TSF. Non-tonal 'quacker' style audible warning signals have been investigated as an alternative to train horns to give warning of impending train movement. Train horns might then be tested at their 'Town' levels in a cutting en-route to Leppington Station.

An alternative to the standard testing procedure has been evaluated by comparison of predicted noise levels with relevant noise criteria at the boundary of the TSF and also at nearby existing residential receivers.

6.1 Non-tonal Audible Warning Signals

Evaluation of the use of the BBS Tek BBS-102 non-tonal 'quacker' style audible warning signals within the TSF indicated the following:

- Both the INP Intrusiveness $L_{Aeq(15minute)}$ criterion of 40 dBA and the sleep disturbance L_{Amax} noise criterion of 50 dBA are predicted to be exceeded along parts of the northern boundary of the land to be acquired (surrounding the TSF) as part of the project.
- Most locations along the southern boundary are predicted to comply with both the Intrusiveness criterion and the sleep disturbance criterion. The largest exceedances predicted along the southern boundary are those adjacent to 215 McCann Road.
- All locations along the western boundary are predicted to comply with the sleep disturbance criterion, however, some sections of this boundary are predicted to exceed the Intrusiveness criterion.
- The INP Intrusiveness $L_{Aeq(15minute)}$ noise criterion of 40 dBA is exceeded at one (1) existing property (the predicted exceedance is 9 dBA) due to the operation of the TSF including the train warning signal.
- The sleep disturbance screening criterion of L_{Amax} 50 dBA is exceeded at two (2) existing residential receivers (the maximum predicted exceedance is 8 dBA) due to the operation of the train warning signal in the TSF to alert staff of an impending train movement.
- The upper sleep disturbance indicative level of L_{Amax} 65 dBA is not predicted to be exceeded at any existing residential receivers due to the operation of the train warning signal within the TSF.

6.2 Horn Testing En-Route to Leppington Station

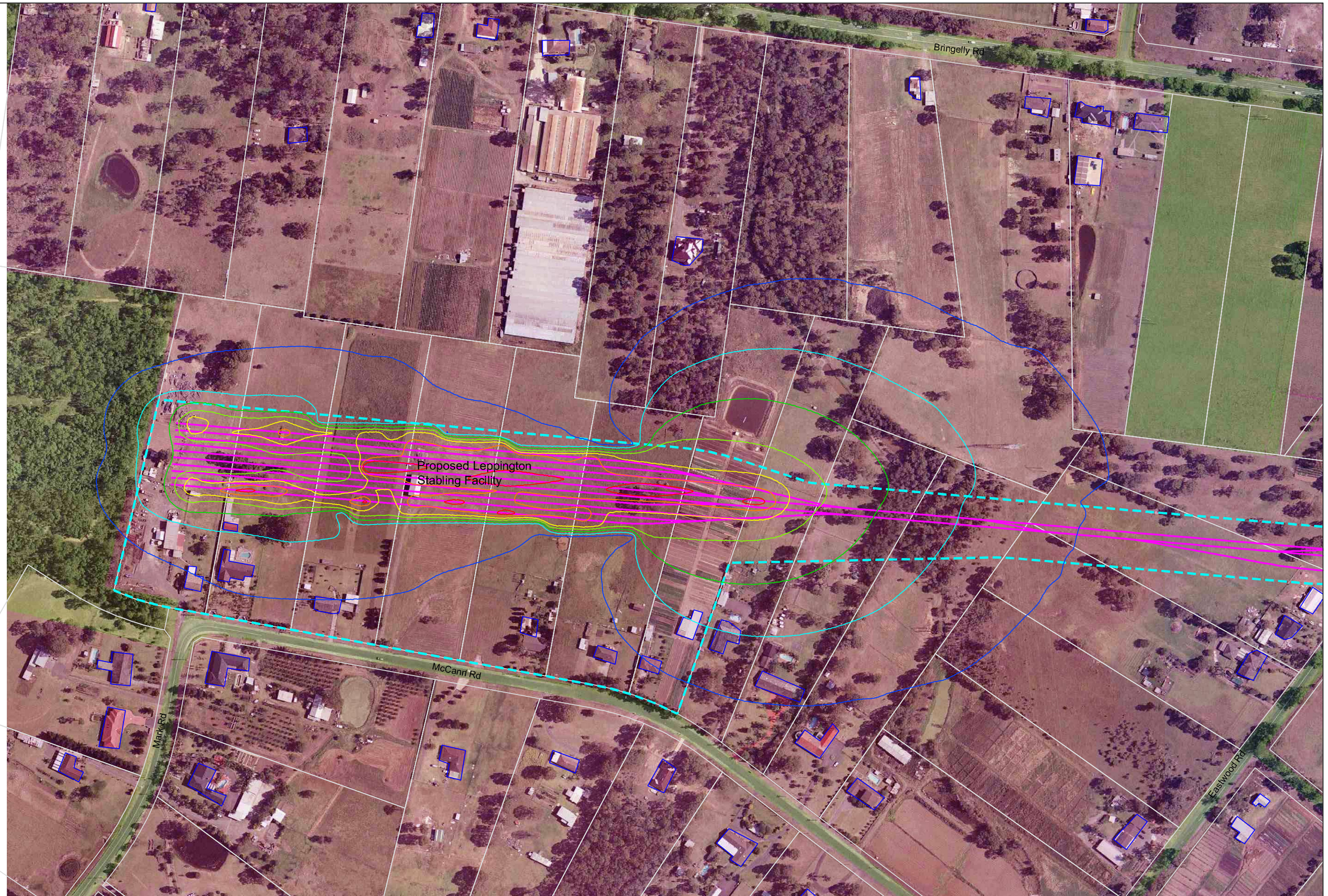
Evaluation of the horn testing between chainage 52.00 km and 52.10 km on the Up track, between the TSF and Leppington Station indicated the following:

- Compliance with the sleep disturbance screening criterion of 50 dBA L_{Amax} is expected at distances beyond 210 m from the rail corridor at 90 degrees to the track test location.
- The sleep disturbance screening criterion of 50 dBA L_{Amax} is predicted to be exceeded at 7 existing residences due to horn noise.
- Compliance with the higher sleep disturbance criterion of 65 dBA is expected at distances beyond 50 m from the rail corridor at 90 degrees to the track test location.
- The higher sleep disturbance criterion of 65 dBA L_{Amax} is predicted to be exceeded at 1 existing residence due to horn noise.
- The IGANRIP L_{Amax} noise trigger level of 80 dBA is exceeded at distances of up to 30 m from the rail corridor at 90 degrees to the track.
- The predicted L_{Amax} noise levels at all existing residential receivers in the vicinity of the testing area, comply with the IGANRIP L_{Amax} noise trigger level of 80 dBA.

The use of a 'quacker' style broadband warning signal to alert staff to train movements at the TSF, while not complying completely with the INP criteria at the boundary of the TSF, would result in a major improvement when compared with the predicted noise levels for Town horn sounding at the TSF as presented in the EA.

In addition, the testing of Town horns in the cutting on the way to Leppington is much less likely to cause sleep disturbance over a wide area than the testing of horns at the TSF as presented in the EA. The alternative horn sounding procedures described in this report would reduce the noise impacts associated with the proposed TSF.

Leppington TSF Overall (Stabling and Train Warning Signal) LAeq(15 minute) Noise Contours



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Legend

- 70 dBA Noise Contour
- 65 dBA Noise Contour
- 60 dBA Noise Contour
- 55 dBA Noise Contour
- 50 dBA Noise Contour
- 45 dBA Noise Contour
- 40 dBA Noise Contour
- South West Rail Link Alignment
- Existing Low Density Residential

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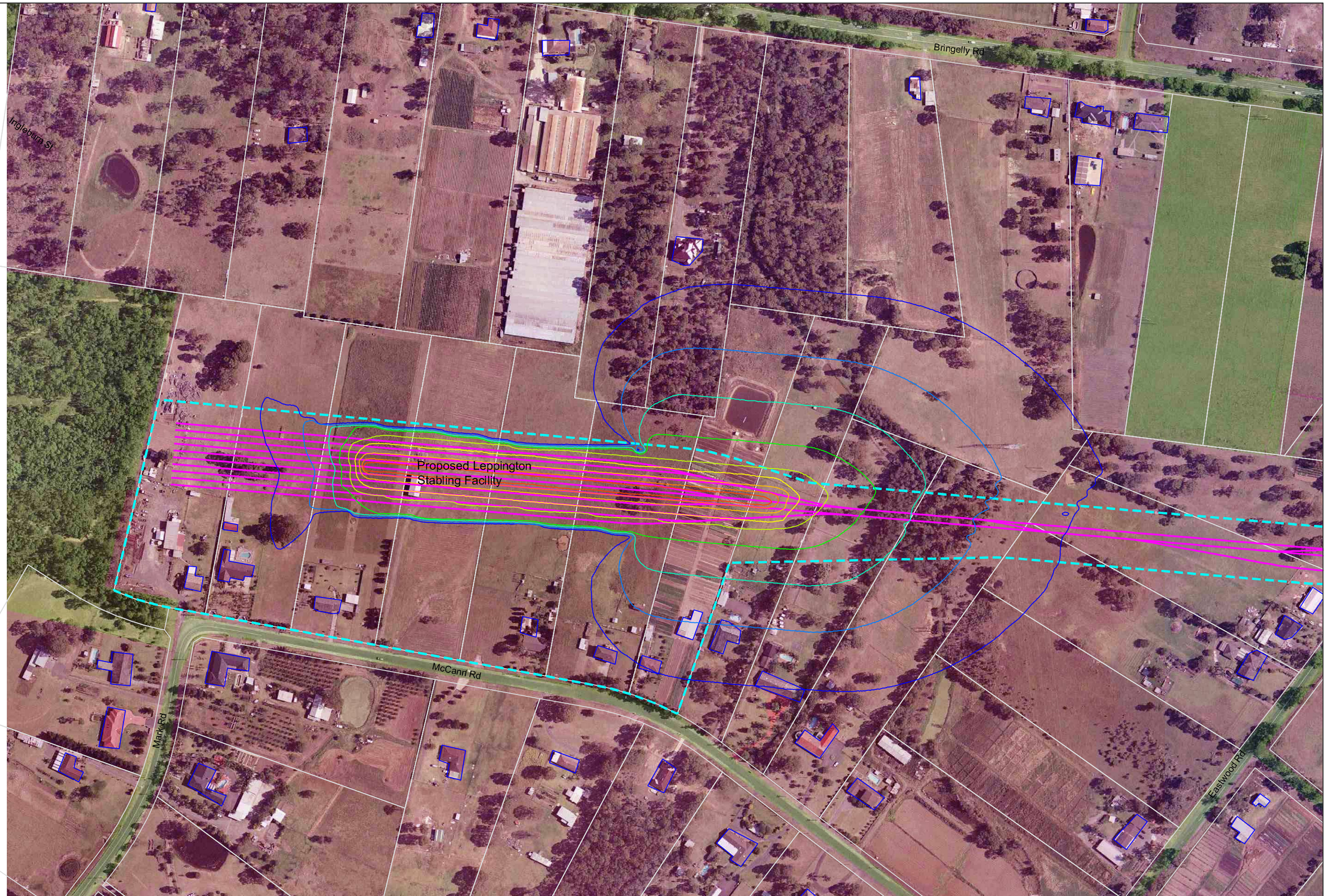
South West Rail Link
Leppington Stabling Facility
LAeq15min Overall Noise Contours

FILE NAME: 10-6055 Overall Noise Contours LAeq15min R1.dwg
DRAWING No.: 10-6055 Leppington Stabling Overall LAeq15min
REVISION: 1

Leppington TSF Train Warning Signal LAmax Noise Contours



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Legend

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- 85 dBA Noise Contour
- 80 dBA Noise Contour
- 75 dBA Noise Contour
- 70 dBA Noise Contour
- 65 dBA Noise Contour
- 60 dBA Noise Contour
- 55 dBA Noise Contour
- 50 dBA Noise Contour
- South West Rail Link Alignment
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FILE NAME
10-6055 Alarm Noise Contours LAmax R1.dwg

South West Rail Link
Leppington TSF
LAmax "Quacker" Train Warning Signal Noise Contours

DRAWING No.
10-6055 Leppington SF "Quacker" Alarm Noise Contour - LAmax

REVISION
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Horn Testing LAmax Noise Contours

75 mm ON ORIGINAL

REV.	DATE	AMENDMENT / ISSUE DESCRIPTION	PREPARED	CHECKED
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Scale = 1:5000

Legend

- 100 dBA Noise Contour
- 95 dBA Noise Contour
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- 85 dBA Noise Contour
- 80 dBA Noise Contour
- 75 dBA Noise Contour
- 70 dBA Noise Contour
- 65 dBA Noise Contour
- 60 dBA Noise Contour
- 55 dBA Noise Contour
- 50 dBA Noise Contour

- South West Rail Link Alignment
- Existing Low Density Residential

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South West Rail Link
LAmax Horn Noise Contours

FILE NAME: Horn Noise VC Up rev1.dwg

DRAWING No.: 10-6055 LAmax Horn Noise Contours

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