6. TECHNICAL REPORTS

6.1 NOISE IMPACT ASSESSMENT

Noise Impact Assessment

Train Support Facility

Pacific National

Noise Impact Assessment

Train Support Facility

Pacific National

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Pacific National

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Report Details:

Filename: 10634 Noise Impact Assessment Rev7.doc
Job #: J0090227-03 Folder #: F10634
Revision: 7 (Final)
Date: 11 November 2010

Endorsements:

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EXECUTIVE SUMMARY

Advitech was engaged by Monteath and Powys to prepare an assessment of potential noise impacts associated with the construction and operation of a Train Service Facility (TSF) at Greta. The facility will be operated by Pacific National and provide essential support to its coal haulage business in the Hunter Valley.

Long term background monitoring data was supplemented with operator attended noise monitoring to characterise the existing noise environment at six locations adjacent to the proposed TSF. These receiving environments were considered representative of a mix of rural, suburban and urban receiver types, dependent upon the level of influence of existing transportation and environmental noise sources. Existing transportation noise associated with the Main Northern Railway and the New England Highway was audible in all receiving environments, and found to present the dominant contribution to ambient noise levels at receivers in Greta, Illalong, Branxton and isolated residences on the New England Highway.

Existing noise levels from transportation sources during the night period were found to exceed the acceptable $L_{Aeq,period}$ noise levels for the identified receiver types provided in the NSW Industrial Noise Policy. Accordingly, the Project Specific Noise Levels (PSNL) for all but one receiving environment were established in terms of the intrusiveness criteria.

Noise impact modelling was undertaken using the Environmental Noise Model (ENM) and Sound Power Level (SWL) data obtained from measurements at existing Pacific National operations. Review of prevailing meteorological conditions was also undertaken such that environmental propagation influences could be appropriately assessed.

Assessment of the impact modelling results indicates noise generated by trains entering the facility would likely exceed the PSNL in receiving environments around Greta, Illalong and the New England Highway; however, these sources are considered to represent existing pass-by impacts and were subsequently excluded from further assessment. The results of noise impact modelling indicate noise generated by sources introduced by the TSF will comply with all relevant criteria under worst case meteorological conditions at receivers in the Greta, Illalong, Tuckers Lane, North Rothbury, Branxton and New England Highway receiving environments.

Review of results indicates unmitigated access road impacts would likely exceed the PSNL at receivers adjacent to the site access. Further assessment indicates night period noise levels may be limited to minor impacts (<2 dB(A)) above the intrusiveness criterion at a single (currently undeveloped) receiver through construction of a two metres barrier adjacent to the access road. While heavy vehicle movements during the day period will continue to exceed the intrusiveness criteria under this arrangement, potential for construction of a larger barrier is limited by environmental constraints on this part of the site. It is therefore proposed heavy vehicle impacts would be managed operationally.

Impact predictions for the TSF were also reviewed against potential impacts associated with the construction of the Hunter Expressway and expansion of the Main Northern Railway to include a third line. The results of this assessment indicate that impacts associated with these cumulative changes to the noise environment, may lead to exceedence of the amenity criteria in some receiving environments. Further analysis of the contribution from TSF operations indicates noise levels generated by the TSF will be significantly lower than those generated by the Hunter Expressway and Third Rail projects, and will effectively make no contribution to the cumulative noise impacts in receiving environments around Greta, Illalong and Branxton.

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APPENDICES

1. INTRODUCTION

Advitech Pty Limited was engaged by Monteath and Powys Pty Ltd to prepare a Noise Impact Assessment (NIA) of potential noise impacts associated with the development of a Train Support Facility (TSF) at Greta, NSW. Pacific National proposes to construct and operate the facility to provide support to its coal haulage business in the Hunter Valley. The location of the proposed facility is provided in **Figure 1**. The site is currently zoned Rural 1a pursuant to the Cessnock Local Environment Plan (LEP) 1989 and is located between the existing Northern Railway and the proposed F3 freeway extension to Branxton. The purpose of this assessment is to provide an analysis of potential noise impacts associated with the construction and operation of the TSF.

This revision (Revision 6) supersedes earlier published versions of the assessment and reflects the proposed development as advised by Pacific National during October 2010. This revision incorporates assessment following review by the NSW Department of Planning including public submissions.

It should be noted that this report was prepared by Advitech Pty Limited for Monteath and Powys ("the customer") in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

1.1 Site Location and Surrounding Land Uses

The site is located at Lot 300, DP1117342 Mansfield Road, Greta (**Figure 1**). The site has an area of approximately 46 hectares and is zoned 1(a) Rural pursuant to the Cessnock LEP (1989). The site surrounds include:

- 2(b) Village zoned residential development to the east (Greta);
- 1(c) Rural Residential development to the south-east (Illalong);
- 1(a) Rural development to the south (adjacent to Tuckers Lane);
- 2(b) Village zoned residential development to the west (North Rothbury);
- 2(a) Residential zoned urban development to the north-west (Branxton); and
- 1(a) Rural development to the north (adjacent to the New England Highway).

The LEP zoning maps for the areas adjacent to the proposed site are provided in **Figure 2**.

Figure 1: Site Location

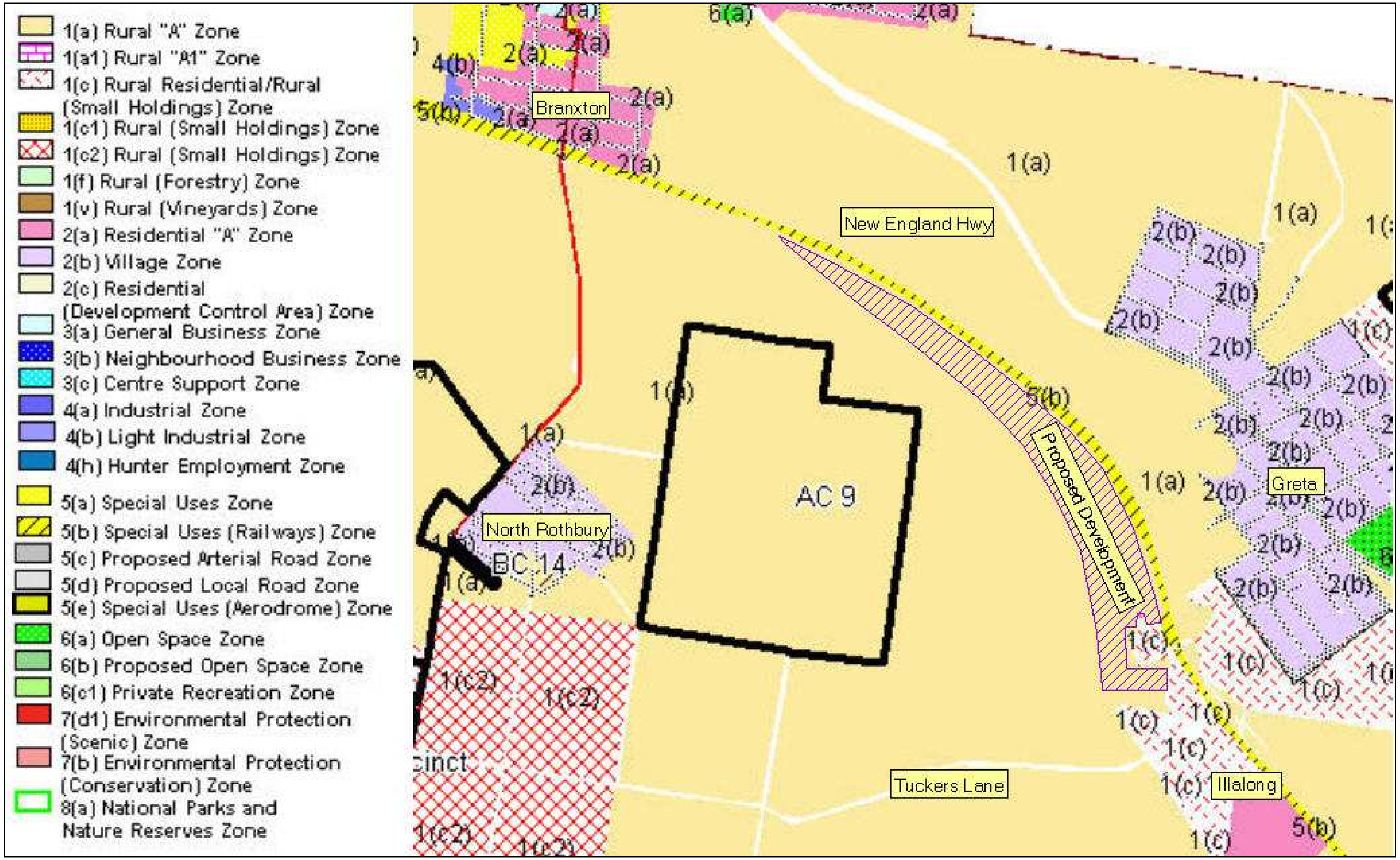


Figure 2: Zoning Plan

1.2 Project Description

Pacific National's intention is to establish the Greta site as a train support facility. The new facility is required to meet the expected growth in coal exports through the Newcastle Port and will allow Pacific National to not only achieve its business objectives but to also meet responsibilities within the Hunter Valley coal chain. The development is referred to as a Train Support Facility, which includes the infrastructure required to service trains as well as provide the administration and ancillary development associated with the project.

1.2.1 Train Support Facility

The facility will operate as a service point for Pacific National's existing trains that utilise the Main Northern Railway. On return trips from delivering commodities to the Port of Newcastle, empty trains will utilise the proposed Greta facility to be re-fuelled, maintained and when necessary change crews. The trains currently operate 24 hours a day, seven days a week, and as a result the facility needs to be available to service the trains on this basis. Once the trains have been re-fuelled and serviced, they will return to the Main Northern Railway for their intended destination. Minor planned maintenance works would also be undertaken at the facility.

The layout of the proposed development is provided in **Figure 3**.

1.2.2 Development Staging

Development of the facility will be undertaken in a construction stage and three (3) operational stages. These stages include:

- **Construction** – vegetation clearance, bulk earthworks, establishment of internal stabling roads and establishment of site buildings and ancillary infrastructure;
- **Stage 1 Operations** –the facility will operate 24 hours a day, 7 days per week with approximately 10 trains serviced by the facility per day. The facility at this stage will have capacity to house 5 trains (totalling 15 locomotives and 455 wagons). Stage 1 operations are proposed to commence immediately upon commissioning of the facility;
- **Stage 2 Operations** - the facility will operate 24 hours a day, 7 days per week with approximately 15 trains serviced by the facility per day. The facility at this stage will have capacity to house 5 trains (totalling 15 locomotives and 455 wagons). Stage 2 operations are proposed to commence in 2014; and
- **Stage 3 Operations** - the facility will operate 24 hours a day, 7 days per week with approximately 25 trains serviced by the facility per day. The facility at this stage will have capacity to house 5 trains (totalling 15 locomotives and 455 wagons). Stage 3 operations are proposed to commence in 2018.

1.3 Sensitive Receivers

A number of potentially noise sensitive receivers were identified adjacent to the proposed development site including residential receivers:

- to the east at Greta;
- to the south-east at Illalong;
- to the south off Tuckers Lane;
- to the west at North Rothbury;
- to the north-west at Branxton; and
- to the north off the New England Highway.

A number of noise sensitive non-residential receivers were also identified within the receiving environments adjacent to the proposed development. These receivers are identified as:

- Greta Public School (Wyndham St);
- Greta Community Pre-school (Water St);
- Greta Arts and Sports Community Hall (Water St); and
- various commercial receivers on the New England Highway.

The location of potentially sensitive receivers adjacent to the development site is shown in **Figure 4.**

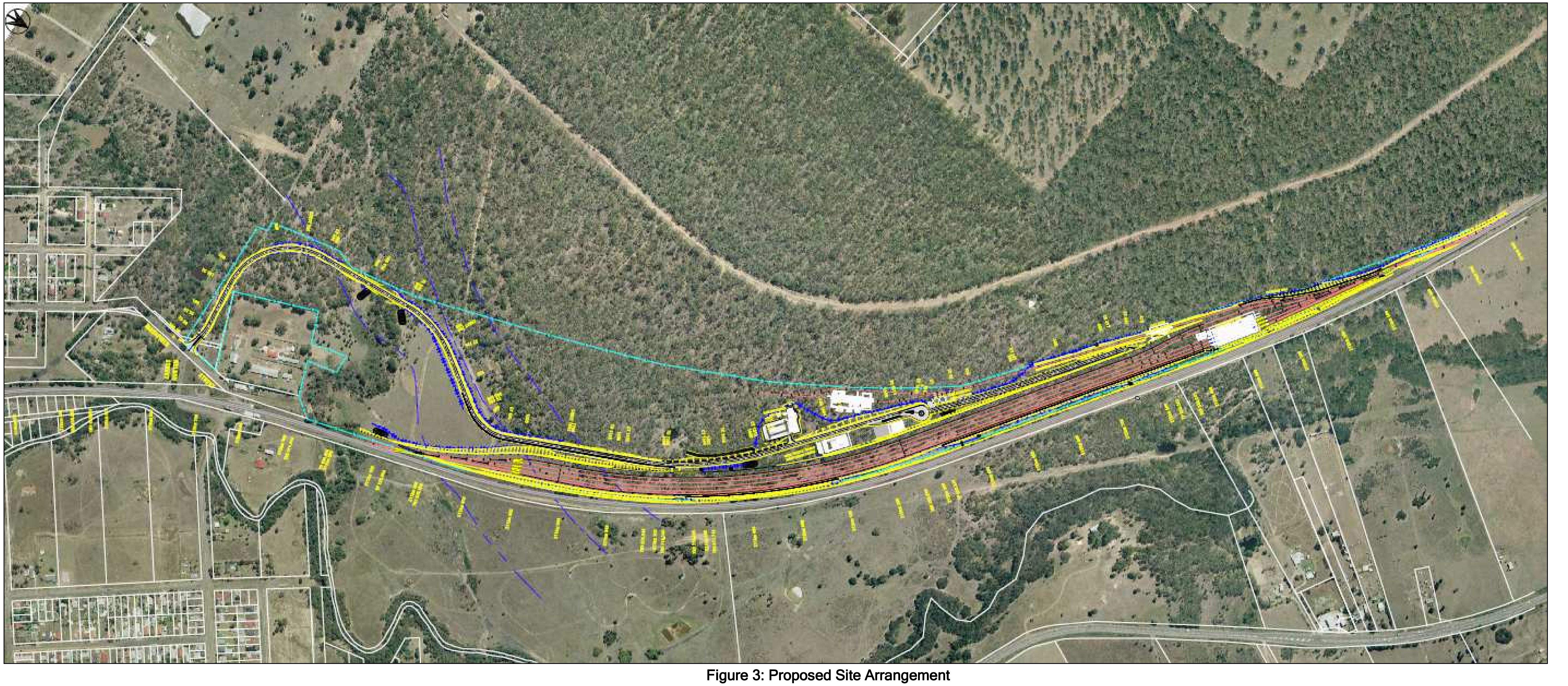


Figure 3: Proposed Site Arrangement

Figure 4: Location of Sensitive Receivers

2. REFERENCES

The following references were used for the purposes of preparing this assessment:

1. AS1055.1-1997: *Acoustics – Description and measurement of environmental noise. Part 1: General procedures*;
2. AS 2706-1984: *Numerical Values: Rounding and interpretation of limiting values;*
3. GHD (2009). *Report on ARTC Minimbah Third Track Environmental Assessment: Noise and Vibration Impact Assessment*, Australian Rail and Track Corporation;
4. GHD (2009). *Noise and Vibration Impact Assessment for Maitland to Minimbah Third Track Project*, Australian Rail and Track Corporation;
5. NSW Department of Environment and Climate Change (2009). *Interim Construction Noise Guideline*, Department of Environment and Climate Change, Sydney*;*
6. NSW Environment Protection Agency (2000). *NSW Industrial Noise Policy*, NSW Environment Protection Agency, Sydney;
7. NSW Environment Protection Agency (1999). *Environmental Criteria for Road Traffic Noise*, NSW Environment Protection Agency, Sydney;
8. NSW Roads and Traffic Authority (2001). *RTA Environmental Noise Management Manual,* NSW RTA, Surry Hills*;*
9. Wearne AJ and Weber CM (2004). *Development of a line based rail noise pollution reduction programme*, Proceedings of *Acoustics 2004*.

3. NOISE ASSESSMENT CRITERIA

3.1 Director General's Requirements

The NSW Department of Planning (DoP) provides the following Director General's Requirements for the assessment of potential noise and vibration impacts of the proposed TSF at Greta:

- noise and vibration from all activities and sources on and off site and impacts to receivers;
- the noise assessment must consider the impact from the project in isolation and in a cumulative context with relevant existing and approved development, including development of the Hunter Expressway and the third railway line between Maitland and Minimbah; and
- taking into account the *NSW Industrial Noise Policy* (DECC, 2000), the *NSW Environmental Criteria for Road Traffic Noise* (EPA, 1999) and the *Interim Construction Noise Guideline* (DECC, 2009).

3.2 EPA Criteria for Industrial Noise Sources

The NSW Industrial Noise Policy (INP) presents two criteria for the assessment of industrial noise sources, intrusive noise impacts and noise amenity levels. In assessing the noise impact of industrial sources both components are considered for sensitive receivers. Typically the more stringent of these criteria would be applied as the Project Specific Noise Level (PSNL) for the development as a means of managing intrusive noise impacts and preserving the amenity of the receiving environment.

3.2.1 Intrusive Noise Impacts

The intrusiveness of an industrial noise source is generally considered acceptable if the predicted $L_{Aeq,15minute}$ impact does not exceed the background noise level by more than 5 dB when measured in the absence of the source. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP and is the median value of the Assessment Background Levels (ABL) determined for the monitoring period. The use of the median accounts for noise level variations over time. The intrusiveness criterion is equal to the RBL + 5dB.

3.2.2 Amenity Noise Level

To limit continuing increases in noise levels, the EPA has identified recommended maximum ambient noise levels for typical receiver areas and land uses. The relevant section of *Table 2.1* of the INP has been reproduced as **Table 1**. Where the existing background noise level from industrial noise sources is close to the Acceptable Noise Level (ANL) for that receiver type, Section 2 of the INP (reproduced as **Table 2**) establishes the requirements for applying a modification factor to account for the existing level of industrial noise. The aim of this component of the INP is to protect against cumulative noise impacts associated with rapid development within the receiving noise environment.

Table 1: Recommended L_{Aeq} noise levels from industrial noise sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended Acceptable Level dB(A)	Recommended Maximum dB(A)
Residential	Suburban	Day Evening Night	55 45 40	60 50 45
	Urban	Day Evening Night	60 50 45	65 55 50
	Urban/Industrial Interface	Day Evening Night	65 55 50	70 60 55
School - internal	All	Noisiest 1-hr	35	40
Place of worship - internal	All	When in use	40	45
Passive recreation	All	When in use	50	55
Active recreation	All	When in use	55	60
Industrial Premises	All	When in use	70	75

Source: Environment Protection Authority INP Table 2.1 (2000)

Table 2: Modification to Acceptable Noise Level (ANL) to account

Total Existing L_{Aeq} from Industrial Sources	Maximum L_{Aeq} for Noise from New Sources Alone
≥ Acceptable Noise Level plus 2	If existing noise level is likely to decrease in future: ANL minus 10 If existing noise level is unlikely to decrease in future: Existing level minus 10
Acceptable Noise Level plus 1	Acceptable noise level minus 8
Acceptable Noise Level	Acceptable noise level minus 8
Acceptable Noise Level minus 1	Acceptable noise level minus 6
Acceptable Noise Level minus 2	Acceptable noise level minus 4
Acceptable Noise Level minus 3	Acceptable noise level minus 3
Acceptable Noise Level minus 4	Acceptable noise level minus 2
Acceptable Noise Level minus 5	Acceptable noise level minus 2
Acceptable Noise Level minus 6	Acceptable noise level minus 1
<Acceptable Noise Level minus 6	Acceptable noise level

Source: Environment Protection Authority INP Table 2.2 (2000)

3.2.3 Background Noise Monitoring

Background noise monitoring is undertaken in order to determine the character of the ambient noise environment adjacent to the proposed development. The monitoring locations selected should be representative of the noise environments at sensitive receivers adjacent to the proposed development.

3.2.4 Project Specific Noise Levels

Project specific noise levels for the development are assigned after determining the relevant noise levels from the intrusiveness and amenity criteria. The project specific noise levels typically reflect the most stringent noise level requirement derived from the intrusiveness and amenity criteria. They set the benchmark against which noise impacts and the need for noise mitigation are assessed.

3.2.5 Meteorological Conditions

The INP notes that meteorological conditions such as temperature inversions and prevailing winds may increase noise levels by focusing sound wave propagation paths towards a single point. Analysis of prevailing meteorological conditions with potential to influence noise propagation is presented in **Section 4**.

3.2.6 Predicting Noise Levels

Having determined the project-specific noise levels the objective is to accurately predict the noise impact from an industrial noise source. The INP presents the following procedure:

1. identify all possible source, site and receiver parameters so that noise can be adequately predicted;
2. predict noise levels from the source at receiver locations, taking into account all important parameters including the source noise levels and locations, operating times, receiver locations, weather conditions applicable to the site, site features and topography, as well as the project-specific noise levels; and
3. compare the predicted noise level with the project-specific noise levels to determine the noise impact.

The INP requires noise impacts to be quantified at all potentially affected receivers. Specifically, the noise levels predicted should correspond to the noise descriptor of the project-specific noise levels applicable to the project. Any assumptions made when determining descriptors should be clearly validated and reported in the noise assessment.

The noise impact of the development can then be determined by comparing the predicted noise level at the receiver with the project-specific noise levels that have been derived for that particular location. The extent of noise impact from the development is defined by the extent to which the predicted noise levels exceed the project-specific noise levels and the number of receivers affected.

3.2.7 Modifying Factors

Where the noise source contains annoying characteristics such as tonality, impulsiveness, intermittency, irregularity or dominant low frequencies the INP requires a modifying factor adjustment to the source noise level. This allows a representative comparison of noise levels to be made. Table 4.1 of the INP outlines the modifying factors with the relevant adjustment for this assessment shown in **Table 3**.

Table 3: Modifying Factor correction

Factor	Assessment/ Measurement	When to Apply	Correction
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: 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz	+5 dB
Low frequency noise	Measurement of A-wt and C-wt noise levels	Measure A-wt and C-wt noise levels over same time period. Correction to be applied if the difference between the two levels exceeds 15dB	+ 5dB
Impulsive Noise	A-weighted fast response and impulse response	If difference in A-weighted maximum noise levels between fast response and impulse response in greater than 2dB	+5 dB

Source: Environmental Protection Authority INP Table 4.1 (2000)

3.3 EPA Sleep Disturbance Guidelines

Part 2 of the *Noise Guide for Local Government* (2004) notes that noise control measures should be applied to protect people from sleep arousal. Although the noise level required to awaken a person from their sleep is dependent on the individual and the stage of their sleep pattern, AS2107 - 1987 recommends a bedroom noise level of 25-30 dB(A).

The *Noise Guide for Local Government* recommends the $L_{A1,1mintue}$ noise level should not exceed the RBL by more than 15 dB when measured outside the bedroom window.

3.4 Road Traffic Noise Guidelines

The EPA's *Environmental Criteria for Road Traffic Noise* (1999) provides a framework for the management of traffic noise issues associated with new developments near existing or new roads, and new or upgraded road developments adjacent to new or planned building developments. Traffic generated by the proposed development should comply with the EPA *Environmental Criteria for Road Traffic Noise* $L_{Aeq,period}$ day time and night time traffic noise levels (the relevant section is reproduced in **Table 4**) for traffic moving through Greta via Nelson Street.

Table 4: Road traffic noise criteria

Type of Development	Criteria, dB(A)	Where Criteria is already Exceeded
8. Land use developments with potential to create additional traffic on collector roads	Day time $L_{Aeq(1hr)}$ 60 Night time $L_{Aeq(1hr)}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

Source: Environmental Criteria for Road Traffic Noise Table 1 (1999)

3.5 NSW Construction Noise Guideline

The NSW Interim Construction Noise Guideline (2009) provides guidance on managing construction works to minimise noise, with an emphasis on communication with and cooperation from all stakeholders affected by construction noise. The guideline does not identify a single approach for managing construction noise, rather it provides a framework for assessing construction noise impacts based on the complexity of the project and condition of the ambient noise environment.

The framework identifies the following steps for managing construction noise impacts:

- identify any sensitive land uses that may be affected;
- identify the operating hours and duration of the proposed construction works;
- determine the noise impacts at sensitive receivers; and
- select and apply the best work practices to minimise noise impacts.

The scale and duration of the construction works, and the number and type of potentially affected sensitive receivers defines the extent to which assessment and management of impacts should be undertaken. The guideline provides both qualitative and quantitative assessment methodologies.

The qualitative approach prioritises the implementation of worksite noise controls over detailed assessment of impacts and is applied in the case of small scale, short duration project such as essential road maintenance or the construction of a residential dwelling.

The quantitative approach is applied to larger projects with potential to affect many sensitive receivers over a longer period of time, or during noise sensitive periods (6pm to 7am) and requires that assessment of potential impacts be undertaken prior to the implementation of management strategies. The quantitative approach establishes management levels for airborne noise incident at typical receiver types as shown in **Table 5**

Table 5: Construction noise management level

Receiver Type	Management Level, dB(A) ($L_{Aeq,15minute}$)
Residential[1]	
Management level	RBL + 10dB(A)
Highly noise affected	75 dB(A)
Other Sensitive Land Uses[2]	
Classroom at school and other educational institutions	50 dB(A) (internal)
Hospital wards & operating theatres	40 dB(A) (internal)
Places of worship	45 dB(A) (internal)
Active recreation areas	65 dB(A) (external)
Passive recreation areas	60 dB(A) (external)
Commercial and Industrial Premises[2]	
Industrial Premises	75dB(A) (external)
Commercial (offices, retail outlets)	70dB(A) (external)

1. Management level for residential receivers during standard hours (7am to 6pm). Management level for residential premises outside standard hours is RBL + 5 dB(A).

2. Management level for commercial, industrial and other sensitive land use applies only when in use.

4. ENVIRONMENTAL NOISE ASSESSMENT

4.1 Continuous Noise Monitoring

Background noise monitoring was undertaken in six (6) sensitive receiving environments adjacent to the proposed development site. The location of the monitoring sites is provided in **Figure 5**. The details of the continuous data logger used for the monitoring are provided in **Table 6**.

Table 6: Monitoring details

Measurement Title	Hunter St, Greta	Mansfield St, Illalong	Tuckers Lane	Scott St, North Rothbury	Queen St, Branxton	New England Hwy
Receiver ID	R1	R2	R3	R4	R5	R6
Serial Number	194444	194531	194538	16-299-450	194410	16-203-513
Run Started	4/9/2009 18:00	4/9/2009 18:00	4/9/2009 18:00	4/9/2009 18:00	4/9/2009 18:00	4/9/2009 18:00
Run Stopped	17/9/2009 6:45	16/9/2009 10:00	17/9/2009 6:45	15/9/2009 18:45	16/9/2009 21:45	17/9/2009 6:45
Frequency Wt	A	A	A	A	A	A
Time Response	Fast	Fast	Fast	Fast	Fast	Fast
Engineering Units	dB(A) SPL	dB(A) SPL	dB(A) SPL	dB(A) SPL	dB(A) SPL	dB(A) SPL
Pre-Mes. Ref	94.0	n/a[1]	94.0	94.1	93.6	92.3
Post-Mes. Ref	93.9	n/a[1]	94.0	n/a[2]	93.8	92.1

Note 1. Pre-measurement and post measurement references were not written to the monitoring results file.

Note 2. Post measurement reference was not taken as logging was terminated prematurely due to battery depletion.

The continuous noise data loggers recorded the following data at 15 minute statistical intervals:

- date, time and temperature;
- maximum and minimum noise levels measured during the interval;
- the equivalent continuous noise level for the interval; and
- statistical noise levels representative of the noise environment.

Tables 8 to 13 show the ABL's for all valid data at each of the monitoring locations. There are a number of periods that are invalid due to strong winds and rainfall which occurred during the monitoring period. This data was excluded in accordance with validation rules established in Appendix B of the INP.

The L_{A1}, L_{A10}, L_{A90} and L_{Aeq} noise levels for the continuous noise loggers are presented graphically in **Appendix I.**

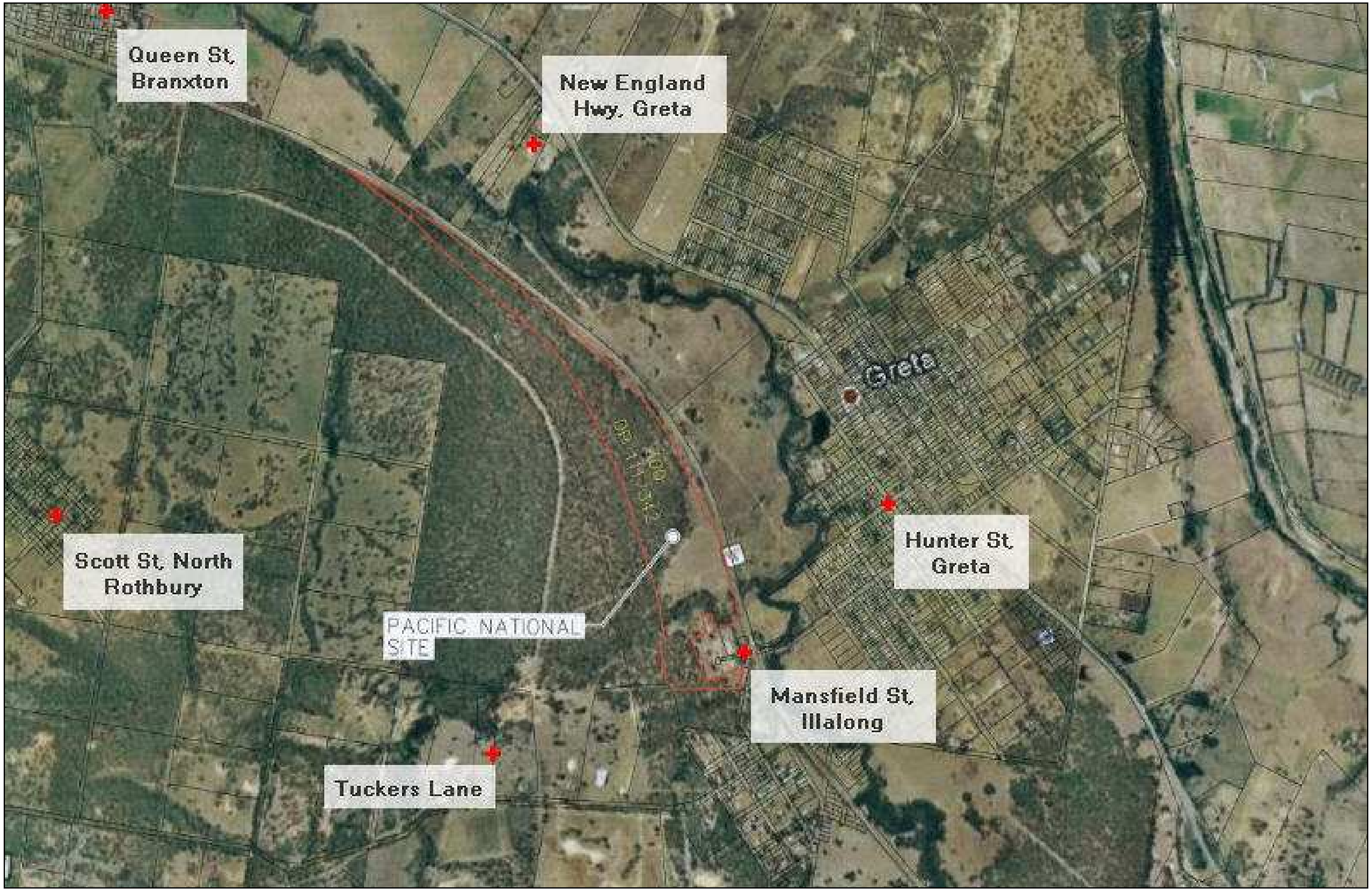


Figure 5: Background monitoring locations

4.2 Noise Monitoring Results

Review of the Cessnock LEP (1989) and the results of operator attended monitoring indicates the receiving environment adjacent to the proposed development is characterised by three (3) distinct receiver types as defined in the INP:

Rural – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:

- an agricultural area, except those used for intensive agricultural activities;
- a rural recreational areas such as resort areas;
- a wilderness area of national park; or
- an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).

This area may be located in either a rural, rural-residential, environment protection zone or scenic protection zone, as defined on a council zoning map (LEP) or other planning instrument.

Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:

- decreasing noise levels in the evening period (1800 to 2200); or
- evening noise levels defined by the natural environment and infrequent human activity;

This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP or other planning instrument.

Urban – an area with an acoustical environment that:

- is dominated by *urban hum* or industrial noise sources;
- has through traffic with characteristically heavy and continuous traffic flows during peak periods; or
- is near commercial districts or industrial districts.

Where *urban hum* means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

This area may be located in either a rural, rural-residential or residential zone, as defined on an LEP of other planning instrument and also includes missed land-use zones such as mixed commercial and residential uses.

A summary of the receiving environments and the receiver types that characterise these environments is provided in **Table 7**.

Table 7: Characterisation of receiving environments

Receiving Environment	Receiver ID	Receiver Type
Greta (east of development)	R1	Urban
Illalong (south-east of development)	R2	Suburban
Tuckers Lane (south of development)	R3	Rural
North Rothbury (west of development)	R4	Rural
Branxton (north-west of development)	R5	Suburban
New England Highway (north of development)	R6	Urban

Receiving environments along the New England Highway around Greta are zoned 1(a) Rural and 2(b) Residential, but are significantly influenced by the passage of traffic at all times during the day and night. These receivers are best characterised as Urban receiver types.

Receiving environments around Branxton and Illalong are zoned 2(a) Residential and 1(c) Rural-residential respectively. These areas are subject to less influence by traffic noise and exhibit decreasing ambient noise levels during the evening and night, and are therefore characterised as Suburban receiver types.

Receiving environments around Tuckers Lane and North Rothbury are zoned 1(a) Rural and 2(b) Residential respectively, but typically experience very low background noise levels defined by the natural environment. These receiving environments are characteristic of the Rural receiver type.

The passage of trains on the existing Northern Railway is audible at all receiver locations. The results of attended monitoring used to characterise the background noise environment are presented in **Appendix II.**

4.2.1 Project Specific Noise Levels

The RBL and Intrusiveness Criteria presented in **Tables 8 to 13** were determined for each monitoring location in accordance with guidelines established in Sections 2 and 3 of the INP. Periods for which the ABL is not presented were omitted from the analysis based on the data exclusion rules outlined in Appendix B of the INP.

4.2.2 Sleep Disturbance Criteria

The sleep disturbance criteria defined in Part 2 of the Noise Guide for Local Government dictate that L_{A1} noise levels do not exceed the L_{A90} background levels by more than 15dB. For the purposes of this assessment background noise levels are considered equal to the Rating Background Level for each of the receiving environments as determined by background noise monitoring.

4.2.2.1 *Background Noise Monitoring – Hunter St, Greta (R1)*

The mean L_{Aeq} and corresponding Amenity Criteria for the Hunter St, Greta monitoring location are presented in **Table 8**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Urban* level from Table 2.1 in the INP.

Table 8: Background noise results – Hunter St, Greta

Time Period	**Day (0700 to 1800)**	**Evening (1800 to 2200)**	**Night (2200 to 0700)**
4/09/2009	-	39.2	-
5/09/2009	39.0	40.3	32.0
6/09/2009	38.0	38.5	30.7
7/09/2009	-	-	31.7
8/09/2009	41.0	38.5	32.7
9/09/2009	43.9	39.0	32.5
10/09/2009	44.0	40.0	33.9
11/09/2009	40.0	43.3	31.0
12/09/2009	39.6	41.5	34.2
13/09/2009	-	41.5	33.5
14/09/2009	38.7	34.5	28.7
15/09/2009	39.0	36.8	31.9
16/09/2009	39.5	36.3	29.0
Rating Background Level (RBL)	40	39	32
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**45**	**44**	**37**
Mean L_{Aeq}	53	50	50
Recommended Acceptable L_{Aeq} Noise Level (Urban)	60	50	45
Amenity Criteria[1]	**60**	**50**	**45**
Project Specific Noise Level	**45**	**44**	**37**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates the night-time noise environment is dominated by the passage of vehicles on the New England Highway. The passage of passenger and heavy vehicles generates noise levels of up to 55 dB(A) in the receiving environment to the south-west of the highway. The impact of trains passing on the northern line is also significant at this location, generating pass by noise levels up to 60 dB(A). Typical pass by times for trains was observed to be on the order of two minutes, dependant on the direction of travel.

4.2.2.2 Background Noise Monitoring – Mansfield St, Illalong (R2

The mean L_{Aeq} and corresponding Amenity Criteria for the Mansfield St, Illalong monitoring location are presented in **Table 9**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Suburban* level from Table 2.1 in the INP.

Table 9: Background noise results – Mansfield St, Illalong

Time Period	Day (0700 to 1800)	Evening (1800 to 2200)	Night (2200 to 0700)
4/09/2009	-	37.0	-
5/09/2009	36.2	38.0	32.5
6/09/2009	35.5	37.5	32.0
7/09/2009	-	-	32.0
8/09/2009	35.0	34.5	31.5
9/09/2009	39.9	35.0	32.2
10/09/2009	40.9	33.5	31.5
11/09/2009	35.0	39.5	30.5
12/09/2009	35.0	36.5	30.5
13/09/2009	-	37.5	31.5
14/09/2009	33.8	34.5	29.5
15/09/2009	35.0	37.0	32.7
16/09/2009	-		
Rating Background Level (RBL)	35	37	32
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**40**	**42**	**37**
Mean L_{Aeq}	56	56	57
Recommended Acceptable L_{Aeq} Noise Level (Suburban)	55	45	40
Amenity Criteria[1]	**55**	**45**	**40**
Project Specific Noise Level	**40**	**40[2]**	**37**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.
2. Evening PSNL set at a level equal to the daytime PSNL in accordance with guidance established in the INP Application Notes

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates the night-time noise environment is dominated by the passage of vehicles on Mansfield Road and the passage of trains on the northern line. Pass by road noise levels of up to 60 dB(A) were observed at residential receivers adjacent to the existing Mansfield Road rail overpass. The passage of trains at this location generates noise levels of up to 68 dB(A) with typical pass by times on the order of 2 minutes. The passage of vehicles on the New England Highway was also audible at this location.

4.2.2.3 *Background Noise Monitoring -Tuckers Lane (R3)*

The mean L_{Aeq} and corresponding Amenity Criteria for the Tuckers Lane monitoring location are presented in **Table 10**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Rural* level from Table 2.1 in the INP.

Table 10: Background noise results – Tuckers Lane

Time Period	Day (0700 to 1800)	Evening (1800 to 2200)	Night (2200 to 0700)
4/09/2009	-	45.2	-
5/09/2009	32.0	41.5	36.7
6/09/2009	31.5	44.5	36.0
7/09/2009	-	-	37.2
8/09/2009	33.0	42.5	37.2
9/09/2009	35.9	41.0	36.2
10/09/2009	39.0	38.8	34.0
11/09/2009	31.2	38.0	34.5
12/09/2009	31.6	41.8	35.2
13/09/2009	-	44.8	37.2
14/09/2009	32.2	41.8	31.5
15/09/2009	32.0	44.5	32.0
16/09/2009	32.0	41.0	30.7
Rating Background Level (RBL)	32	42	36
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**37**	**47**	**41**
Mean L_{Aeq}	56	51	50
Recommended Acceptable L_{Aeq} Noise Level (Rural)	50	45	40
Amenity Criteria[1]	**50**	**45**	**40**
Project Specific Noise Level	**37**	**37[2]**	**37[2]**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.
2. Evening and night PSNL set at a level equal to the daytime PSNL in accordance with guidance established in the INP Application Notes.

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates noise levels are dominated by the natural environment at this location. Trains on the northern line are audible at this location, generating pass by noise levels of 38 to 40dB(A). Heavy vehicles on the New England Highway are also audible in this receiving environment, however only as a distant background source.

4.2.2.4 Background Noise Monitoring – Scott St, North Rothbury (R4)

The mean L_{Aeq} and corresponding Amenity Criteria for the Scott St, North Rothbury monitoring location are presented in **Table 11**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Rural* level from Table 2.1 in the INP.

Table 11: Background noise results – Scott St, North Rothbury

Time Period	**Day (0700 to 1800)**	**Evening (1800 to 2200)**	**Night (2200 to 0700)**
4/09/2009	-	36.8	-
5/09/2009	32.1	32.3	26.3
6/09/2009	31.7	34.2	27.0
7/09/2009	-	-	27.2
8/09/2009	36.0	34.4	28.8
9/09/2009	40.0	35.0	27.3
10/09/2009	40.6	35.1	26.2
11/09/2009	34.5	33.9	25.8
12/09/2009	34.0	31.7	26.7
13/09/2009	-	35.3	26.1
14/09/2009	34.7	29.1	25.0
15/09/2009	31.7	-	
16/09/2009	-	-	-
Rating Background Level (RBL)	34	34	30
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**39**	**39**	**35**
Mean L_{Aeq}	50	48	43
Recommended Acceptable L_{Aeq} Noise Level (Rural)	50	45	40
Amenity Criteria[1]	**50**	**45**	**40**
Project Specific Noise Level	**39**	**39**	**35**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates the background noise environment at this location is dominated by the passage of vehicles on the New England Highway and Wine Country Drive. Pass by levels of up to 43 dB(A) were observed for vehicles on Wine Country Drive, with impacts up to 40 dB(A) from the New England Highway. Trains on the northern line generate noise levels of 40 to 42 dB(A) with pass by times on the order of 3 minutes.

4.2.2.5 Background Noise Monitoring – Queen St, Branxton (R5)

The mean L_{Aeq} and corresponding Amenity Criteria for the Queen St, Branxton monitoring location are presented in **Table 12**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Suburban* level from Table 2.1 in the INP.

Table 12: Background noise results – Queen St, Branxton

Time Period	Day (0700 to 1800)	Evening (1800 to 2200)	Night (2200 to 0700)
4/09/2009	-	39.5	-
5/09/2009	38.0	40.0	32.7
6/09/2009	36.5	40.0	31.0
7/09/2009	-	-	30.7
8/09/2009	39.5	39.0	31.3
9/09/2009	44.0	38.8	33.2
10/09/2009	44.0	38.3	35.5
11/09/2009	39.0	42.0	32.2
12/09/2009	38.5	42.0	33.0
13/09/2009	-	39.8	34.2
14/09/2009	37.5	35.0	28.5
15/09/2009	37.5	36.0	32.0
16/09/2009	38.5	37.3	
Rating Background Level (RBL)	39	39	32
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**44**	**44**	**37**
Mean L_{Aeq}	53	54	50
Recommended Acceptable L_{Aeq} Noise Level (Suburban)	55	45	40
Amenity Criteria[1]	**55**	**45**	**40**
Project Specific Noise Level	**44**	**44**	**37**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates the night-time noise environment is dominated by the passage of vehicles on the New England Highway. The passage of passenger and heavy vehicles generates noise levels of up to 50 dB(A) in the receiving environment to the south of the highway. The impact of trains passing on the northern line is also significant at this location, generating pass by noise levels up to 58 dB(A). Typical pass by times for trains was observed to be on the order of two and a half minutes.

4.2.2.6 *Background Noise Monitoring – New England Highway, Greta (R6)*

The mean L_{Aeq} and corresponding Amenity Criteria for the New England Highway, Greta monitoring location are presented in **Table 13**. The recommended L_{Aeq} noise level used to determine the Amenity Criteria is the *Acceptable Urban* level from Table 2.1 in the INP.

Table 13: Background noise results – New England Highway, Greta

Time Period	**Day (0700 to 1800)**	**Evening (1800 to 2200)**	**Night (2200 to 0700)**
4/09/2009	-	43.1	-
5/09/2009	41.4	42.2	33.2
6/09/2009	39.9	40.7	32.3
7/09/2009	-	-	35.0
8/09/2009	43.1	41.1	33.9
9/09/2009	48.7	43.1	36.3
10/09/2009	47.8	44.9	34.6
11/09/2009	43.3	46.2	32.3
12/09/2009	43.7	45.1	31.9
13/09/2009	-	45.4	32.6
14/09/2009	39.7	37.7	29.4
15/09/2009	40.6	40.6	33.7
16/09/2009	42.0	40.4	32.3
Rating Background Level (RBL)	43	43	33
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**48**	**48**	**38**
Mean L_{Aeq}	55	53	53
Recommended Acceptable L_{Aeq} Noise Level (Suburban)	60	50	45
Amenity Criteria[1]	**60**	**50**	**45**
Project Specific Noise Level	**48**	**48**	**38**

1. Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

Assessment of attended noise monitoring results for this location presented in **Appendix II** indicates the night-time noise environment is dominated by the passage of vehicles on the New England Highway. The passage of vehicles generates $L_{Aeq,15minute}$ noise levels of up to 60 dB(A) in the receiving environment adjacent to the highway. Unattended monitoring results presented in **Appendix I** indicate the receiving environment is subject to rising background noise levels due to increasing traffic volumes from approximately 4:00am. Trains on the northern line are audible at this location, generating noise levels up to 62 dB(A) with pass by times of approximately 90 seconds.

4.3 Project Specific Noise Levels

4.3.1 Non-Residential Sensitive Receivers

Additional non-residential receivers were identified as potentially sensitive to noise impacts associated with the proposed TSF. These receivers (and their corresponding INP defined receiver types) were identified as:

- Greta Public School (Wyndham St) (School Classroom (internal));
- Greta Community Pre-school (Water St) (Passive Recreation Area);
- Greta Arts and Sports Community Hall (Water St) (Passive Recreation Area); and
- various commercial receivers on the New England Highway (Commercial Premises).

The PSNL for these receivers were determined based on data from the background monitoring location in Hunter St, Greta. As the amenity criteria apply only when these receivers are in use, the PSNL were determined only for the following periods:

- Greta Public School – Day period (school only in use at this time);
- Greta Community Pre-school – Day period (only in use at this time);
- Greta Community Hall – Evening period (assumed to be in use during the day or evening);
- Commercial receivers – Night period (may be in use 24hrs per day).

Only the most stringent PSNL is presented for commercial receivers and the Arts and Sport Community Hall as compliance with this criterion means noise imission will comply with all other less stringent criteria. Assessment of the PSNL is presented in **Table 14** to **Table 17.**

4.3.1.1 Analysis of PSNL – Greta Public School

An analysis of the PSNL for Greta Public School is presented in **Table 14**.

Table 14: Assessment of PSNL – Greta Public School

	Day (0700 to 1800)
Rating Background Level (RBL)	40
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)	**45**
Mean L_{Aeq}	53
Recommended Acceptable L_{Aeq} Noise Level (School Classroom)	45[1] (35 internal + 10)
Amenity Criteria[2]	**45**
Project Specific Noise Level	**45**

1 - The NSW Interim Construction Noise Guideline advises that as a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation. An external indicator of 45 dB (internal amenity level + 10dB) is therefore applied to this receiver as a means of assessing noise impacts.

2 - Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP, whereby transportation (road and rail) noise is distinguished from site-specific industrial noise sources. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

4.3.1.2 Analysis of PSNL – Greta Community Pre-School

An analysis of the PSNL for the Greta Community Pre-School is presented in **Table 15**.

Table 15: Assessment of PSNL – Greta Community Pre-school

	Day (0700 to 1800)
Rating Background Level (RBL)	40
Intrusiveness Criteria **$L_{Aeq,15min}$ (RBL +5)**	**45**
Mean L_{Aeq}	53
Recommended Acceptable L_{Aeq} Noise Level (Passive Recreation Area)	50
Amenity Criteria[1]	**50**
Project Specific Noise Level	**45**

1 - Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

4.3.1.3 Analysis of PSNL – Greta Arts and Sport Community Hall

An analysis of the PSNL for the Greta Arts and Sport Community Halll is presented in **Table 16**.

Table 16: Assessment of PSNL – Greta Arts and Sport Community Hall

	Day (0700 to 1800)	**Evening (1800 to 2200)**
Rating Background Level (RBL)	40	39
Intrusiveness Criteria **$L_{Aeq,15min}$ (RBL +5)**	**45**	**44**
Mean L_{Aeq}	53	50
Recommended Acceptable L_{Aeq} Noise Level (Passive Recreation Area)	50 (when in use)	
Amenity Criteria[1]	**50**	**50**
Project Specific Noise Level	**45**	**44**

1 - Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

4.3.1.4 Analysis of PSNL – Commercial Receivers

An analysis of the PSNL for commercial receivers in Greta is presented in **Table 17**.

Table 17: Assessment of PSNL – Commercial receivers

	Day (0700 to 1800)	**Evening (1800 to 2200)**	**Night (2200 to 0700)**
Rating Background Level (RBL)	40	39	32
Intrusiveness Criteria $L_{Aeq,15min}$ (RBL +5)[1]	**n/a**	**n/a**	**n/a**
Mean L_{Aeq}	53	50	50
Recommended Acceptable L_{Aeq} Noise Level (Commercial)		65 (when in use)	
Amenity Criteria[2]	**65**	**65**	**65**
Project Specific Noise Level	**65**	**65**	**65**

1. Intrusiveness Criteria do not apply to commercial or industrial receivers according to INP Application Notes.

1 - Existing mean L_{Aeq} noise levels are not considered to contain any contribution from industrial noise sources in accordance with provisions of Section 2.2 of the INP. The amenity criteria are therefore equal to the acceptable noise level for the receiver type.

4.3.2 Summary of Project Specific Noise Levels

A summary of the project specific noise levels for residential and non-residential receivers is presented in **Table 18** and **Table 19** respectively. The PSNL for all receivers and receiving environments were determined in accordance with provisions established in the NSW Industrial Noise Policy.

Table 18: Summary of project specific noise levels for residential receivers, dB(A)

		Intrusiveness Criteria ($L_{Aeq,15minute}$)			**Amenity Criteria ($L_{Aeq,period}$)**			**Sleep Disturbance**
Receiving Environment	**ID**	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	
Greta (east of development)	R1	45	44	37	60	50	45	47
Illalong (south-east of development)	R2	40	40[1]	37	55	45	40	47
Tuckers Lane (south of development)	R3	37	37[1]	37[1]	50	45	40	51
North Rothbury (west of development)	R4	39	39	35	50	45	40	45
Branxton (north-west of development)	R5	44	44	37	55	45	40	47
New England Highway (north of development)	R6	48	48	38	60	50	45	48

1. PSNL for evening and night periods adjusted such as to not exceed PSNL for the less sensitive daytime period in accordance with guidelines established in the INP Application Notes.

Table 19: Summary of project specific noise levels for non-residential receivers, dB(A)

	Project Specific Noise Level[1]		
Receiver	**Day**	**Evening**	**Night**
Greta Public School	45	n/a	n/a
Greta Community Pre-School	45	n/a	n/a
Greta Arts and Sport Community Hall	45	44	n/a
Commercial Receivers	65	65	65

1 - Averaging times for L_{Aeq} PSNL vary with receiver type in accordance with provisions established in Table 2.1 of the INP. For the purposes of this assessment, the PSNL for non-residential receivers are considered in terms of $L_{Aeq,15minute}$ noise level as this represents the most conservative assessment of impacts.

It should be noted that the sleep disturbance criteria do not apply to non-residential receivers as they are not considered to be in use during the night period.

The intrusiveness criterion was found to be the limiting criterion for all receiving environments with the exception of the Rural areas off Tuckers Lane and commercial receivers in Greta. The intrusiveness criterion is based on measured background (L_{90}) noise level at each of the receiver locations and would be subject to change in response to any changes in the character of the ambient noise environment.

For the purposes of this assessment, NSW DoP requires analysis of the cumulative impacts of the Hunter Expressway extension and construction of a third rail line between Maitland and Minimbah. **Figure 6** shows the approximate location of these infrastructure projects in relation to the proposed TSF. The amenity criteria for each of the receiving environment are also presented in **Table 18** for the purposes of assessing impacts from multiple developments.

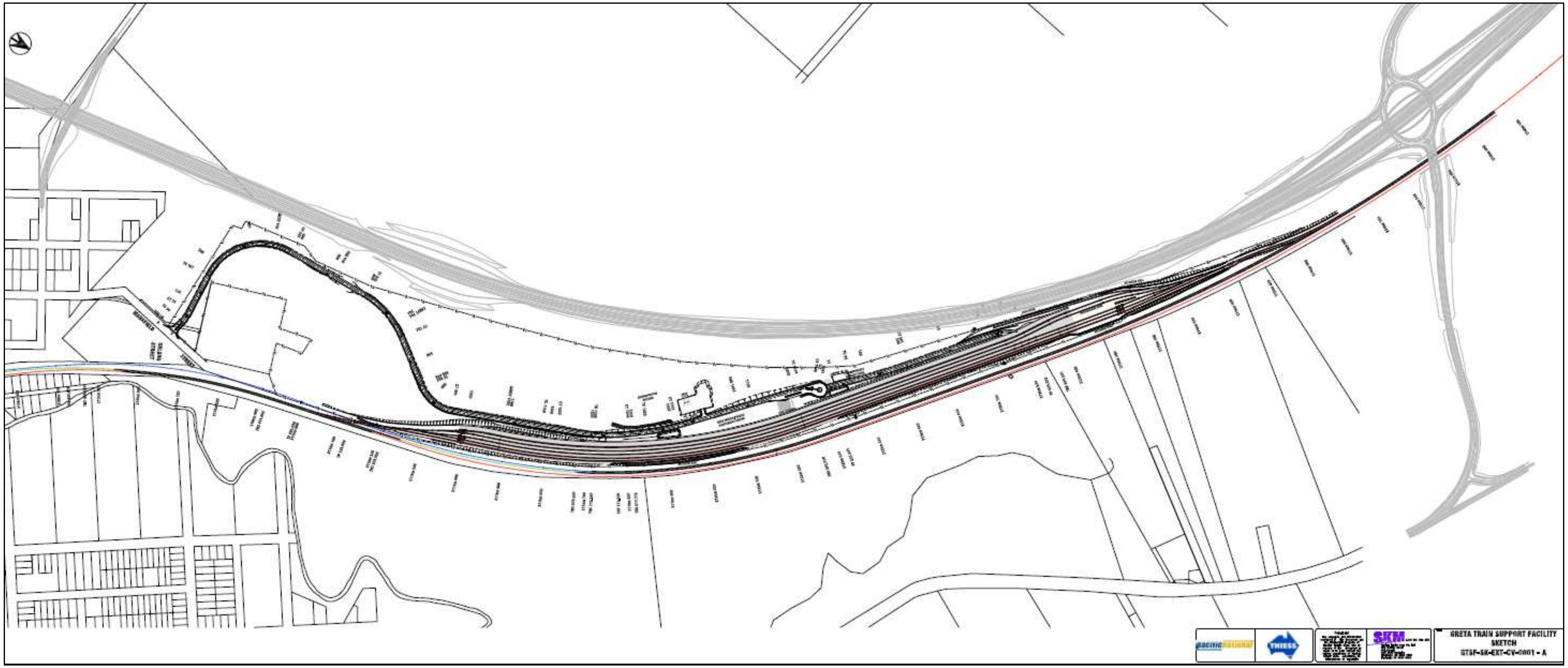


Figure 6: Location of proposed TSF, Hunter Expressway and Maitland to Minimbah Third Track

5. METEOROLOGICAL IMPACTS

5.1 Significance of Meteorological Impacts

Review of meteorological monitoring data representative of Greta was undertaken for the purposes of identifying any significant prevailing meteorology with potential to adversely impact on the propagation of noise from the proposed development. Section 5 of the INP considers a prevailing meteorological scenario to be significant if it is observed more than 30% of the time during an assessment period (day, evening or night) during any season.

5.2 Assessment of Meteorological Impacts

Meteorological data from the Bureau of Meteorology (BoM) Automatic Weather Station (AWS) at Cessnock was analysed for the purposes of identifying significant meteorological conditions that may affect the Greta locality. The Cessnock AWS is located approximately 15km to the south of Greta.

5.2.1 Gradient Winds

Analysis of seasonal wind data was undertaken for the purposes of identifying prevailing gradient winds that may enhance the propagation of noise from the development. The presence of gradient winds is considered significant when wind speeds less than 3 m/s at 10 metres height are observed to occur more than 30% of an assessment period in any season. Seasonal wind roses for the day, evening and night assessment periods are presented in **Appendix III.** A summary of significant gradient winds is provided in **Table 20**.

Table 20: Summary of significant meteorology

	Wind Direction ± 22.5°, Wind Speed <3m/s, Frequency ≥ 30%		
Season	**Day**	**Evening**	**Night**
Autumn	Nil	S (31%)	SE (30%), S (57%), **SW (55%)**, W (36%)
Winter	Nil	S (30%), **SW (30%)**	S (44%), **SW (48%)**, W (40%)
Spring	Nil	Nil	S (50%), **SW (49%)**, W (32%)
Summer	Nil	Nil	SE (34%), **S (47%)**, SW (41%)

5.2.2 Temperature Inversions

Analysis of Pasquill Gifford atmospheric stability classes was undertaken in accordance with the methodology provided in Appendix E of the INP. This methodology was used to assess atmospheric stability during the night period based on daytime stability classes, wind speed and sigma theta results. The results presented in **Figure 7** indicate that F and G stability classes (indicative moderate to strong inversions) occur more than 30% of the night period during winter. Consequently, assessment of impacts of temperature inversions on noise propagation will be included in detailed impact modelling.

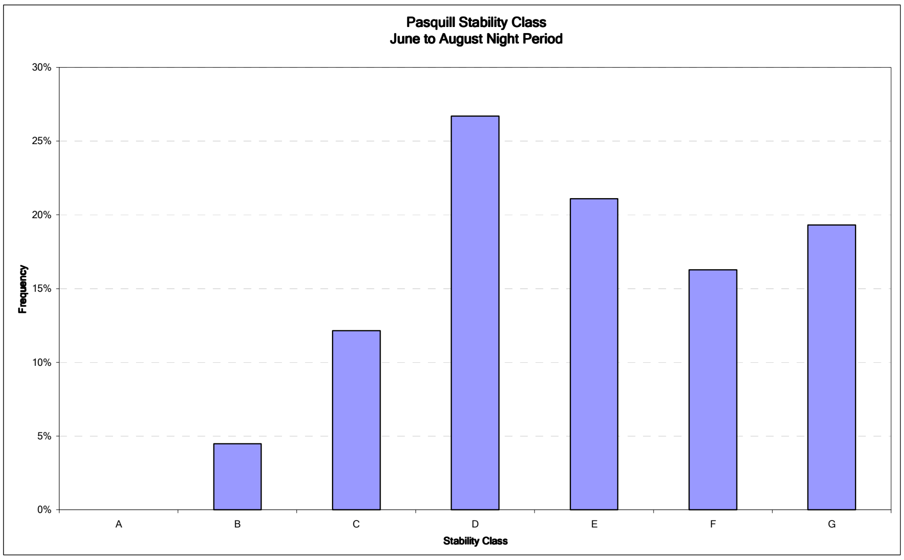


Figure 7: Winter night time atmospheric stability classes, Cessnock AWS

5.3 Meteorological Scenarios for Noise Impact Prediction

The results presented in **Section 4.2** indicate some meteorological scenarios occur with sufficient frequency that consideration of their potential influence on noise propagation be considered as part of the Noise Impact Assessment. Meteorological scenarios to be included as part of impact modelling are summarised in **Table 21**.

Table 21: Meteorological input parameters

Scenario	Period	Air Temperature	Relative Humidity	Wind Speed	Vertical Temperature Gradient
Neutral	All	18°C	60%	0 m/s	0°C / 100m
Adverse Summer, Spring, Autumn	Evening and Night	12°C	75%	3 m/s	0°C / 100m
Adverse Winter	Evening and Night	6°C	90%	0 m/s	3°C / 100m

The INP provides default meteorological parameters for the assessment of temperature inversion impacts of 3°C / 100m lapse rate with 2m/s drainage flow. For the purposes of this assessment no drainage flow will be modelled as the development is located at the bottom of a gully and any drainage flow would likely be towards the source. The impact of temperature inversions on the propagation of noise will therefore be modelled on neutral wind conditions.

6. OPERATIONAL NOISE IMPACTS

6.1 Modelling Methodology

Prediction of the cumulative $L_{Aeq,15minute}$ noise level resulting from the proposed development was undertaken by modelling noise sources using the Environmental Noise Model (ENM) software. ENM calculates the noise level at specified receiver locations (Single Point Calculation) and generates noise level contours over a defined area (Contour Calculation).

The predicted cumulative $L_{Aeq,15minute}$ noise levels are then compared against the project-specific noise levels. If the project-specific noise levels are exceeded, feasible and reasonable noise mitigation strategies will need to be assessed for the proposed development, to ensure compatibility with the existing noise environment. If the proposed development can achieve the project-specific noise levels during the night time period it will also achieve the less stringent day and evening criteria.

6.2 Noise Sources

The modelled impact of the proposed operation was based on the Sound Power Level (SWL) and location of noise sources within the project, consistent with the site arrangement provided in (**Figure 3**). The purpose of this assessment is to provide detailed analysis of potential noise impacts and identify conflicts with the existing noise environment. The third octave SWLs applied to the model are based on measurements made of existing Pacific National operations and surrogate processes that are considered representative of stationary noise sources that comprise the proposed operation. The representative noise sources used in the model are presented in **Table 22**.

Table 22: Representative source noise levels

Description	SWL, dB(lin)
Idling locomotive (per unit)	112
Locomotive and wagon set (passby)	108
Idling semi-trailer	106
Light vehicles on internal roadway	98
Heavy vehicles on internal roadway	112
Maintenance workshop operations	99
Wash-bay operations	100

The model presents a worst case noise impact for Stage 3 operations, comprising:

- an idling locomotive set (3 x locomotives) in the provisioning shed on tracks 1 to 3;
- an idling locomotive set to the south of the provisioning shed on tracks 4 and 5;
- one train entering the site via the arrival road and internal track No.1;
- one train leaving the site via internal track No.2 and the departure road;
- operations within maintenance workshop and wash bay buildings;
- vehicle movements (light and heavy vehicles) on internal roadways; and
- idling semi-trailer pumping fuel to storage tanks.

It should be noted that while the impact predictions are made on the basis of the $L_{Aeq,15minute}$ criteria, this level of activity is unlikely to occur simultaneously in any given 15 minute period. The maximum expected level of site activity for Stage 3 operations includes 25 train movements and 5 fuel deliveries per day, and 4 light vehicle movements per hour. On this basis the model predictions will likely overestimate the impacts associated with the development as emissions from these sources will rarely occur at the same time. Furthermore, level of site activity will vary throughout the day, resulting in extended periods of reduced noise emissions from the operation.

6.3 Assumptions of the Model

The following assumptions are made with regards to the operations stage noise model:

- the SWL for idling locomotives are based on measurements of stationary 82 class locomotives carried out at the Hunter Bulk Terminal (HBT) Port Waratah operations. The SWL for this source was time weighted assuming operation for the full duration of the 15 minute assessment period. A locomotive set was assumed to comprise three (3) individual locomotive units. The SWL for this source contains a +5dB modifying factor for tonal characteristics detected during 1/3 octave analysis;
- the SWL for trains entering the TSF from the main northern line are based on pass by measurements of locomotives and empty wagon sets within the unloading yard at HBT Kooragang Island operations. The SWL for this source was time weighted assuming a typical pass by time of 3 minutes and 30 seconds during any 15 minute assessment period. This pass by time assumes a train length of 1500m and an average speed of 25km/h. The SWL for this source contains a +5dB modifying factor for tonal characteristics detected during 1/3 octave analysis;
- all trains enter the site via the arrival and internal track before proceeding directly to the provisioning shed. Locomotive sets on tracks 1 to 3 are to be contained entirely within the provisioning shed and stationary locomotives on tracks 4 and 5 are located to the south of the provisioning shed to such that the tail end of trains do not block track access to internal track junctions. The modelled SWL for locomotives within the provisioning shed was adjusted to account for transmission losses through the building. Pending advice on the final design of these structures, it was assumed that buildings are constructed of colourbond sheeting mounted on a steel frame. This is likely to provide a conservative assessment of actual transmission loss depending on the final construction of the building structures;
- impact predictions for traffic movements on internal roadways within the site are based on pass by L_{Aeq} noise levels for vehicles travelling at 50km/h. The SWL for this source is based on the predicted maximum number of hourly vehicle movements for Stage 3 operations and assumes:
  - 1 heavy vehicle movement per 15 minute assessment period during the day;
  - 4 light vehicle movement per 15 minute assessment period during the night;
- impact predictions assume heavy vehicles do not access the site between the hours of 22:00 and 7:00;
- the SWL for the idling semi-trailer delivering fuel to the tank farm is based on octave SPL provided for assessment of common noise sources on construction sites (DEFRA 2005). The SWL for this source was time weighted assuming operation for the full duration of the 15 minute assessment period. It is also assumed unloading point is located to the west of the tank farm and that the storage tank structures will act as a barrier to noise emissions to the east of the site;

- the SWL for the maintenance shed and wash-bay sources account for transmission losses attributable to the buildings in which these operations are housed. Pending advice on the final design of these structures, it was assumed that buildings are constructed of colourbond sheeting mounted on a steel frame. This is likely to provide a conservative assessment of actual transmission loss depending on the final construction of the building structures. The SWLs for these sources are time weighted assuming operation for the full duration of the 15 minute assessment period; and
- two rail emission source heights were considered relevant to the model. Emissions from wheel / rail interaction were modelled at a height equal to RL +0.5m and emissions from engine (including cumulative impacts of cooling fans and exhaust) were modelled as a height equal to RL +3.5m. Adjustments of -5.5dB and -1.5dB for wheel /rail and engine noise (respectively) were made from total noise levels based on data presented by Wearne and Weber (2004);
- emissions associated with light vehicles on the site access road were modelled with source heights of RL +0.5m. Adjustments were made to total source noise levels for heavy vehicles to account for multiple points of emission, including:
  - RL + 0.5m for tyre noise (adjustment = total – 5.4dB);
  - RL + 1.5m for engine noise (adjustment = total – 2.4dB); and
  - RL + 3.5m for exhaust noise (adjustment = total – 8.5dB).
- the emission height for all operational noise sources was assumed to be equal to the final site RL + 3.5 metres;
- the results presented are based on an amended version of the model (presented in the Revision 4 NIA) to account for changes to the proposed development, including an alternate alignment for the site access road, and removal of the wheel lathe process and crippled wagon sidings. The noise model is representative of the preferred project arrangement at October 2010; and
- where presented, impact predictions for daytime operations are provided for comparison, and include impacts associated with heavy vehicle access to the facility via Mansfield Road and the site access road.

6.3.1 Modifying Factor

The results presented in **Section 6.4** include a +5 dB modifying factor correction for tonal noises detected during analysis of 1/3 octave sound pressure levels, in accordance with Table 4.1 of the INP.

6.4 Results

Preliminary modelling results presented in **Table 23** indicate noise impacts generated by the proposed development may exceed the PSNL in some receiving environments. It should be noted that additional receiver points were modelled for receivers located:

- in the hamlet of Illalong (R2(a)); and
- on the New England Highway at Greta (R6(a)).

The PSNL for these locations was assumed the same as at background monitoring locations for these receiving environments.

Table 23: Predicted $L_{Aeq,15minute}$ noise level, dB(A) (without mitigation)

Description	R1	R2	R2(a)	R3	R4	R5	R6	R6(a)
Day Period Operations								
Neutral Conditions	34	**48**	40	<30	<30	<30	34	34
Night Period Operations								
Neutral Conditions	32	**39**	32	<30	<30	<30	34	34
Adverse Spring / Summer / Autumn	34	**38**	30	<30	<30	<30	**40**	**42**
Adverse Winter	35	**41**	36	30	<30	<30	38	**39**
Ambient $L_{Aeq(night)}$ Noise Level	50	57		50	43	50	53	
PSNL Day (0700-1800)	45	40		37	39	44	48	
Evening (1800-2200)	44	40		37	39	44	48	
Night (2200-0700)	37	37		37	35	37	38	

6.4.1 Review of On-site Traffic Noise Impacts

Review of modelling results indicates traffic noise impacts associated with internal vehicle movements are likely to significantly exceed the PSNL in the receiving environment adjacent to the site access. While the impact is likely to be restricted to peak periods, the extent and frequency of the impact was considered significant to the community, particularly during the early morning shoulder period.

An investigation into the efficacy of potential mitigation options was undertaken as a means of assessing ways in which impacts associated with vehicle movements on the site access road may be managed at the planning stage of the development. Preliminary investigation suggested operational controls to restrict heavy vehicle access to the day period would reduce impacts, however exceedence of the PSNL may still occur under worst case meteorological conditions.

A detailed noise model was constructed such that discrete impacts at each of the (existing and undeveloped) receivers adjacent to the access road could be better understood as shown in **Figure 8**.

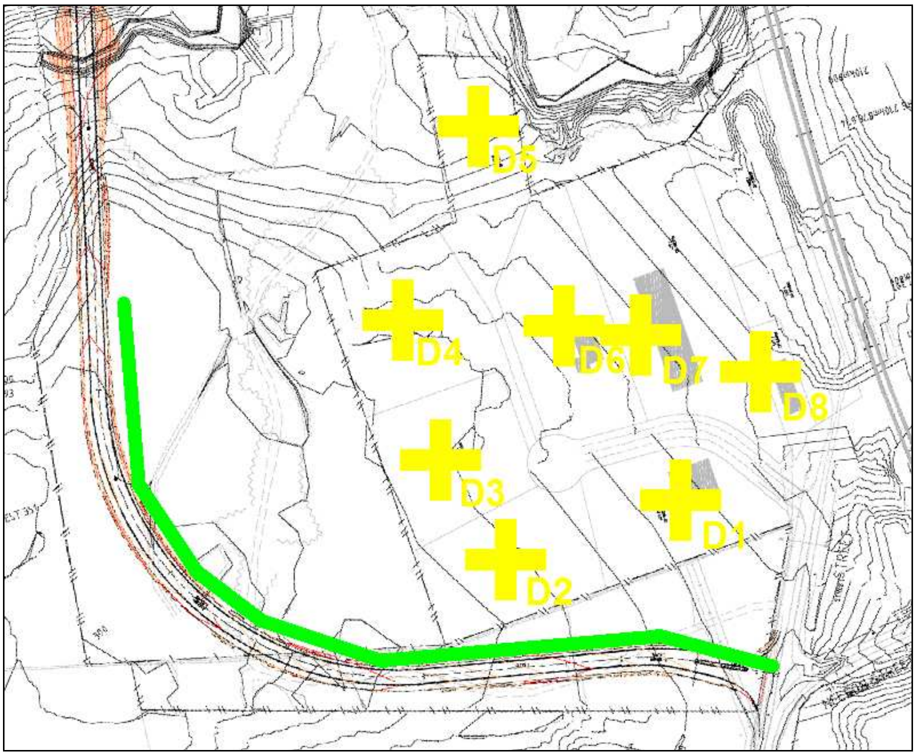


Figure 8: Detailed site access model

Preliminary mitigation design was undertaken, indicating impacts associated with both light and heavy vehicle movements could be ameliorated against their respective (night and day) criteria. However advice relating to environmental and engineering constraints at this location (following preliminary design) initiated further review of potential engineered mitigation strategies. The results of this assessment are provided in **Table 24**.

Table 24: Predicted worst case $L_{Aeq,15minute}$ internal traffic noise level, dB(A)

Description	D1	D2	D3	D4	D5	D6	D7	D8
Day Period Operations								
Unmitigated	**53**	**55**	**52**	**50**	**48**	**48**	**48**	**48**
4m barrier	40	**42**	40	38	35	37	37	36
2m barrier	**46**	**49**	**47**	**45**	**41**	**43**	**43**	**43**
Night Period Operations								
Unmitigated	**40**	**44**	**39**	35	**42**	34	35	36
4m barrier	30	33	30	<30	<30	<30	<30	<30
2m barrier	36	**39**	36	35	33	34	34	33
Ambient $L_{Aeq(night)}$ Noise Level				57				
PSNL Day (0700-1800)				40				
Evening (1800-2200)				40				
Night (2200-0700)				37				

The results of this investigation indicate that night period impacts from internal road noise may be ameliorated at 7 of the 8 receivers by:

- implementing controls to restrict heavy vehicle access to the site to the day period; and
- construction of a barrier between the roadway and adjacent receivers to mitigate emissions from vehicles accessing the site. The barrier should commence immediately to the north of the site access gate and follow the eastern shoulder of the roadway to the top of the approach to the Sawyers Creek crossing (**Figure 8**). The barrier will be approximately 500 metres long and RL+2m in height. The top of the barrier should be located as close as is practicable to the shoulder of the roadway in order to maximise its efficacy.

While the results presented in **Table 24** indicate greater rates of mitigation may be achieved through the construction of an RL +4m barrier, site constraints dictate the footprint of such a barrier would be difficult to accommodate. Construction of an RL +2m barrier will effectively mitigate night period noise impacts at all but one of the adjacent receivers, and while exceedence of the day period criteria is anticipated, it is considered this may be managed by negotiation with the NSW Department of Planning and affected landowners where required.

6.4.2 Review of Rail Noise Impacts

Analysis of impacts under the mitigated road noise contribution scenario indicates potential impacts of trains entering the site and approaching the provisioning shed may continue to generate noise levels above the PSNL for receivers on Mansfield Road. Further analysis presented in **Table 25** indicates the impact from rail sources may be reduced by the construction of a 4m high barrier adjacent to the arrival road. These results indicate exceedence of the night period PSNL may occur under temperature inversion conditions despite construction of a 4m barrier at the (rail) arrival road.

Table 25: Predicted $L_{Aeq,15minute}$ noise level, dB(A) (barriers at road and rail access)

Description	R1	R2	R2(a)	R3	R4	R5	R6	R6(a)
Day Period Operations								
Neutral	33	**45**	40	< 30	< 30	< 30	34	34
Night Period Operations								
Neutral Conditions	32	**38**	32	< 30	< 30	< 30	34	34
Adverse Spring / Summer / Autumn	36	**38**	< 30	< 30	< 30	< 30	**40**	**42**
Adverse Winter	36	**40**	36	< 30	< 30	< 30	38	**39**
Ambient $L_{Aeq(night)}$ Noise Level	50	57		50	43	50	53	
PSNL Day (0700-1800)	45	40		37	39	44	48	
Evening (1800-2200)	44	40		37	39	44	48	
Night (2200-0700)	37	37		37	35	37	38	

Further review of source classification was undertaken to determine the requirements for design of additional mitigation of noise generated by locomotives entering the facility. This investigation sought to better define differences between existing rail sources and those that would be introduced by the facility. Section 6.1 of the INP provides guidance relating to parameters that should be included in industrial noise impact modelling, including:

"All noise sources related to the proposed development, including vehicles that operate on-site;"

It is considered that trains entering the site and approaching the provisioning shed, while within the boundary of the project site, do not represent a noise source specific to the proposed development as this traffic would (in the absence of the facility) pass-by the site. While this source is considered independent of the proposed development, TSF operations will positively impact on noise generated by this source as trains approaching the provisioning shed will be travelling at reduced speed, and therefore generate lower levels of noise than existing main-line pass-by events. This will effectively reduce ambient noise levels in receiving noise environments around Greta.

Rail movements within the TSF would only be considered additional to existing impacts after such time as train-sets come to a stop at the provisioning shed. On the basis of this assessment, it is considered new rail sources introduced by the TSF would include:

- movement of locomotives on internal track to and from the maintenance shed or wash-bay;
- idling locomoitves in or adjacent to the provisioning shed; and
- trains departing the site and re-entering the main rail corridor to the north of the facility.

While trains entering the facility and approaching the provisioning shed are not considered to represent a new L_{Aeq} source of noise, it is acknowledged this activity may induce changes in the character of the noise emission as trains navigate track junctions. It is considered these sources may introduce new peak (L_{A1}) characteristics which should be assessed as a new noise source in accordance with provisions of the INP. Detailed assessment of these impacts is presented in **Section 7**.

Further amendments to the noise model were undertaken to provide an impact assessment representative of noise generated only by new sources that will be introduced by the proposed TSF. This assessment excludes impacts associated with trains entering the site and approaching the provisioning shed as presented in **Table 25**. The results of this assessment are provided in **Table 26**. **Figure 9** to **Figure 11** show the predicted noise level contours for each of the scenarios outlined in **Table 26.**

Table 26: Predicted $L_{Aeq,15minute}$ noise level, dB(A) (mitigated in absence of rail arrivals)

Description	R1	R2	R2(a)	R3	R4	R5	R6	R6(a)
Day Period Operations								
Neutral Conditions	31	**46**	40	< 30	< 30	< 30	33	< 30
Night Period Operations								
Neutral Conditions	<30	32	<30	<30	<30	<30	32	<30
Adverse Spring / Summer / Autumn	31	33	<30	<30	<30	<30	38	31
Adverse Winter	30	32	31	<30	<30	<30	35	<30
Ambient $L_{Aeq(night)}$ Noise Level	50	57		50	43	50	53	
PSNL Day (0700-1800)	45	40		37	39	44	48	
Evening (1800-2200)	44	40		37	39	44	48	
Night (2200-0700)	37	37		37	35	37	38	

Results of this assessment indicate that impacts associated with new sources introduced by the proposed TSF comply with the night period PSNL for all receiving environments under all meteorological conditions.

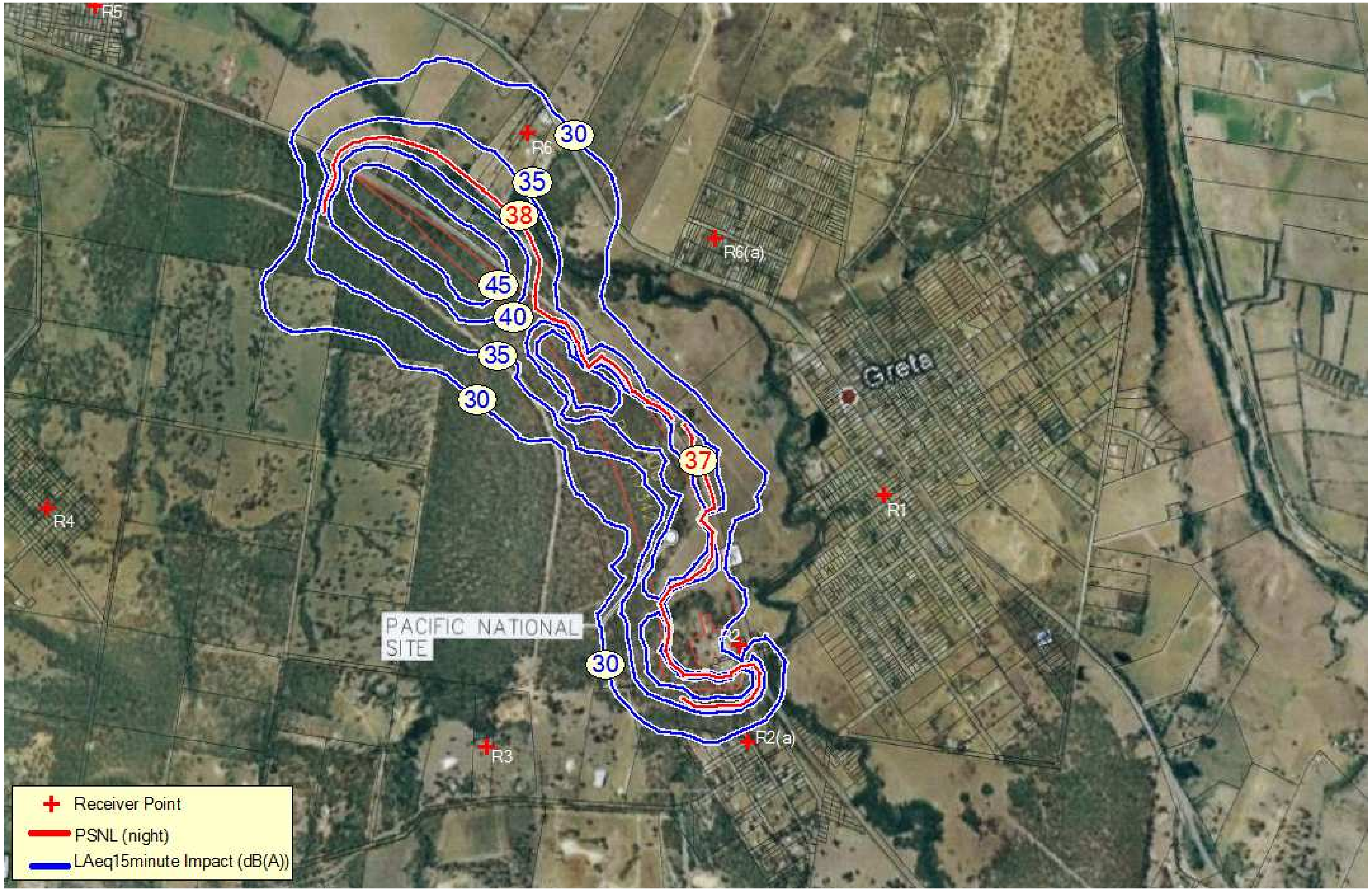


Figure 9: Predicted $L_{Aeq,15minute}$ noise level, neutral conditions

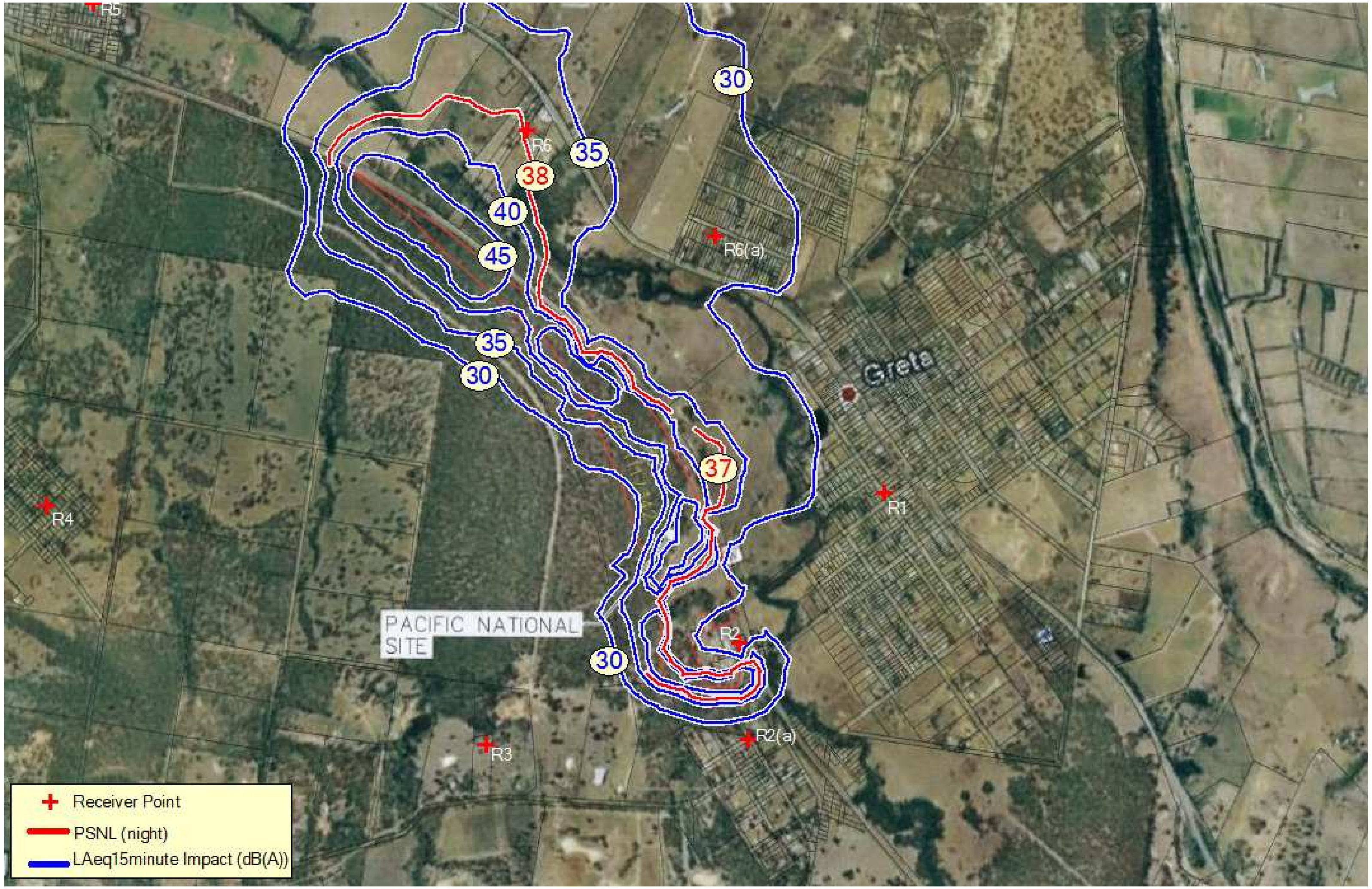


Figure 10: Predicted $L_{Aeq,15minute}$ noise level, adverse SSW winds

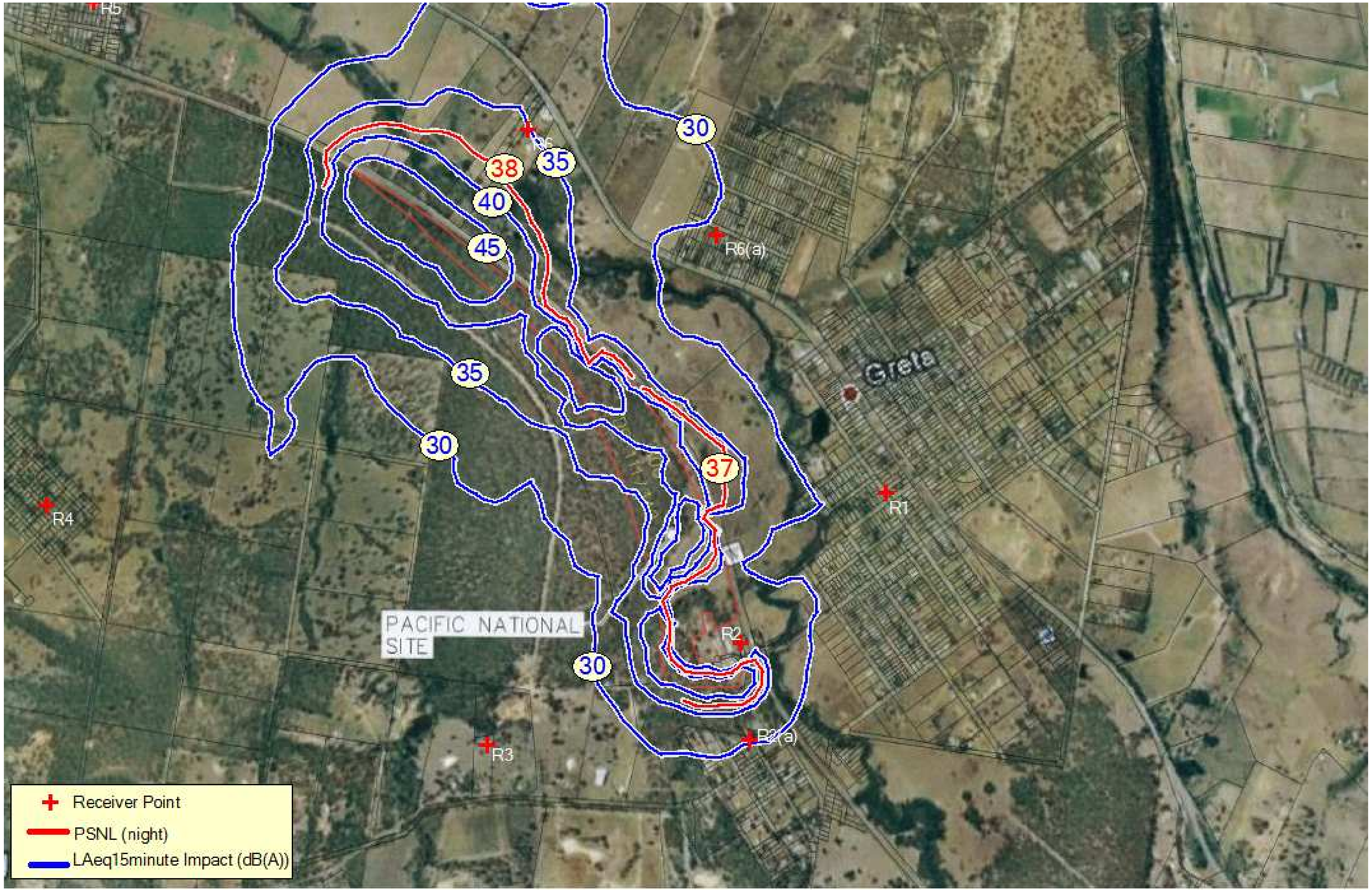


Figure 11: Predicted $L_{Aeq,15minute}$ noise level, adverse Winter conditions

6.5 Interpretation of Modelled Impact Predictions

6.5.1 Greta Receiving Environment (R1)

The results presented in **Section 6.4** indicate that noise impacts will comply with the PSNL criteria for all receivers in the Greta receiving environment under all significant meteorological conditions. The model indicates the proposed development will comply with the day, evening and night time criteria for Stage 3 operations.

6.5.2 Illalong Receiving Environment (R2)

The results presented in **Section 6.4** indicate that Stage 3 noise impacts will comply with the night period PSNL for all (existing and future) receivers in the Illalong receiving environment under all significant meteorological conditions.

Exceedence of the day period PSNL may occur at receivers immediately adjacent to the site access road, however it is considered this may be ameliorated through implementation of mitigation strategies as discussed in **Section 6.4.1**.

6.5.3 Tuckers Lane Receiving Environment (R3)

The results presented in **Section 6.4** indicate that noise impacts will comply with the PSNL criteria for all receivers in the Tuckers Lane receiving environment under all significant meteorological conditions. The model indicates the proposed development will comply with the day, evening and night time criteria for Stage 3 operations.

6.5.4 North Rothbury Receiving Environment (R4)

The results presented in **Section 6.4** indicate that noise impact will comply with the PSNL criteria for all receivers in the North Rothbury receiving environment under all significant meteorological conditions. The model indicates the proposed development will comply with the day, evening and night time criteria for Stage 3 operations.

6.5.5 Branxton Receiving Environment (R5)

The results presented in **Section 6.4** indicate that noise impact will comply with the PSNL criteria for all receivers in the Branxton receiving environment under all significant meteorological conditions. The model indicates the proposed development will comply with the day, evening and night time criteria for Stage 3 operations.

6.5.6 New England Highway Receiving Environment (R6)

The results presented in **Section 6.4** indicate that noise impact will comply with the PSNL criteria for all receivers in the New England Highway receiving environment under all significant meteorological conditions. The model indicates the proposed development will comply with the day, evening and night time criteria for Stage 3 operations.

6.5.7 Assessment of Impacts at Non-Residential Receivers

Review of impact predictions presents in **Figure 9** to **Figure 11** indicates Stage 3 operations impacts are likely to be well below the PSNL for all non-residential receivers identified in **Section 4.3.1**.

6.5.8 Assessment of Impacts above the PSNL

Table 27 provides an assessment of the number of receivers likely to experience noise impacts above the PSNL during Stage 3 operations.

Table 27: Quantification of impacts above the night period PSNL, Stage 3 operations

Receiving Environment	Neutral	Adverse Spring / Summer / Autumn	Adverse Winter
Greta	0	0	0
Mansfield Rd (at access road)	0	1	1
Illalong	0	0	0
Tuckers Lane	0	0	0
North Rothbury	0	0	0
Branxton receiving	0	0	0
New England Highway (Greta)	0	0	0
Total	0	1	1

Table 27 indicates one receiver adjacent to the site access may experience noise impacts above that of the night period PSNL following introduction of new noise sources associated with TSF operations. It should also be noted the impacted receiver is the Lot closest to the access road and is currently undeveloped. This assessment assumes implementation of works to mitigate operational noise impacts as discussed in **Section 6.4.1.**

6.5.8.1 Assumptions of the Assessment

Receivers were identified from cadastral data overlain on aerial photography of the receiving environment adjacent to the proposed TSF. Discrete receivers were considered to be any lot (developed or undeveloped) located in areas zoned either 1(a) Rural, 1(c) Rural Residential and 2(b) Village under provisions established in the Cessnock LEP 1989. The counts are considered to provide a conservative estimate of the actual number of receivers likely to experience impacts exceeding the PSNL, as this assessment:

- assumes all identified lots have been, or are to be developed;
- applies no corrections to account for lots that contain commercial, open space or other non-residential land-use activities;
- considers only the contribution from the TSF and applies no corrections for localised noise impacts that may mask noise emissions from the TSF; and
- applies no corrections for barrier effects generated by building structures that may locally attenuate noise levels at receivers.

7. SLEEP DISTURBANCE NOISE IMPACTS

The Noise Guide for Local Government suggests that to avoid sleep disturbance, the L_{A1} noise level associated with the source (that is the noise level which is exceeded for one per cent of the time) should not exceed the background noise level by more than 15 dB.

7.1 Sleep Disturbance Noise Criteria

Using the RBL as a guide, the corresponding maximum noise level to avoid sleep disturbance at adjacent residential receivers during the night period is presented in **Table 28**.

Table 28: Sleep disturbance criteria

Receiving Environment	RBL (night) dB(A)	Sleep Disturbance Criteria, dB(A)
Greta (east of development)	32	47
Illalong (south-east of development)	32	47
Tuckers Lane (south of development)	36	51
North Rothbury (west of development)	30	45
Branxton (north-west of development)	32	47
New England Highway (north of development)	33	48

7.2 Assessment of Transient Noise Impacts

Transient noise sources contributing to L_{A1} noise levels generated by the proposed facility are likely to be generated by bunching and stretching of wagons when trains are stopping, starting or shunting. The passage of vehicles on the internal roadways at night will also generate transient noise events.

7.2.1 Transient Rail Noise

The predicted noise level that would contribute to sleep disturbance was modelled based on the difference between measured L_{Aeq} and L_{A1} noise levels from unattended monitoring data from the Hunter Bulk Terminal (HBT) operations at Kooragang Island. The results of this monitoring are presented in **Figure 12**. A summary of the monitoring results are presented in **Table 29.** Analysis of monitoring data indicates that on average L_{A1} noise levels exceed L_{Aeq} noise levels by approximately 7dB(A).

Table 29: Sleep disturbance criteria

	L_{A1} - L_{Aeq} Differential
50th percentile	7 dB(A)
95th percentile	12 dB(A)

The *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (DECC 2007) suggests that transient noise generated by rail traffic be assessed in terms of the 50th and 95th percentile L_{Amax} noise level. While it is acknowledged that the *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* does not apply to the assessment of noise from rolling stock maintenance facilities, as the character of noise generated by train pass by and wagon movements is similar, application of the 95th percentile difference between L_{Aeq} and L_{A1} noise levels is considered an appropriate indicator of transient noise impact for the proposed development. This represents a more conservative approach than provided by the INP, which typically considers the distribution of potential impacts by requiring assessment of 90th percentile noise levels.

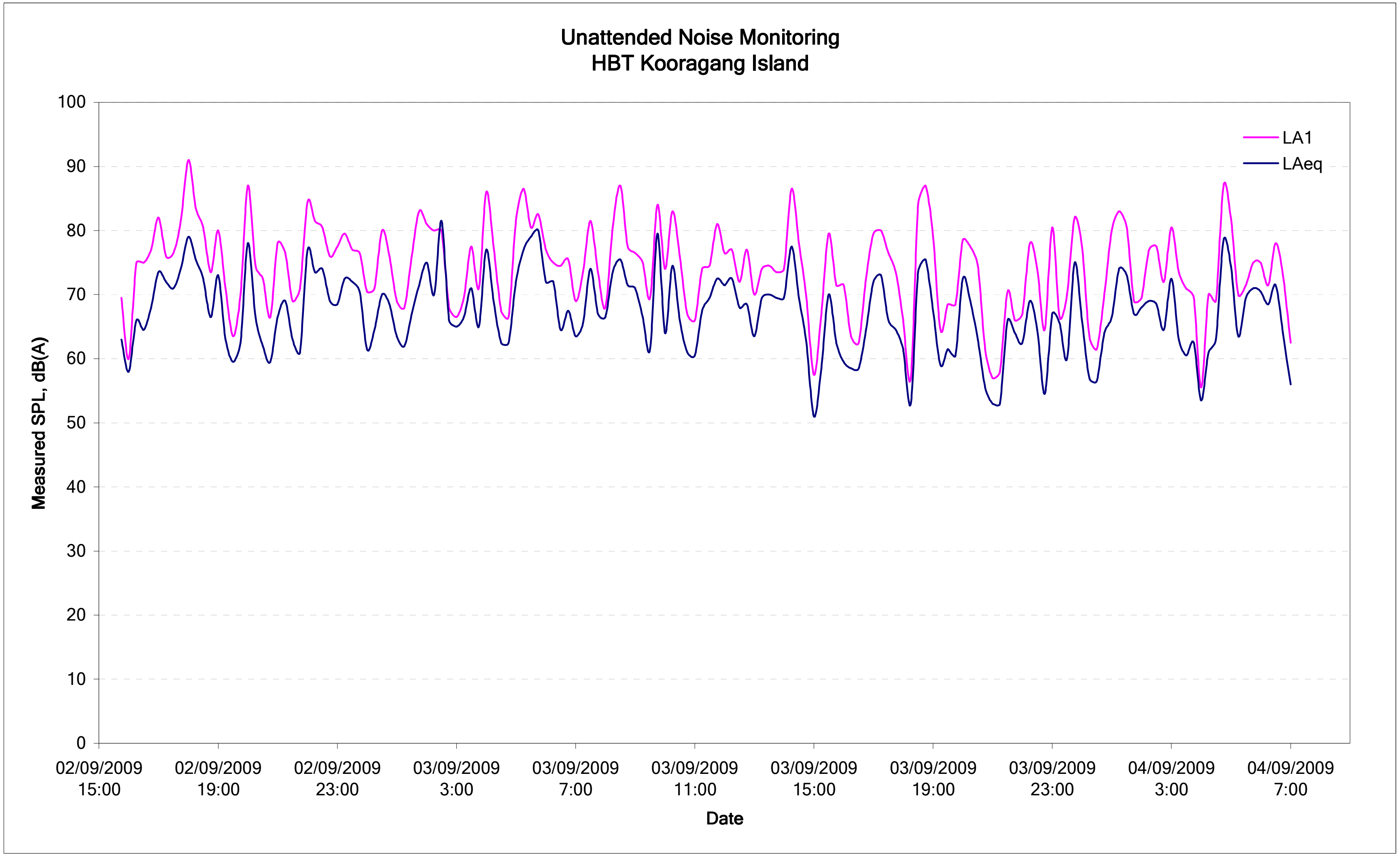


Figure 12: Unattended noise monitoring results, HBT operations Kooragang Island

It should also be noted the stabling yard and provisioning facilities at the HBT Kooragang Island site are subject to very little topographic relief which would enhance the prevalence of bunching and stretching of wagons as trains stop and start. Information available at the time of the assessment indicates the track cross sections of the proposed TSF at Greta are subject to more significant relief, meaning wagons are more likely to remain compressed or under tension, leading to a reduction in bunching or stretching on departure. It is therefore considered the distribution of measured difference between L_{Aeq} and L_{A1} impacts presented in **Figure 12** provides a conservative assessment of L_{A1} noise levels likely to be experienced at Greta.

Assessment of sleep disturbance impacts generated by transient noise sources is assessed in terms of an L_{A1} noise level equal to the $L_{Aeq,15minute}$ impact plus 12 dB(A). This provides an assessment of potential sleep disturbing noise impacts from 95% of transient noise events.

7.2.2 Transient Road Noise

Noise generated by vehicles on the internal roadway will have the potential to create sleep disturbance impacts at receivers adjacent to the site entry. The noise level that would contribute to sleep disturbance from this source is based on the results of operator attended monitoring at receivers on Mansfield Road. Analysis of monitoring data indicates that the L_{A1} noise level for pass by events on Mansfield Road exceeds the L_{Aeq} level by up to 15 dB(A). While it is acknowledged that vehicles entering the site are likely to be travelling at lower speeds than those observed in the monitoring data, application of the L_{Aeq} plus 15dB indicator as a means of assessing transient road noise impacts is considered a conservative assessment of potential sleep disturbance impacts.

7.2.3 Other Transient Noise Sources

Transient noise sources contributing to L_{A1} noise levels from maintenance operations may include materials handling operations and reversing alarms from vehicles moving around the maintenance facilities.

The predicted noise level that would contribute to sleep disturbance from these sources is modelled on L_{A1} noise levels associated with materials handling operations; observed during operator attended monitoring within a fabrication workshop from the Advitech noise source library. Materials handling L_{A1} levels are typically observed to be up to 10dB(A) greater than the equivalent L_{Aeq} noise level; however, greater attenuation of L_{A1} noise levels would be expected due to the distribution of sound energy higher in the frequency spectrum.

7.3 Assumptions of the Model

The following assumptions are made with regards to the sleep disturbance noise model:

- source L_{A1} noise levels for rail movements are based on monitoring data from existing Pacific National operations considered representative of proposed operations at Greta;
- while discussion presented in **Section 6.4** indicates L_{Aeq} noise levels associated with trains entering the facility are excluded from impact assessment, L_{A1} source data for these activities were retained in the L_{A1} noise model to account for changes in noise characteristics that may be introduced by trains entering the facility. Impact predictions presented in **Section 7.4** therefore contain assessment of characteristics that may be associated with peak noise events generated by trains exiting the main line;

- source L_{A1} noise levels for traffic movements are based on attended monitoring data of vehicle pass by noise levels at sensitive receivers on Mansfield Road and are considered to conservatively represent the expected L_{A1} impact. The L_{A1} source SWL based on a single vehicle pass-by (as opposed to maximum expected 4 vehicle movements per 15 minute period as outlined in the operations noise model), as this rate of traffic movement is considered representative of potential $L_{A1,1minute}$ impacts;
- impact predictions assume the construction of the site access road and arrival road noise barriers as discussed in **Section 6.4;**
- impact predictions assume heavy vehicles do not access the site between the hours of 22:00 and 7:00; and
- predicted L_{A1} noise levels are the contribution from proposed operations only and do not include contribution from existing noise sources including road and rail traffic.

7.4 Results

Preliminary modelling results suggested L_{A1} noise impacts from trains entering the facility may exceed 50 dB(A) at receivers adjacent to the site access off Mansfield Rd. The barrier adjacent to the rail arrivals road (as discussed in **Section 6.4.2**) was consequently re-introduced into the model in order to mitigate these impacts. The results presented in **Table 30** are considered representative of worst case impacts in the presence of this barrier.

The +12dB correction between L_{A1} and L_{Aeq} noise levels associated with proposed rail operations was applied in order to provide an assessment potential sleep disturbance impacts for 95% of transient noise events. The predicted L_{A1} noise level is therefore considered to represent the expected worst case impact.

Table 30: Predicted L_{A1} noise level (with arrival road barrier), dB(A)

Description	R1	R2	R2(a)	R3	R4	R5	R6	R6(a)
Predicted $L_{Aeq,15minute}$ Noise Level[1]								
Neutral Conditions	32	35	31	<30	<30	<30	34	34
Adverse Spring / Summer / Autumn	34	33	<30	<30	<30	<30	40	42
Adverse Winter	35	38	35	30	<30	<30	38	39
L_{A1} correction factor — Rail Sources				+12 dB				
Road Source				+15 dB				
Maintenance Operations Sources				+10 dB				
Predicted L_{A1} noise level								
Neutral Conditions	43	46	41	35	30	<30	46	45
Adverse Spring / Summer / Autumn	46	45	38	31	<30	32	**52**	**54**
Adverse Winter	46	**49**	46	42	40	35	**50**	**51**
Existing L_{A1} Noise Level	60	57		37	36	45	57	
Sleep Disturbance Level Night (2200-0700)	47	47		51	45	47	48	

Note 1: Predicted $L_{Aeq,15minute}$ noise level including contribution from trains entering the facility as presented in **Table 25**.

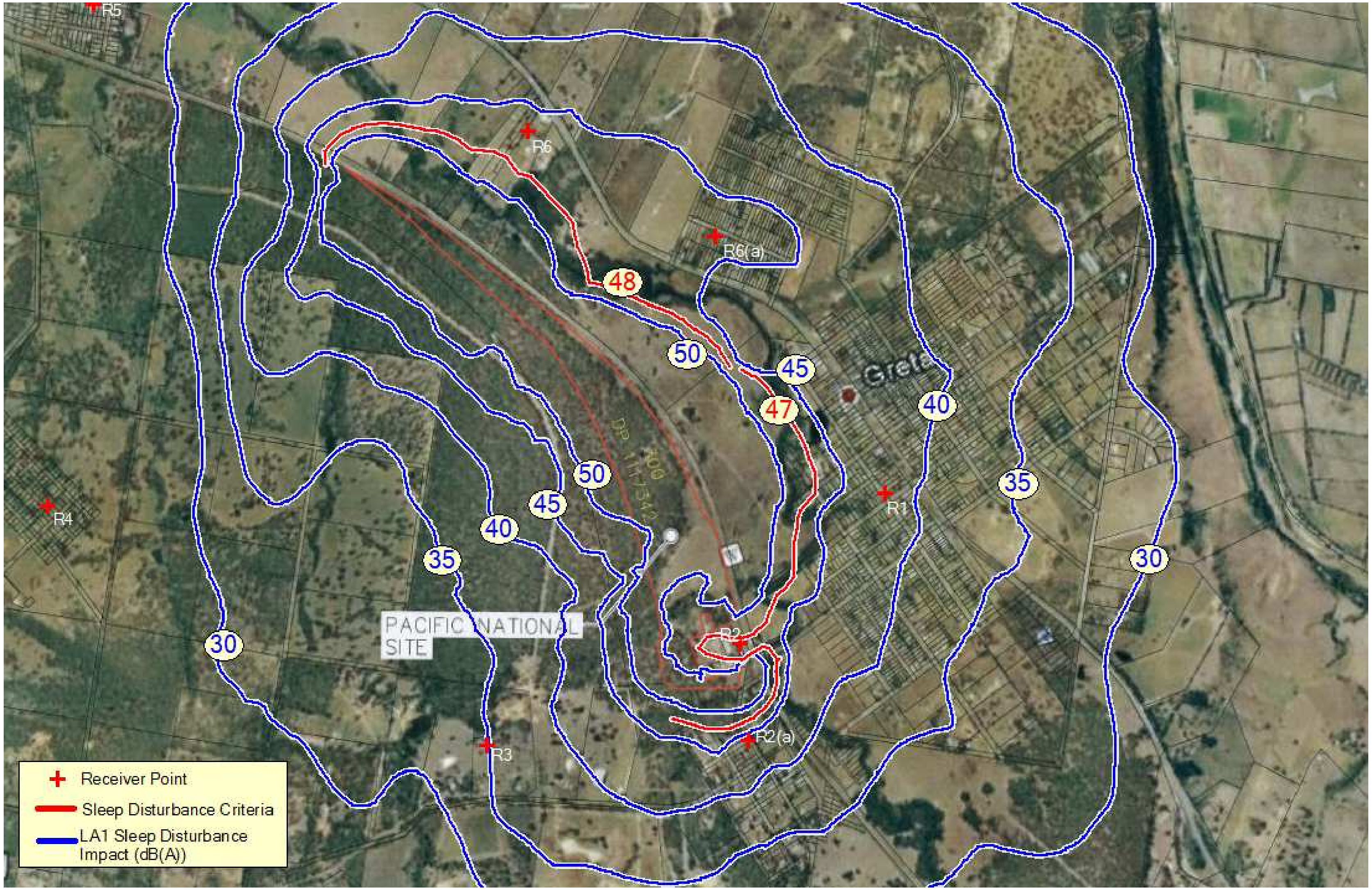


Figure 13: Predicted L_{A1} noise level, neutral conditions

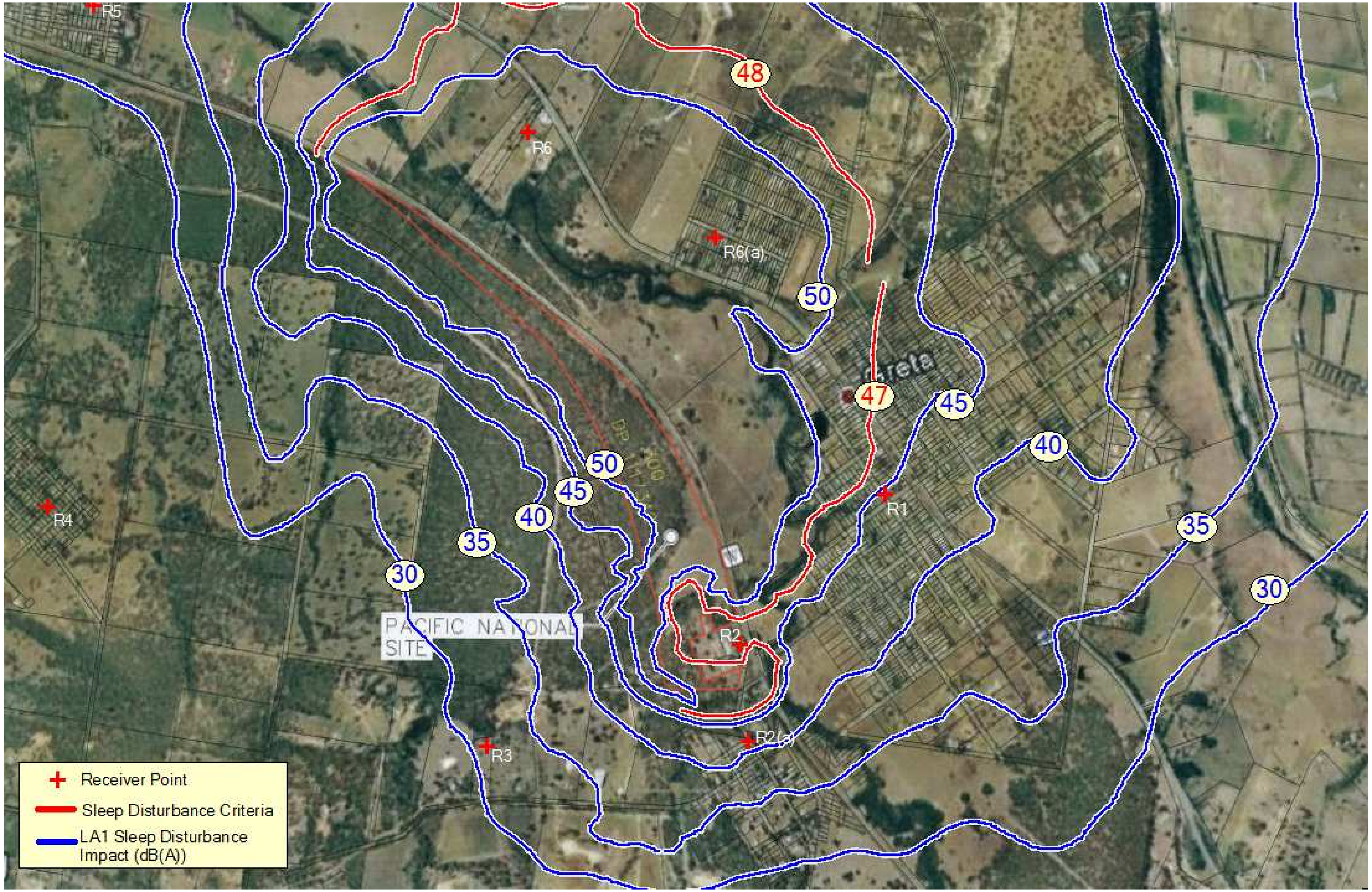


Figure 14: Predicted L_{A1} noise level, adverse SSW winds

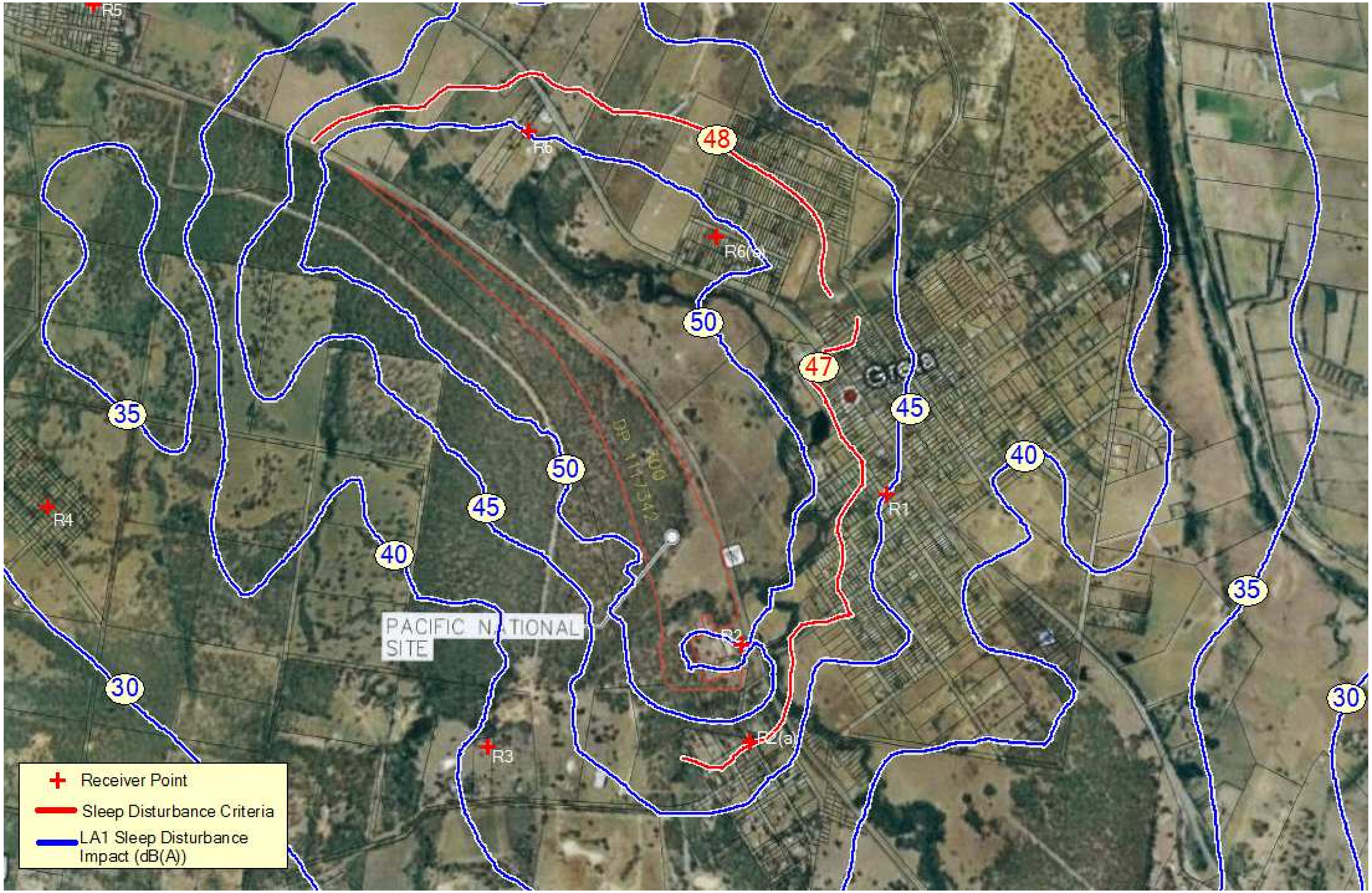


Figure 15: Predicted L_{A1} noise level, adverse Winter conditions

7.5 Interpretation of Modelled Impact Predictions

7.5.1 Greta Receiving Environment (R1)

The results indicate that impacts will comply with the sleep disturbance criteria for the majority of receivers in Greta. Predicted L_{A1} noise levels indicate minor exceedences of the sleep disturbance criteria may occur:

- under neutral conditions the L_{A1} noise impact would comply with the sleep disturbance criteria for the all receivers in Greta;
- under SSW winds the L_{A1} noise impact would likely exceed the sleep disturbance at receivers in Greta, including those north-east of the New England Highway. Receivers on Wyndham and Sale Streets closest to the industrial development may experience L_{A1} noise levels up to 50 dB(A) under these meteorological conditions; and
- during periods of temperature inversion L_{A1} noise impact would likely exceed the sleep disturbance criteria for some receivers to the south-west of the New England Highway in Greta. Receivers on Wyndham and Sale Streets closest to the proposed TSF may experience L_{A1} noise levels up to 49 dB(A) under these meteorological conditions.

While the assessment indicates the sleep disturbance criteria may be exceeded during Stage 3 operations of the TSF, these results should be interpreted in the context of the ambient noise environment. Analysis of attended monitoring data presented in **Appendix II** indicates that ambient L_{A1} noise levels from existing transportation sources may reach levels up to 60 dB(A). While the TSF is considered an industrial noise source, the character of transient emissions from site operations is likely to be generally consistent with existing noise sources.

While L_{A1} emissions from the TSF may exceed the criteria with a maximum expected level of 49 dB(A), this impact is similar in character to, but significantly lower than existing L_{A1} noise levels experienced in the Greta receiving environment.

7.5.2 Illalong Receiving Environment (R2)

The results indicate that impacts will comply with the sleep disturbance criteria for the majority of receivers in Illalong. Predicted L_{A1} noise levels indicate minor exceedences of the sleep disturbance criteria may occur:

- under neutral conditions the L_{A1} noise impact would comply with the sleep disturbance criteria for the all (existing and future) receivers in Illalong village. L_{A1} noise impacts are also expected to comply with the sleep disturbance criterion at receivers adjacent to the site access on Mansfield St under these conditions;
- under SSW winds the L_{A1} noise impact would likely comply with the sleep disturbance criteria for the all receivers (existing and future) in Illalong village. L_{A1} noise impacts are also expected to comply with the sleep disturbance criterion at receivers adjacent to the site access on Mansfield St under these conditions; and
- during periods of temperature inversion the L_{A1} noise impact would likely comply with the sleep disturbance criteria for the all receivers (existing and future) in Illalong village. L_{A1} noise levels at receivers on Mansfield St adjacent to the site access road may experience noise levels up to 49 dB(A).

These results assume restrictions on access to the site by heavy vehicles between the hours of 10pm and 7am. Detailed review of modelling outputs indicates the L_{A1} noise levels in the Illalong receiving environment are generated by vehicles accessing the site via the Mansfield Road entrance. Review of attended monitoring results presented in **Appendix II** indicates that ambient L_{A1} noise levels associated with the passage of vehicles on Mansfield and Camp Roads may reach 56 dB(A), while the passage of trains generates L_{A1} noise levels up to 70 dB(A) at receivers on Mansfield Road.

While L_{A1} emissions from the TSF may exceed the criteria with a maximum expected level of 50 dB(A), this impact is similar to L_{A1} noise levels currently experienced in the Illalong receiving environment. The character of the L_{A1} impact is unlikely to differ significantly from existing road noise impacts associated with the poor alignment of the Mansfield Street rail overpass.

7.5.3 Tuckers Lane Receiving Environment (R3)

The results presented in **Section 6.4** indicate that noise impacts will comply with the sleep disturbance criteria for all receivers in the Tuckers Lane receiving environment under all significant meteorological conditions.

7.5.4 North Rothbury Receiving Environment (R4)

The results presented in **Section 6.4** indicate that noise impacts will comply with the sleep disturbance criteria for all receivers in the North Rothbury receiving environment under all significant meteorological conditions.

7.5.5 Branxton Receiving Environment (R5)

The results presented in **Section 6.4** indicate that noise impacts will comply with the sleep disturbance criteria for all receivers in the Branxton receiving environment under all significant meteorological conditions.

7.5.6 New England Highway Receiving Environment (R6)

The results indicate that predicted L_{A1} noise levels may be above the sleep disturbance criteria for sensitive receivers to the north of the development along the New England Highway:

- under neutral conditions exceedence of the L_{A1} criterion is not expected to occur;
- under SSW winds the L_{A1} noise impact would likely exceed the sleep disturbance criteria for receivers along the highway. L_{A1} noise levels at receivers on the New England Highway may experience noise levels up to 55 dB(A); and
- during periods of temperature inversion L_{A1} noise impact would likely exceed the sleep disturbance criteria for the majority of receivers along the highway. L_{A1} noise levels at receivers on the New England Highway may experience noise levels up to 52 dB(A).

While the assessment indicates the sleep disturbance criteria may be exceeded during Stage 3 operations, these results should be interpreted in the context of the ambient noise environment. Analysis of attended monitoring data presented in **Appendix II** indicates that ambient L_{A1} noise levels from existing transportation sources may reach levels up to 64 dB(A). While L_{A1} emissions from the TSF are likely to exceed the criteria with a maximum expected level of 54 dB(A), the character of the impact is consistent with that from existing transportation sources, albeit at significantly lower levels.

7.5.7 Assessment of Impacts above the Sleep Disturbance Noise Level

Table 31 provides an assessment of the number of receivers likely to experience noise impacts above the Sleep Disturbance noise level during Stage 3 operations.

Table 31: Quantification of Impacts above the Sleep Disturbance Criteria, Stage 3 operations

Receiving Environment	Neutral	Adverse Spring / Summer / Autumn	Adverse Winter
Greta	0	80	60
Mansfield Rd (at access road)	0	8	8
Illalong	0	0	20
Tuckers Lane	0	0	0
North Rothbury	0	0	0
Branxton receiving	0	0	0
New England Highway (Greta)	0	255	180
Total	0	345^	270^

^ While the assessment indicates the Sleep Disturbance Criteria may be exceeded at up to 340 receivers, review of monitoring data for these locations (Appendix II) indicates these receivers already experience noise levels well in excess of the Sleep Disturbance Criteria.

Table 31 indicates receiving environments in Greta and adjacent to the New England Highway are likely to be most affected by noise levels exceeding the Sleep Disturbance level under worst case conditions. This analysis should be interpreted in the context of monitoring and modelling results presented in **Section 4.2** and **Table 30** that indicate L_{A1} noise levels associated with existing transportation sources exceed:

- TSF impact predictions by a minimum of 2 dB(A); and
- the sleep disturbance criteria by 10 dB(A).

Consequently, while transient noise impacts associated with TSF operations may exceed the Sleep Disturbance criteria at up to 345 receivers under worst case conditions, this represents the maximum extent of impacts as:

- these receivers are likely to currently experience similar or greater impacts from existing transportation sources; and
- this assessment is likely to overestimate the number of receivers affected, as no detailed assessment of receiver types or occupancy of individual lots has been undertaken.

Furthermore, the guidelines that establish the Sleep Disturbance criteria recognise these impacts are heavily influenced by the character and sensitivity of the individual to noise. Given the nature of the development, the character of proposed impacts is unlikely to differ significantly from existing impacts in the receiving environment adjacent to the rail corridor. Therefore, while quantitative analysis indicates the Sleep Disturbance criteria may be exceeded at 345 receivers under worst case conditions, existing impacts, occupancy and community response should be considered when assessing whether this constitutes an adverse impact that occurs at all 345 receivers.

7.5.7.1 Assumptions of the Assessment

Receivers were identified from cadastral data overlain on aerial photography of the receiving environment adjacent to the proposed TSF. Discrete receivers were considered to be any lot (developed or undeveloped) located in areas zoned either 1(a) Rural, 1(c) Rural Residential and 2(b) Village under provisions established in the Cessnock LEP 1989. The counts are considered to provide a conservative estimate of the actual number of receivers likely to experience impacts exceeding the Sleep Disturbance noise level, as this assessment:

- assumes all identified lots have been, or are to be developed;
- applies no corrections to account for lots that contain commercial, open space or other non-residential land-use activities;
- considers only the contribution from the TSF and applies no corrections for localised noise impacts that may mask noise imissions from the TSF; and
- applies no corrections for barrier effects generated by building structures that may locally attenuate noise levels at receivers.

8. CONSTRUCTION NOISE IMPACTS

8.1 Staging of Construction Works

It is estimated that the construction works associated with the proposed development will take 12 months. Detailed information relating to the construction program is not available at this stage of the development, however the following summary of works is provided:

- vegetation clearance and major earthworks (including blasting);
- establishment of rail sidings and turnouts from main northern line;
- construction of buildings, tank farm and ancillary infrastructure;
- construction of internal roadways; and
- commissioning of site infrastructure.

Major earthworks and establishment of final site levels are identified as potentially significant sources of construction noise, given the expected requirement for blasting, rock breaking equipment and the significant volume of material to be extracted. While the type and number of specific items of plant are not known at the time of this assessment, it is assumed that the following construction plant will be utilised as part of the construction works:

- excavators;
- dozers;
- scrapers;
- dump trucks;
- water cart;
- backhoe;
- specialised track laying plant.
- rigid heavy vehicles;
- semitrailers;
- mobile cranes;
- concrete trucks and boom pumps;
- asphalt laying plant;
- rock breaking and crushing equipment;

It is anticipated that cut material will be transported within the site only where it is required for use as fill or for construction of noise barriers at the site boundary. While it is acknowledged that the entire construction program is anticipated to last approximately 12 months, individual stages within the project will occur over shorter durations and are likely to be mobile in nature. For the purposes of this assessment, construction works are considered in terms of two major components:

- **Phase1**: major earthworks and establishment of final levels; and
- **Phase 2**: establishment of rail sidings, site infrastructure and ancillary services.

A separate assessment of potential overpressure and ground vibration impacts associated with blasting is presented in the Blasting and Vibration Impact Assessment for the proposed development.

8.1.1 Construction Hours

It is understood that proposed working hours for the construction phase of the development will be generally consistent with the standard hours of construction (7am to 6pm Monday to Friday, 8am to 1pm Saturday) as outlined in the *Interim Construction Noise Guideline* (DECC, 2009).

The TSF will connect to the proposed third rail line in the Main Northern Rail corridor, and as such it is not anticipated this phase of the construction schedule will be dependent on track possession for the completion of connection works. While the requirement for 24 hour operations (that would be associated with works during periods of track possession) is not expected, assessment of potential impacts of night-period construction works is presented below.

8.2 Construction Noise Criteria

Due to the scale of the proposed development, detailed quantitative assessment of potential construction noise impacts will be undertaken against the management levels presented in the *Interim Construction Noise Guideline* (DECC, 2009).

8.2.1 Construction Noise Management Levels

The management noise levels associated with construction for each of the sensitive receivers is presented in **Table 32**. These are the limits with which construction noise impacts would have to comply.

Table 32: Construction noise management levels, residential receivers

<table>
<tr><th>Receiving</th><th>Receiver</th><th colspan="2">Management Level, $L_{Aeq,15minute}$</th><th colspan="2">Construction Noise Criteria, dB(A)</th></tr>
<tr><th>Environment</th><th>ID</th><th>Std Hours</th><th>Non Std Hours</th><th>Std Hours</th><th>Non Std Hours</th></tr>
<tr><td>Greta</td><td>R1</td><td rowspan="8">RBL + 10</td><td rowspan="8">RBL + 5</td><td>50</td><td>37</td></tr>
<tr><td>Mansfield Rd</td><td>R2</td><td rowspan="2">45</td><td rowspan="2">37</td></tr>
<tr><td>Illalong</td><td>R2(a)</td></tr>
<tr><td>Tuckers Lane</td><td>R3</td><td>42</td><td>36</td></tr>
<tr><td>North Rothbury</td><td>R4</td><td>44</td><td>35</td></tr>
<tr><td>Branxton</td><td>R5</td><td>49</td><td>37</td></tr>
<tr><td>New England Hwy</td><td>R6</td><td rowspan="2">53</td><td rowspan="2">38</td></tr>
<tr><td>New England Hwy, Greta</td><td>R6(a)</td></tr>
</table>

Table 33: Construction noise management levels, non-residential receivers

	Construction Noise Criteria, dB(A)	
Receiver	**Std Hours**	**Non Std Hours**
Greta Public School	60[1] (external)	n/a[2]
Greta Community Pre-School	60 (external)	n/a[2]
Greta Arts and Sports Community Hall	60 (external)	60 (external)
Commercial Receivers	70 (external)	70 (external)

1 - The NSW Interim Construction Noise Guideline advises that as a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation. An external indicator of 60 dB (internal amenity level + 10dB) is therefore applied to this receiver as a means of assessing noise impacts.

2 - Construction noise criteria do not apply as these receivers are not considered to be in use during non-standard work hours.

8.3 Assessment of Construction Noise

An inventory of the acoustically significant equipment to be utilised during construction works is provided in **Table 34**. Operating Sound Power Levels (SWL) for each item of plant were calculated based on typical operating L_{Aeq} Sound Pressure Levels published by the UK Department for Environment, Food and Rural Affairs (DEFRA, 2005). Items of construction plant are grouped based on expected utilisation in major components of the construction works.

Table 34: Construction equipment and typical SWL

Construction Equipment	Typical Operating SPL[1], dB(A)
Phase 1: Major Earthworks	
Tracked Excavator	77
Wheeled Backhoe Loader	67
Bulldozer	80
Road Scraper	87[2]
Dump Truck	81
Water Cart	81
Rock Breaker on Excavator	81[4]
Crushing Plant	90[4]
Roller	79
Semi-trailer	80
Phase 2: Rail Sidings and Site Infrastructure	
Mobile Telescopic Crane	67
Concrete Truck and Pump	75
Concrete Truck	80
Wheeled Backhoe Loader	67
Semi Trailer	80
Asphalt Paver	77
Track laying equipment	80[3]

Note: 1. Typical SPL measured at 10m from the source, DEFRA (2005).
Note: 2. +5dB(A) modifying factor applied for potentially tonal or impulsive noise character
Note: 3. +10dB(A) modifying factor applied for potentially tonal and impulsive noise character
Note 4: Advised SPL for crushing plant at 7m, provided by construction contractor

Construction noise impacts were modelled based on two work phases; major earthworks followed by establishment of site infrastructure. The model assumes that major earthworks are finalised prior to commencing works on site infrastructures. The following construction sources were modelled for the purposes of assessing impacts:

1. works around the provisioning shed and departure road;
2. works around the administration centre, maintenance shed and tank farm;
3. works around the arrival road;
4. works to construct the internal roadway and site entrance; and
5. crushing of blasted rock.

It is considered that this approach is representative of both the mobile nature of construction noise and worst case potential impacts. The location of these sources is provided in **Figure 16**.

Figure 16: Location of construction noise sources

8.4 Assumptions of the Model

The following assumptions are made with regards to the construction stage noise model:

- detailed information relating to the nature of specialist track laying equipment required for the construction works was not available at the time of the assessment. The assumed SWL for these items of plant is based on monitoring data for locomotive pass by at existing Pacific National HBT Kooragang Island Operations. A +10dB modifying factor was then applied to this source to account for potentially annoying noise characteristics such as tonality of impulsiveness that may be generated by this equipment;
- the operating SPL at 7 m from the crushing plant is 90 dB(A) with a source height of RL +2.0 m as advised by the construction contractor;
- the model assumes all equipment is operating at full power continuously during the 15 minute assessment period. This is likely to present a conservative assessment of potential impacts as most items of plant are expected to be mobile in this time period;
- the Phase 1 (neutral) model assumes all earthmoving sources are operational at all locations as shown in **Figure 16**;
- the Phase 2 (neutral) model assumes all equipment used for establishment of site infrastructure are operational at all locations as shown in **Figure 16**;
- the Phase 2 (adverse winter night-time) model assumes only equipment required for, or ancillary to track laying is utilised where the arrival and departure roads join the main northern line;
- the modelled location of construction source 4 was adjusted during Revision 6 assessments following advice from the construction contractor relating to works adjacent to and changes to the alignment of the access road at the site entry. Variations observed in reported construction noise impacts from earlier revisions of the NIA may be attributed to refinements of the construction noise model;
- construction noise impacts are considered to occur only at existing receivers (developed Lots) adjacent to the site access road;
- no assessment of potential overpressure or ground vibration impacts associated with blasting are presented in the construction noise model. These impacts are assessed as part of the Blast and Vibration Impact Assessment for the project; and
- predicted noise levels are the contribution from proposed construction operations only and do not include contribution from existing noise sources including road and rail traffic.

8.5 Results

The predicted cumulative $L_{Aeq,15minute}$ construction noise levels at the nearest sensitive receivers is shown in **Table 35**. **Figure 17** to **Figure 19** show the predicted noise level contours for each of the scenarios outlined in **Table 35.** Construction noise impacts were modelled only for neutral conditions as no significant scenarios were identified during assessment of daytime meteorological data in **Section 4**.

Analysis of impacts under adverse night time Winter conditions is also presented for the purposes of assessing potential worst case impacts, however it is not anticipated at this stage of the assessment that 24 hour operations will be required. Results in bold text in **Table 35** indicate a predicted impact greater than the construction noise criterion for that receiving environment.

Table 35: Predicted $L_{Aeq,15minute}$ construction noise level, dB(A)

Description	R1	R2[1]	R2(a)	R3	R4	R5	R6	R6(a)
Neutral Conditions -Phase 1	50	**67-72**	**55**	**43**	33	30	52	48
Neutral Conditions -Phase 2	40	**57-61**	45	33	30	<30	49	44
Adverse Winter Night - Phase 2[2]	**39**	**49**	**42**	31	32	32	**44**	36
Ambient $L_{Aeq(day)}$ Noise Level	53	56		56	50	53	55	
Construction Noise Criteria								
Standard Hours (0700-1800)	50	45		42	44	49	53	
Non Standard Hours(1800-0700)	37	37		36	35	37	38	

Note 1. Expected range of impacts at receivers adjacent to the site access road to account for relative variation in separation distances between construction sources an these receivers. Worst case impacts are based on minimum expected separation distances.

Note 2. Works during the night period are unlikely to occur as part of the construction phase

8.5.1 Impacts from Construction Plant at the Site Access

Review of modelling results indicates receivers adjacent to the site access may experience significant noise impacts during construction of the TSF. These imissions represent the cumulative impacts associated multiple items of mobile earthmoving plant that are anticipated to operate during construction of the access road, and are considered to represent worst case potential impacts based on minimum separation distances. While this impact may only be present for a number of weeks over the 12 month construction period, it is considered significant and additional review was undertaken to assess opportunities for mitigation at these receivers.

Previous assessment assumed the barrier adjacent to the site access proposed for mitigation of operational noise impacts would be constructed following completion of Stage 1 earthworks. Subsequent review and discussion with the construction contractor suggest construction of this barrier may also provide benefit in terms of mitigation of construction noise impacts. **Table 36** demonstrates the expected reduction in construction noise impacts following implementation of the access road noise barrier during an early phase of Stage 1 works.

Table 36: Predicted $L_{Aeq,15minute}$ construction noise level, dB(A), with barrier

Description	R1	R2	R2(a)	R3	R4	R5	R6	R6(a)
No Access Road Barrier								
Neutral Conditions -Phase 1	50	**67-72**	**55**	**43**	33	30	52	48
With Access Road Barrier								
Neutral Conditions -Phase 1	49	**64-68**	**55**	**43**	33	30	52	48
Neutral Conditions -Phase 2	39	**55-59**	45	33	30	<30	49	44
Ambient $L_{Aeq(day)}$ Noise Level	53	56		56	50	53	55	
Construction Noise Criteria								
Standard Hours (0700-1800)	50	45		42	44	49	53	
Non Standard Hours(1800-0700)	37	37		36	35	37	38	

Results presented in **Table 36** indicate the access road operations barrier will serve to significantly reduce noise levels during both Stage 1 and Stage 2 construction works. It should be noted this level of impact is anticipated only to occur during short term works to the south of Sawyers Creek. Additional modelling indicates that as construction works shift to areas immediately north of Sawyers Creek, worst case impacts are likely to decrease to levels below 60 dB(A) at existing receivers at the site access and 52 dB(A) on the northern approach to Illalong village.

8.5.2 Modifying Factor

The results presented in **Table 36** and **Figure 17** to **Figure 19** include a +5 dB modifying factor correction for potentially impulsive and tonal characteristics detected during analysis of 1/1 octave sound pressure levels in accordance with Table 4.3 of the *Interim Construction Noise Guideline* (DECC, 2009).

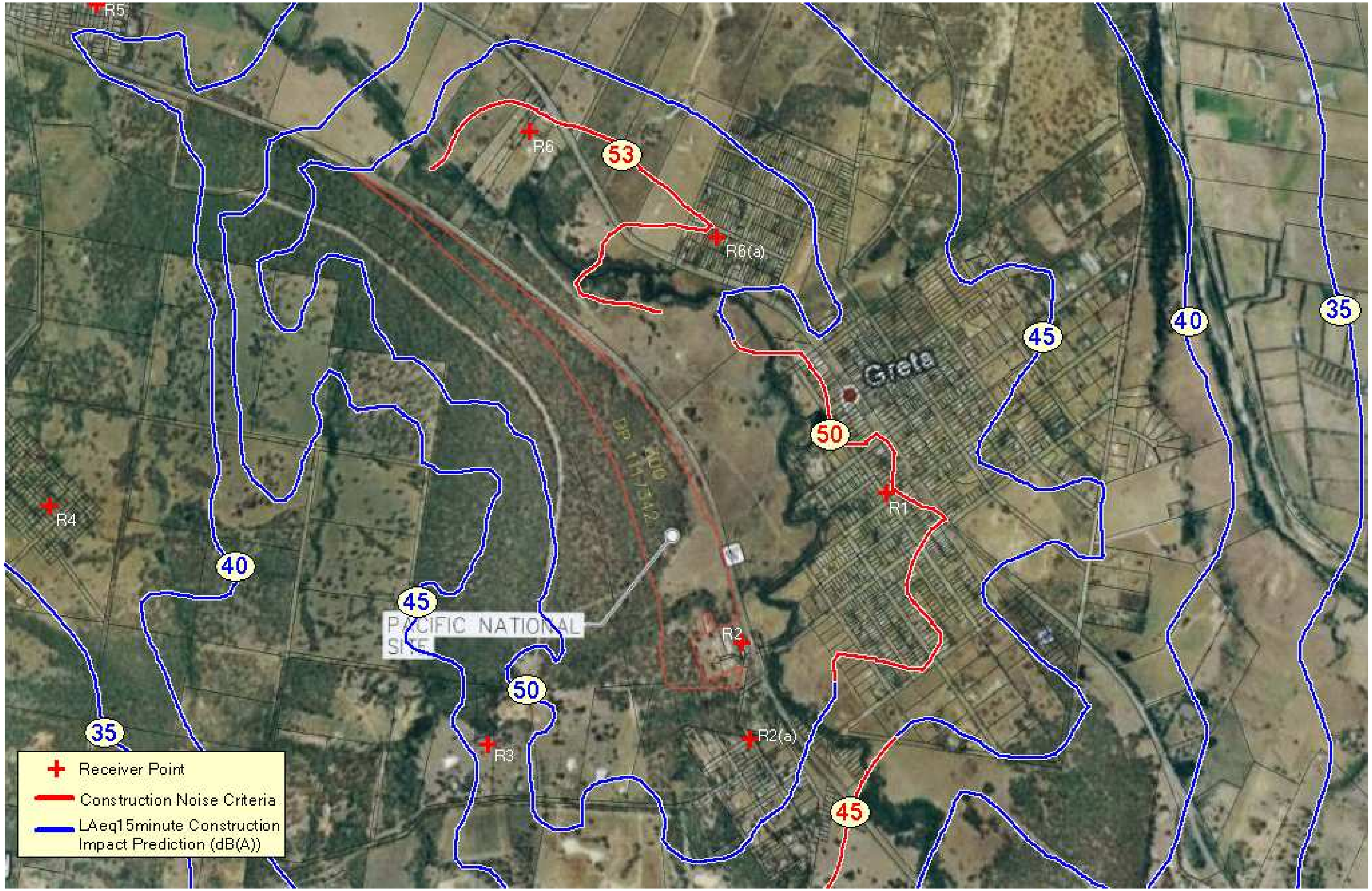


Figure 17: Predicted Phase 1 construction noise impact, neutral conditions

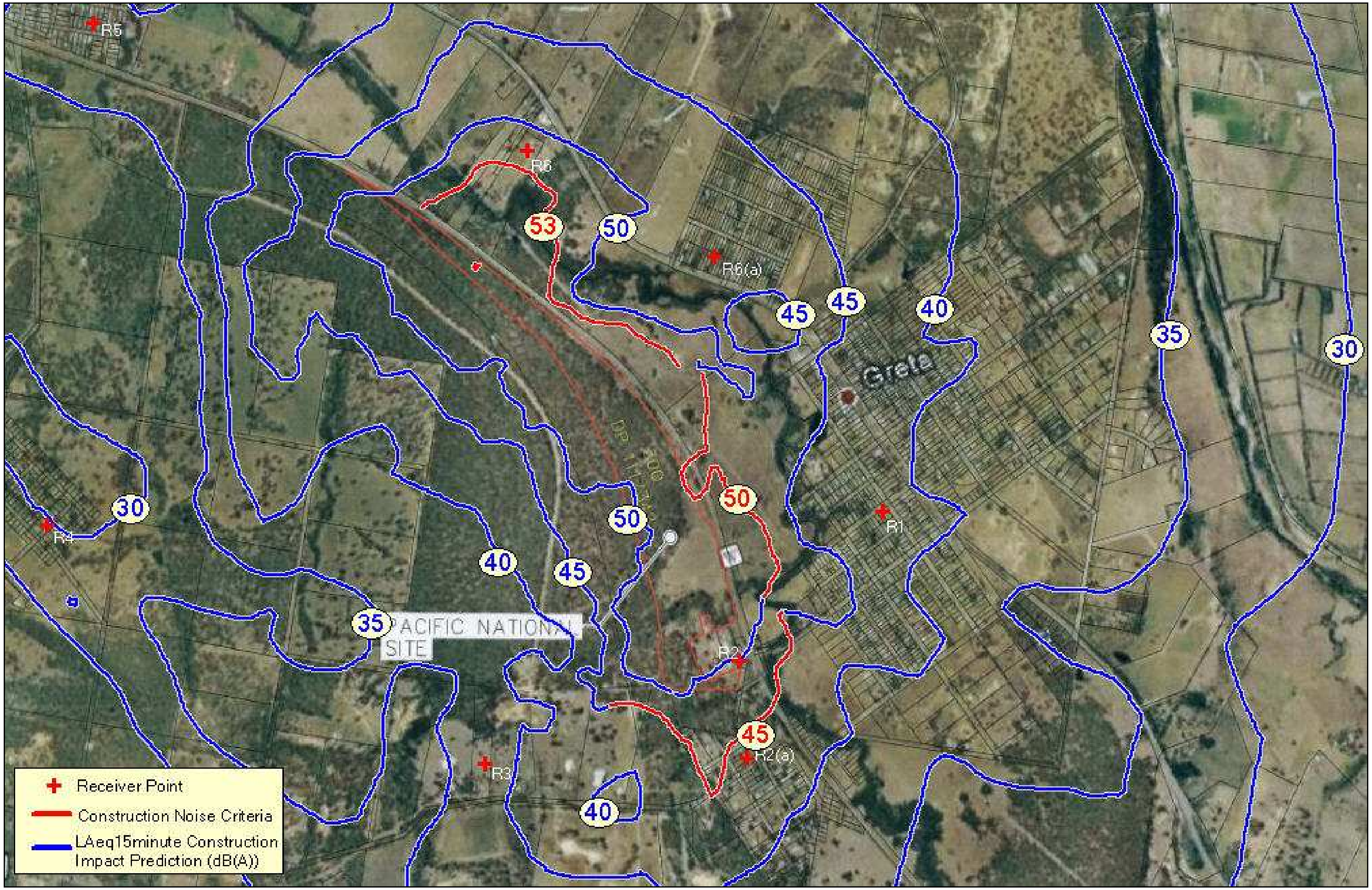


Figure 18: Predicted Phase 2 construction noise impact, neutral conditions

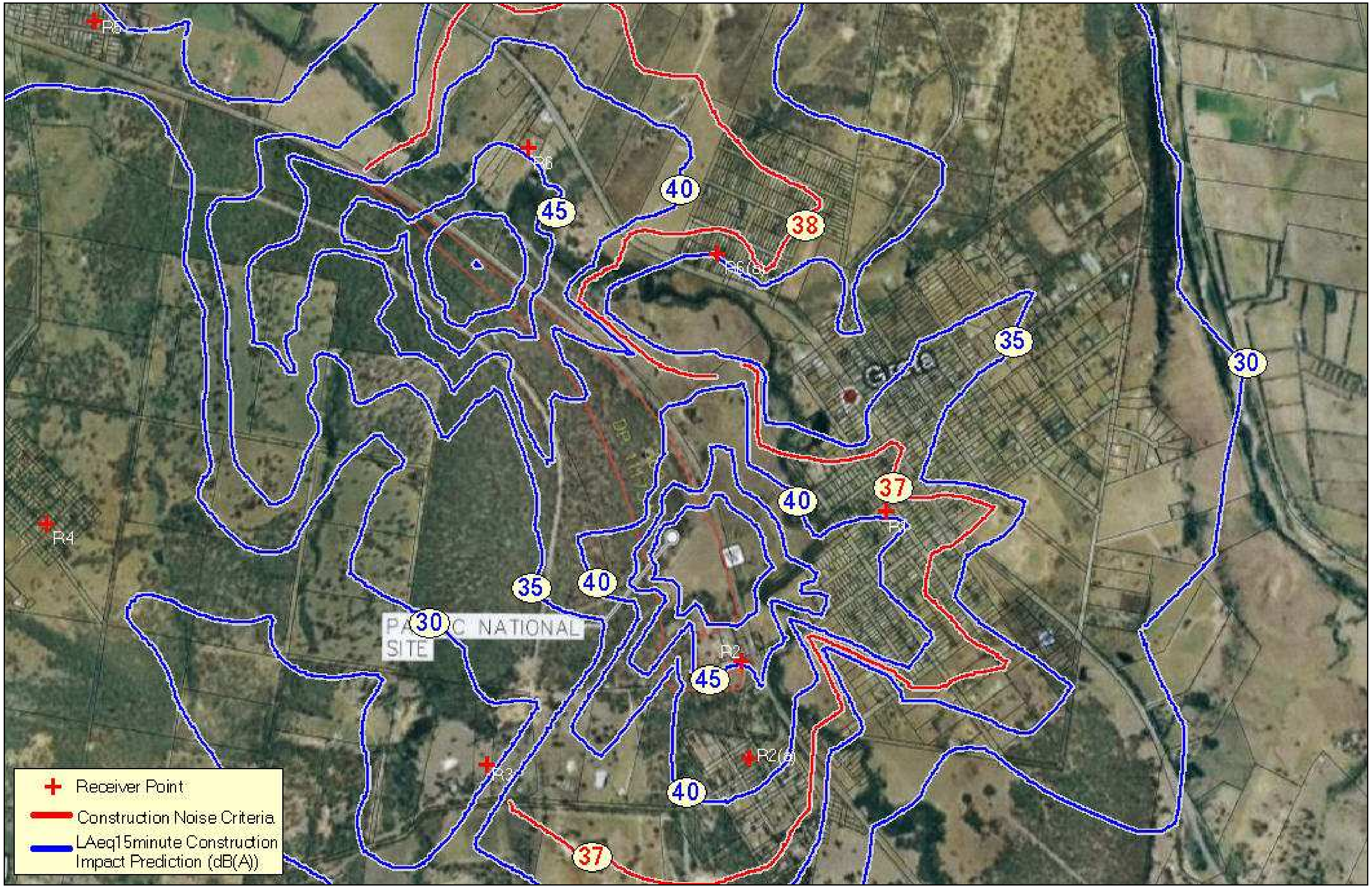


Figure 19: Predicted Phase 2 construction noise impact, Adverse winter conditions

8.6 Interpretation of Modelled Impact Predictions

Proposed construction activities will be restricted to the standard hours of construction (7am to 6pm) as detailed in the *Interim Construction Noise Guideline (DECC 2009)*. It should be noted that works during the night are not expected during Phase 2 of the construction period, however assessment of these impacts is presented for the purposes of understanding potential impacts should circumstances change. Track possessions on the Main Northern Line are usually of 48 hours in duration, meaning any impact (should these works be required) may occur only in the short term.

8.6.1 Greta Receiving Environment (R1)

The results indicate that predicted construction noise impacts may exceed the criteria for sensitive receivers in Greta:

- Phase 1 works would likely exceed the construction noise criteria for the majority of receivers to the south of the New England Highway. Construction noise impacts up to 53 dB(A) may be experienced at these receivers under worst case operational conditions;
- Phase 2 works would likely comply with the construction noise criteria at all receivers in the village of Greta; and
- Phase 2 works would likely exceed the criteria under adverse winter night-time conditions where 24 hour operations may be required during track possessions. Construction noise levels would be likely to exceed the criteria for most receivers south of the New England Highway, with impacts expected to approach 45 dB(A) under these operational and meteorological conditions.

It should be noted the Stage 2 (24hr operations) scenario is not expected to occur as the current proposal limits works to the standard hours of construction. While the assessment indicates the construction noise criteria may be exceeded during Phase 1 construction works, these results should be interpreted in the context of the ambient noise environment. Analysis of background monitoring data presented in **Section 3.2** and **Appendix I** indicates that predicted construction noise impacts are consistent with ambient $L_{Aeq,period}$ noise levels from existing noise sources.

Additionally, while predicted impacts do exceed the construction noise criteria, they remain below the amenity criteria noise levels for the receiving environment of 60 dB(A) (daytime). Given the temporary nature of construction noise impacts and the potential for masking by existing transportation noise sources, the impact may be effectively managed by on-site work practices.

8.6.2 Illalong Receiving Environment (R2)

The results indicate that predicted construction noise impacts are likely to exceed the criteria for sensitive receivers to the south-east of the site in Illalong:

- Phase 1 works present the most significant construction noise impact, with noise levels expected to approach the Highly Noise Affected management level of 75dB(A) at receivers adjacent to the site entry during construction of the site access road and noise barrier. $L_{Aeq,15minute}$ noise levels during this stage of Phase 1 works may reach 72dB(A) at receivers closest to construction works, however it should be noted that the duration of these construction works will be significantly shorter than for major earthworks on the remainder of the site. Further assessment of construction noise impacts and potential management opportunities are presented in **Section 8.7**;

- Phase 2 works would likely comply with the construction noise criteria at receivers to the south-east of the site in Illalong, but may exceed the criteria at receivers on Mansfield Road during standard work hours; and
- Phase 2 works would be likely to exceed the criteria under adverse winter night-time conditions if 24 hour operations were required. Construction noise levels would likely exceed the criteria for receivers adjacent to the site access road and in the village of Illalong, with impacts up to 49 dB(A) under these operational and meteorological conditions at receivers on Mansfield Road and 42 dB(A) at receivers in Illalong.

It is considered that where observed, impacts above the construction noise criteria would be limited to existing receivers in Illalong. Noise impacts would comply with the construction noise criteria at all receivers (existing or proposed) to the south of Illalong village. Further assessment of measures to mitigate construction noise impacts in the Illalong receiving environment are presented in **Section 8.7**.

8.6.3 Tuckers Lane Receiving Environment (R3)

The results presented in **Section 8.4** indicate that noise impact may exceed the construction noise criteria by 1 dB(A) at receivers in the Tuckers Lane receiving environment during Phase 1 earthworks. Predicted noise impacts are expected to comply at these receivers during the construction Phase 2 scenario.

8.6.4 North Rothbury Receiving Environment (R4)

The results presented in **Section 8.4** indicate that noise impact will comply with the construction noise criteria for all receivers in the North Rothbury receiving environment under all meteorological conditions at all stages of the construction program.

8.6.5 Branxton Receiving Environment (R5)

The results presented in **Section 8.4** indicate that noise impact will comply with the construction noise criteria for all receivers in the Branxton receiving environment under all meteorological conditions at all stages of the construction program.

8.6.6 New England Highway Receiving Environment (R6)

The results indicate that predicted construction noise impacts may exceed the criteria for sensitive receivers to the north of the development along the New England Highway under adverse winter night-time conditions, only where 24 hour construction works occur. It should be noted that this scenario is not expected to occur, as the current proposal limits works to the standard hours of construction.

Modelling results indicate impacts generated by construction works undertaken during standard work hours may result in only minor exceedence of the construction noise criteria at a small number of receivers to the south of the New England Highway

8.6.7 Assessment of Impacts at Non-Residential Receivers

Review of impact predictions presents in **Figure 17** to **Figure 19** indicates construction noise impacts are likely to be below the construction noise management level for all non-residential receivers identified in **Section 4.3.1**.

8.6.8 Assessment of Impacts above the Construction Noise Management Level

Table 37 provides an assessment of the number of receivers likely to experience noise impacts above the noise management levels listed in **Table 32** during the construction phase of the project.

Table 37: Quantification of Impacts above the Construction Noise Management Level

Receiving Environment	Neutral Phase 1	Neutral Phase 2
Greta	275	0
Mansfield Rd (at access road)	4[2]	4[2]
Illalong	90	10
Tuckers Lane	10	0
North Rothbury	0	0
Branxton receiving	0	0
New England Highway (Greta)	5	0
Total	390	20

Note 1. Works during the night period are not proposed to occur as part of the construction phase

Note 2. Refers to Lots that that are currently developed.

Table 37 indicates receiving environments in Greta and adjacent to the New England Highway are likely to be most affected by noise levels exceeding that of the PSNL under worst case conditions. The results also suggest impacts at up to 100 receivers in the receiving environment at Illalong; this impact will be limited to the construction around the site access road; hence, these impacts are unlikely to persist for the duration of the 12 month construction program.

This analysis should be interpreted in the context of monitoring and modelling results presented in **Section 4.2** and **Table 36,** that indicate ambient L_{Aeq} noise levels associated with existing transportation sources that exceed impact predictions by a minimum 3 dB(A) in these receiving environments. Hence, while TSF noise impacts above that of the construction noise management level may affect up to 320 receivers, under worst case operational conditions, this:

- impact is likely to be consistent with the level of impact associated with existing transportation sources;
- assessment may overestimate the number of receivers affected, as no detailed assessment of receiver types or occupancy of individual lots has been undertaken.

Quantification of impacts during periods of track possession works that coincide with worst case meteorological impacts (Adverse Winter Night Phase 2) was not undertaken as this scenario is not anticipated to occur as part of the construction program as discussed in **Section 8.1.1**.

8.6.8.1 Assumptions of the Assessment

Receivers were identified from cadastral data overlain on aerial photography of the receiving environment adjacent to the proposed TSF. Discrete receivers were considered to be any lot (developed or undeveloped) located in areas zoned either 1(a) Rural, 1(c) Rural Residential and 2(b) Village under provisions established in the Cessnock LEP 1989. The counts are considered to provide a conservative estimate of the actual number of receivers likely to experience impacts exceeding the construction noise management level, as this assessment:

- assumes all identified lots have been, or are to be developed;
- applies no corrections to account for lots that contain commercial, open space or other non-residential land-use activities;
- considers only the contribution from the TSF and applies no corrections for localised noise impacts that may mask noise emissions from the TSF; and
- applies no corrections for barrier effects generated by building structures that may locally attenuate noise levels at receivers.

8.7 Mitigating Construction Noise Impacts

It should be noted the assessment presented in **Table 36** assumes minimum separation distances and (with the exception of the access road noise barrier) source to receiver propagation profiles based on natural terrain. For the purposes of understanding potential mitigation of construction noise impacts, terrain features (including cuttings, stockpiles, significant items of stationary plant and site sheds) may be utilised to take advantage of localised barrier effects. Analysis presented in **Table 36** indicates source imissions may be reduced by up to 4 dB(A) where noise generating plant can be located to optimise barrier effects of terrain features.

Further measures that may be implemented to reduce specific construction noise impacts include:

- utilising alternatives to traditional tonal reversing alarms. This may include:
  - non-tonal reversing alarms (which may reduce effective imissions by 5dB(A));
  - alarms that adjust volume based on ambient noise levels; or
  - managing traffic flows to minimise vehicle or plant movements in the reverse direction; and
- maintaining roadways in such a manner as to limit excess noise generated by interactions between plant and the road surface.

Due to the small separation distances between construction works and sensitive receivers, impacts above that of the construction noise criteria are likely to remain following construction of the access road barrier. Additional measures to assist in the effective management of these impacts include:

- consult potentially impacted receivers at an early stage and engage effective communication strategies;
- maintain and operate noise generating equipment in an efficient manner;
- educate plant operators as to on-site noise management obligations;
- locate site compounds and receiving areas away from sensitive receivers;
- strictly adhere to standard work hours, and schedule noisier activities during less sensitive times of the day (e.g. 9am to 12pm and 2pm to 5pm);
- schedule respite periods for high impact activities;
- avoid clustering and minimise the number of plant working at any one time to limit cumulative impacts;
- turn off, or reduce idle speeds on stationary equipment when not in use;
- in the case of directional noise (e.g. cooling fans, mufflers), orientate the source such as to direct the greatest noise emission away from adjacent receivers;
- avoid dropping materials from height; and
- undertaking monitoring during early stages of high impact works to understand realised noise impacts, and use this information to guide future noise management.

It is recommended a Construction Noise Management Plan (CNMP) be prepared prior to commencement of construction works. This plan should outline mitigation and management strategies relevant to the management of construction noise impacts, and detail the communication strategy between the construction contractor and potentially affected residents. The CNMP should also provide a system for receiving, managing and responding to complaints as part of a broader Construction Environment Management Plan (CEMP).

9. ROAD TRAFFIC NOISE

9.1 Traffic Routes

Access to the site for road traffic will typically be via the New England Highway and Nelson Street. While it is expected that the Hunter Expressway will reduce vehicle numbers on the New England Highway following completion of its construction in 2014, it is considered that location of an interchange to the west of Illalong will continue generate to steady traffic flows along Nelson St as residents are likely to access Greta via this route.

Any changes to site access routes following construction of the Hunter Expressway reduce traffic noise impacts associated with the development, as access to the site via the approved F3 alignment south of the site will reduce exposure to receivers in Greta.

9.2 Environmental Criteria for Road Traffic Noise

Traffic generated by the proposed development should comply with the EPA *Environmental Criteria for Road Traffic Noise* (ECRTN) $L_{Aeq,period}$ day time and night time traffic noise levels (the relevant section is reproduced in Table 38) for traffic moving through Greta via Nelson Street.

Table 38: Road traffic noise criteria

Type of Development	Criteria, dB(A)	Where Criteria is already Exceeded
7. Land use developmets with potential to create additional traffic on existing arterial roads	Day time $L_{Aeq(15hr)}$ 60 Night time $L_{Aeq(9hr)}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
8. Land use developments with potential to create additional traffic on collector roads	Day time $L_{Aeq(1hr)}$ 60 Night time $L_{Aeq(1hr)}$ 55	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

Source: Environmental Criteria for Road Traffic Noise Table 1 (1999)

In accordance with Guidelines established in Section 2.2 of the ECRTN, Nelson Street is identified as a collector road as it is the corridor along which traffic travels south from Greta to Kurri Kurri.

9.3 Assessment of Road Traffic Noise

9.3.1 Existing Traffic Noise Impacts

Assessment of attended and unattended noise monitoring data indicates that ambient 95th percentile $L_{Aeq,1hour}$ noise levels (the $L_{Aeq,1hou}$r noise level observed 95% of the time) for receivers on the Nelson Street and Mansfield Street corridor are in the order of 58 dB(A). Review of unattended monitoring data presented in **Figure 20** indicates there is no significant diurnal change in $L_{Aeq,1hour}$ noise levels, potentially due to the influence of rail traffic during the night period. Road and rail traffic are the dominant sources in this receiving environment and review of attended monitoring results presented in **Figure 21**, indicates that typical Sound Exposure Levels (SEL) for pass-by events are in the order of 55 to 57 dB(A) and 66 to 67 dB(A) for road and rail traffic respectively.

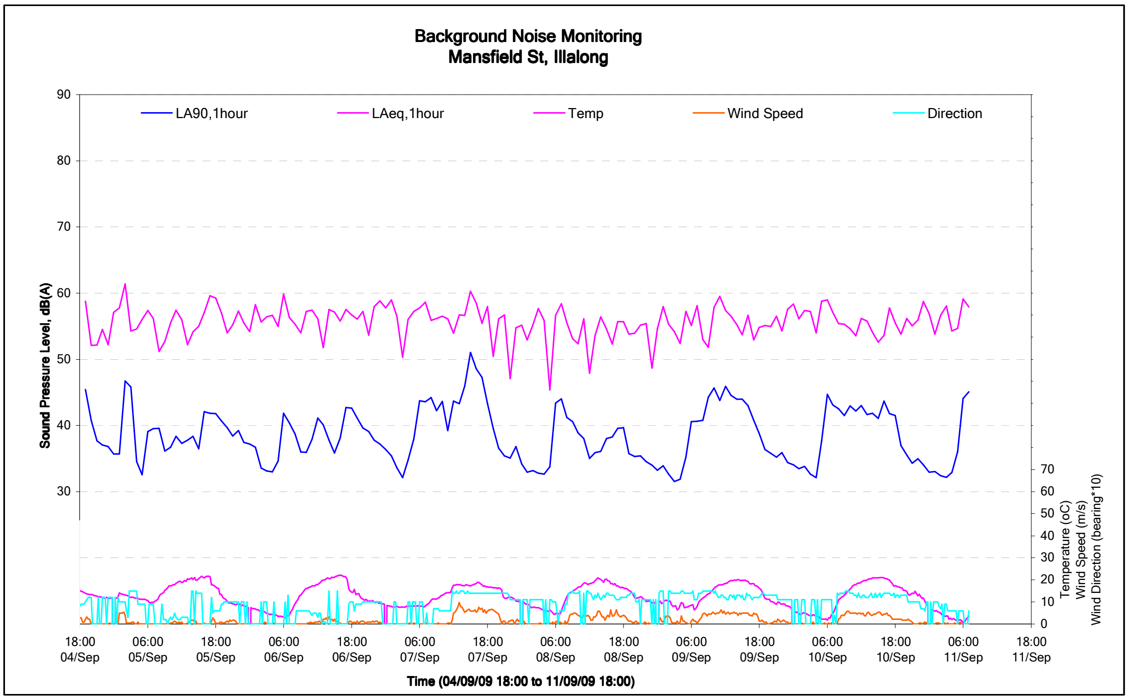


Figure 20: Ambient $L_{Aeq,1hour}$ noise levels, Mansfield St Illalong

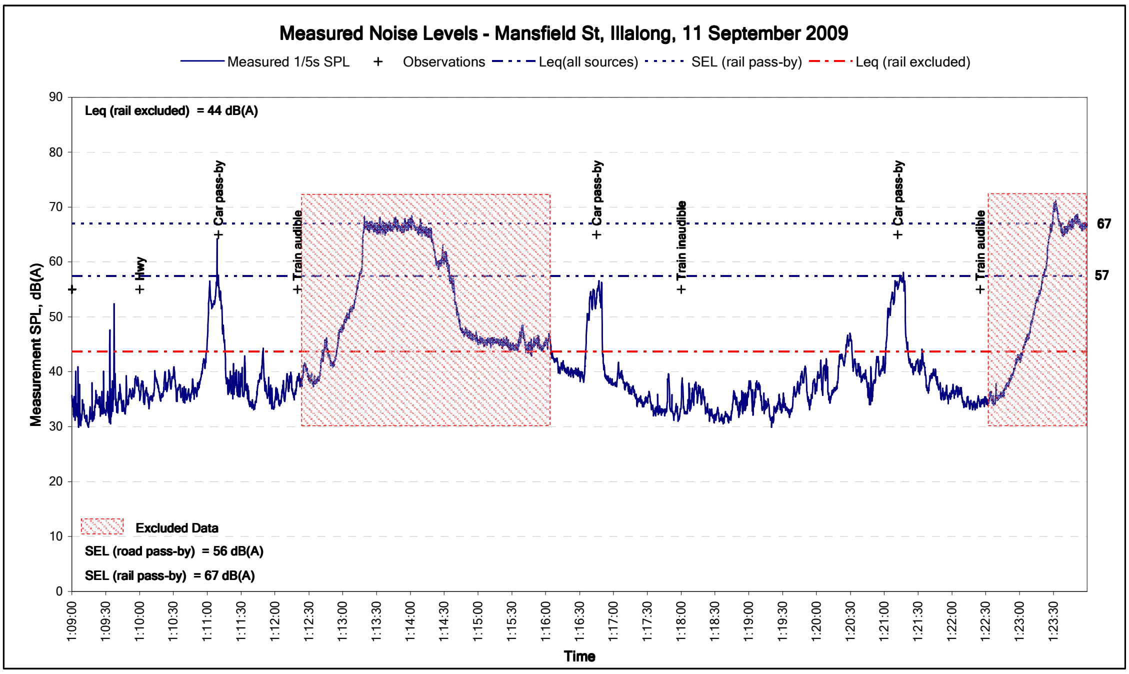


Figure 21: Assessment of road noise contribution, Mansfield Street Illalong

9.3.2 Future Traffic Noise Impacts

Information available at the time of the assessment indicates site operation will generate approximately 110 in and out vehicle movements per day, with the majority of these movements expected to occur via the New England Highway and Nelson Street access. Peak times for vehicle movements are expected to be as follows:

- morning peak: 6:00am to 8:00am (38 cars accessing the site); and
- afternoon peak: 2:30pm to 6:00pm (38 cars accessing the site).

Maximum vehicle flow rates of up to 17 vehicles per hour are expected between 7:00am and 5:00pm.

The project Traffic Impact Assessment provides information relating to current peak vehicle movements on proposed access routes for the development and are reproduced in **Table 39**. These results indicate traffic generated by the proposed development may increase traffic movements on Nelson Street by up to 5.5% during peak periods.

Table 39: Propsoed changes to peak traffic flow

	Existing Peak Flow (vehicles per hour)	TSF Contribution (vehicles per hour)	Percent change
New England Highway	1422	17	+1.2%
Nelson Street	312	17	+5.5%

A simple model was established to assess the impact of road noise based on pass by SEL and traffic count data on Nelson St. Predicted $L_{Aeq,15minute}$ road noise impacts were found to be consistent with the assessed $L_{Aeq,15minute}$ noise level following exclusion of rail impacts presented in **Figure 21**. The results presented in **Table 40** are considered to sufficiently validate the road noise model.

Table 40: Road noise model validation

Pass-by Event (3 Vehicles)	$L_{Aeq,15minute}$
Predicted Impact	45.0
Measured Impact	43.8

The model was used to characterise existing impacts of road traffic noise generated during times of peak flow and offer an analysis of potential changes following commencement of operations at the proposed TSF. The results of this assessment are presented in **Table 41**.

Table 41: Road noise impact prediction

	Existing		Future	
Peak Impact	Vehicles / hr	$L_{Aeq,1hour}$	Vehicles / hr	$L_{Aeq,1hour}$
New England Highway	1422	66.7	1439	66.8
Nelson St / Mansfield St	312	60.1	329	60.4

Based on the assumptions of the model presented in **Section 8.3.3**, it must be noted that the impact predictions provided in **Table 41** are for noise levels at the road verge. Decay due to increasing separation distances means noise levels at the façade of receiver structures will be lower than the impact predictions.

These predictions indicate that traffic generated by the proposed development may increase $L_{Aeq,1hour}$ noise levels by 0.1 and 0.3 dB(A) at receivers adjacent to the New England Highway and Nelson Street respectively. While impact predictions indicate existing noise levels exceed the criteria, guidelines presented in the ECRTN indicate that road noise levels may be considered acceptable where the increase is less than 2dB(A). Hence, it is considered the impact of road noise generated by the proposed development is acceptable in accordance with guidelines presented in the ECRTN.

9.3.3 Assumptions of the Road Traffic Noise Model

Key assumptions of the modelled sleep disturbance noise impacts include:

- the model is based on measured SEL at the road verge on Mansfield Street and is likely to overestimate the road noise impact:
  - received at the façade of residences as the separation distance to these receivers is greater than to the measuring point in which the model is based; and
  - the monitoring location on which the model is based is adjacent to the Mansfield Street rail overpass. Pass by SELs from this location are likely to be greater than for a straight section of road due to longer pass by times as vehicles negotiate the poor road alignment of the overpass;
- assessment of changes to peak flows only are presented as it is considered this provides an assessment of worst case $L_{Aeq,1hour}$ noise impacts; and
- the impact predictions are for the contribution from road traffic only and do not include contribution from existing noise sources including rail traffic.

10. ASSESSMENT OF CUMULATIVE NOISE IMPACTS

10.1 Methodology and Reference Material

The NSW Department of Planning (DoP) provides the following Director General's Requirements for the assessment of cumulative noise impacts associated with the proposed TSF and other transportation infrastructure currently approved or under assessment at in the Greta locality:

> *The noise assessment must consider the impact from the project in isolation and in a cumulative context with relevant existing and approved development, including development of the Hunter Expressway and the third railway line between Maitland and Minimbah.*

This assessment is based on guidelines established in the INP and publicly available information relating to the assessment of noise impacts associated with the aforementioned infrastructure projects.

It should be noted that at the time of this assessment no information relating to noise impacts associated with the Maitland to Minimbah third rail line was publicly available. Hence, the cumulative impact assessment is based on typical rail noise impacts presented in the noise assessment for upgrade of the Minimbah to Singleton section of the northern line. The following documents are referenced for the purposes of this assessment:

- Atkins Acoustics (2007). *F3 Freeway to Branxton Link: Noise Assessment (Revision 3)*, NSW Roads and Traffic Authority, Newcastle;
- Masson, Wilson & Twiney (2001). *Review of Traffic Modelling and Project Justification (Draft Report): Proposed Highway Link F3 Freeway to Branxton;* and
- GHD (2008). *Report on ARTC Minimbah Third Track Environmental Assessment: Noise and Vibration Impact Assessment (Revision 1)*, Australian Rail and Track Corporation.

In the absence of DoP or DECCW issued guidelines on quantitative assessment of cumulative noise impacts, this assessment presents as a qualitative review of potential noise impacts on the amenity of the receiving environment associated with the three major proposed developments. Where noise impacts are not provided for discrete receptors in the referenced noise impact assessments, general extrapolation of impacts was undertaken based upon:

- the distance from the source to receiving environments; and
- the assumption that both rail and road corridors presents as a line noise source.

10.2 Assessment of Cumulative Noise Impacts

10.2.1 Tuckers Lane, North Rothbury and Branxton Receiving Environments

Review of impact predictions presented in **Section 5** to **Section 7** indicates the following receiving environments will experience negligible noise impacts:

- Tuckers lane (south of the development);
- North Rothbury (west of the development); and
- Branxton (north-west of the development).

As the impact of the proposed TSF on these receiving environments is considered negligible, no further assessment of cumulative noise impacts is presented for these locations.

10.2.2 Greta Receiving Environment (R1)

Review of operator attended monitoring results presented in **Appendix II** indicates the ambient noise environment at this location is dominated by relatively equal contributions from road and rail noise. In the absence of any other significant industrial or environmental noise sources, it is conservatively assumed that these sources provide an equal contribution to the measured $L_{Aeq,night}$ ambient noise level in this receiving environment of 50 dB(A). These sources are therefore assumed to each contribute 47 dB(A) at this monitoring location.

10.2.2.1 Hunter Expressway Noise Impacts

Review of the NIA for the Hunter Expressway indicates that mitigated $L_{Aeq,9hr}$ noise levels will comply with the night period ECRTN criterion of 55 dB(A) for all receivers in Greta. General extrapolation of the prediction for mitigated 2026 $L_{Aeq,9hr}$ impacts indicates road noise levels associated with the Hunter Expressway may approach 41 dB(A) during the night period.

10.2.2.2 New England Highway Noise Impacts

Review of the EA for the Hunter Expressway indicates that traffic volumes on the New England Highway are expected to decrease by up to 60% following completion of the Newcastle to Branxton link. Assuming a 60% reduction vehicle pass by events, $L_{Aeq,period}$ noise levels generated by the New England Highway at this location are likely to reduce to a level in the order of 43 dB(A).

10.2.2.3 Potential Third Rail line Noise Impacts

The Minimbah Third Track Environmental Assessment (GHD 2008) indicates receivers more than 500m from the rail line on the Minimbah to Whittingham section of the line may experience an increase in current $L_{Aeq,9hr}$ noise levels from rail sources by up to 2dB(A). The monitoring location in Greta is approximately 1000m from the rail corridor, so the impact is conservatively assessed as a potential +1dB(A) increase.

10.2.2.4 Cumulative Noise Impact

Data presented in **Table 42** provides an assessment of potential cumulative noise impacts associated with the Hunter Expressway, third rail line and Train Support Facility.

Table 42: Cumulative noise impact

	Assessed Contribution, dB(A)
Hunter Expressway	41
New England Highway	43
Third Rail	48
Train Support Facility	< 30
Ambient $L_{Aeq,night}$	50
Cumulative $L_{Aeq,night}$ (all sources)	50
Cumulative $L_{Aeq,night}$ (without TSF)	50
Amenity Criteria	45

The results presented in **Table 42** indicate the cumulative noise impacts associated with the three developments will not generate cumulative noise impacts exceeding ambient night period noise levels. It should be noted however, the contribution from the TSF is not significant in comparison to existing levels of transportation noise, and will have negligible influence on cumulative $L_{Aeq,period}$ noise levels.

10.2.3 Illalong Receiving Environment (R2)

10.2.3.1 Hunter Expressway Noise Impacts

Review of the NIA for the Hunter Expressway link indicates that mitigated $L_{Aeq,9hr}$ noise levels will comply with the night period ECRTN criterion of 55 dB(A) for all receivers in Illalong. General extrapolation of the prediction for mitigated 2026 $L_{Aeq,9hr}$ impacts indicates road noise levels associated with the Hunter Expressway may approach 53 dB(A) during the night period at receivers on Mansfield Road, adjacent to the TSF site access.

10.2.3.2 Potential Third Rail line Noise Impacts

Review of operator attended monitoring results presented in **Appendix II** indicates $L_{Aeq,15minute}$ noise impacts associated with the passage of coal trains on the northern line may reach levels of 57 dB(A) at receivers in Mansfield Street adjacent to the TSF site access. This impact is based on the passage of 1 train in the 15 minute assessment period, or (on average) 4 per hour. Review of predicted rail movements in the Minimbah Third Track Environmental Assessment (GHD 2008) indicates the rail corridor will handle approximately 140 train movements per day by the year 2018, equating to approximately 6 train movements per hour. Assuming the measured rail contribution presented in the attended monitoring results is representative of the long term impact, a conservative assessment of future rail noise impact is made based on extrapolated impacts presented in the GHD report.

The assessment indicates that receivers between 100m and 300m from the rail line on the Minimbah to Whittingham section of track may experience an increase in current $L_{Aeq,9hr}$ noise levels from rail sources between 1 and 4 dB(A). Receivers closest to the site access road are approximately 250m from the rail corridor, so the future impact is conservatively assessed as a potential +2 dB(A) increase.

10.2.3.3 Cumulative Noise Impact

Assessment presented in **Table 43** provides an assessment of potential cumulative noise impacts associated with the Hunter Expressway, third rail line and Train Support Facility.

Table 43: Cumulative noise impact

	Assessed Contribution
Hunter Expressway	53
Third Rail	59
Train Support Facility	30
Ambient $L_{Aeq,night}$	57
Cumulative $L_{Aeq,night}$ (all sources)	60
Cumulative $L_{Aeq,night}$ (without TSF)	60
Amenity Criteria	40

The results presented in **Table 43** indicate the cumulative noise impacts associated with the three developments may generate cumulative noise impacts exceeding ambient night period noise levels. Review of the contribution from each of the development sources indicates the cumulative noise impact will be dominated by traffic on the rail corridor. The contribution from the TSF is not considered significant in comparison to either existing or anticipated levels of transportation noise, and will have negligible influence on cumulative $L_{Aeq,period}$ noise levels.

10.2.4 New England Highway Receiving Environment (R6)

Review of operator attended monitoring results presented in **Appendix II** indicates the ambient noise environment at this location is dominated by the passage of vehicles on the New England Highway, with some observed contribution from rail noise likely at receivers more distant from the road corridor. Analysis of attended monitoring results indicates an $L_{Aeq,15minute}$ contribution of 57 dB(A) from road noise on the New England Highway. Rail noise contribution from the same dataset were assessed to be 56 dB(A).

It is acknowledged that this data was collected during the early morning peak and may not be representative of long term impacts in this receiving environment, as L_{Aeq} contributions are greater than ambient $L_{Aeq,period}$ results presented in **Section 3.2.** To ensure representative assessment, the relative contribution from these source is based on the measured $L_{Aeq,period}$ result for the night period (presented in **Section 3.2**), adjusted in accordance with the relationship between road and rail contributions presented above.

Table 44: Cumulative noise impact

	Measured $L_{Aeq,15minute}$	Ambient $L_{Aeq, night}$	Assessed Contribution
New England Highway	57	53	50
Rail Contribution	56		49
All Sources	60		53

10.2.4.1 Hunter Expressway Noise Impacts

Review of the NIA for the Hunter Expressway link indicates that mitigated $L_{Aeq,9hr}$ noise levels will comply with the night period ECRTN criterion of 55 dB(A) for all receivers on the New England Highway. General extrapolation of the prediction for mitigated 2026 $L_{Aeq,9hr}$ impacts indicates road noise levels associated with the Hunter Expressway may approach 55 dB(A) at receivers to the south of the highway and 50 dB(A) at receivers to the north during the night period.

10.2.4.2 New England Highway Noise Impacts

Review of the EA for the Hunter Expressway indicates that traffic volumes on the New England Highway are expected to decrease by approximately 60% following completion of the Newcastle to Branxton link. Assuming a 60% reduction vehicle pass by events, noise levels generated by the New England Highway at this location are likely to reduce to a level on the order of 46 dB(A).

10.2.4.3 Potential Third Rail line Noise Impacts

The Minimbah Third Track Environmental Assessment (GHD 2008) indicates that receivers approximately 500m from the rail line on the Minimbah to Whittingham section of track may experience an increase in current $L_{Aeq,9hr}$ noise levels from rail sources by up to 2dB(A). Separation distances to receivers on the New England Highway corridor range from approximately 400m to the south of the highway to more than 600m on the northern side of the highway. The impact is assessed as a potential +1dB(A) increase for receivers to the north of the highway and +2 dB(A) for receivers to the south.

10.2.4.4 Cumulative Noise Impact

Assessment presented in **Table 45** provides an assessment of potential cumulative noise impacts associated with the Hunter Expressway, third rail line and Train Support Facility.

Table 45: Cumulative noise impact

	Assessed Contribution	
	South of Highway	**North of Highway**
Hunter Expressway	55	50
New England Highway	46	46
Third Rail	51	50
Train Support Facility	38	30
Ambient $L_{Aeq,night}$	53	
Cumulative $L_{Aeq,night}$ (all sources)	57	54
Cumulative $L_{Aeq,night}$ (without TSF)	57	54
Amenity Criteria	45	

The results presented in **Table 45** indicate the cumulative noise impacts associated with the three developments may generate cumulative noise impacts exceeding ambient night period noise levels. Review of the contribution from each of the development sources indicates the cumulative noise impact will be dominated by road noise from the Hunter Expressway with a moderate contribution from the rail corridor. The contribution from the TSF is not considered significant in comparison to either existing or anticipated levels of transportation noise, and will have negligible influence on cumulative $L_{Aeq,period}$ noise levels.

10.3 Assumptions of the Assessment

The following assumptions are made with regards to the assessment:

- predicted $L_{Aeq,15minute}$ noise impacts from TSF operations are used as an indicator of potential $L_{Aeq,peiod}$ impacts. This is likely to present a conservative assessment of the contribution from TSF operations to cumulative noise levels;
- predicted $L_{Aeq,15minute}$ noise impacts from TSF operations represent the greatest impact under worst case meteorological conditions specific to the receiving environment;
- assessment of night period impacts only is presented as noise levels generated by the TSF are compliant with the PSNL for the day and evening period;

- interpretation of potential future rail noise impacts is based on single point impact predictions provided for the Minimbah Third Track Environmental Assessment (GHD 2008). While it is understood that these results are subject to influence from intervening topography, for the purposes of this assessment, no correction is made for results potentially affected by intervening topography that may enhance or attenuate noise from distant rail sources. Impact predictions are assumed to be influenced only by source to receiver distance attenuation functions; and
- the amenity criteria presented is based on an assessment of background monitoring data which identified urban receiving environments adjacent to the New England Highway and in Greta and a suburban receiving environment at Illalong. The characteristics that define these receiver types may be subject to change during the operation phase of these developments, with receiving environments along the New England Highway corridor potentially redefined as suburban receivers. Potential changes to the amenity criteria are not considered to impact on the outcomes of this assessment; however, existing and future transportation noise impacts significantly exceed both the existing amenity criteria and the expected contribution from the TSF.

11. RECOMMENDED MITIGATION MEASURES

11.1 Engineered Noise Mitigation

Modelling results indicate worst case noise impacts for receiving environments in Greta, Illalong and on the New England Highway comply with the day and evening period PSNL under all significant meteorological conditions. As the development is proposed to operate 24 hours a day, the night period PSNL becomes the limiting criterion for the assessment of noise impacts. Assessment of unmitigated operations indicates significant noise impacts may be experienced by the receiver cluster adjacent to the site access road off Mansfield Road.

Assessment of potential mitigation options presented in **Section 6.4** indicates the construction of a barrier adjacent to the site access road will effectively mitigate impacts generated by light vehicle access to the site during the night period. Construction of a barrier adjacent to the arrival (rail) road will also reduce L_{A1} noise imissions from wheel interactions at track junctions introduced by access to the TSF. The nominal location of these barriers is provided in **Figure 22**.

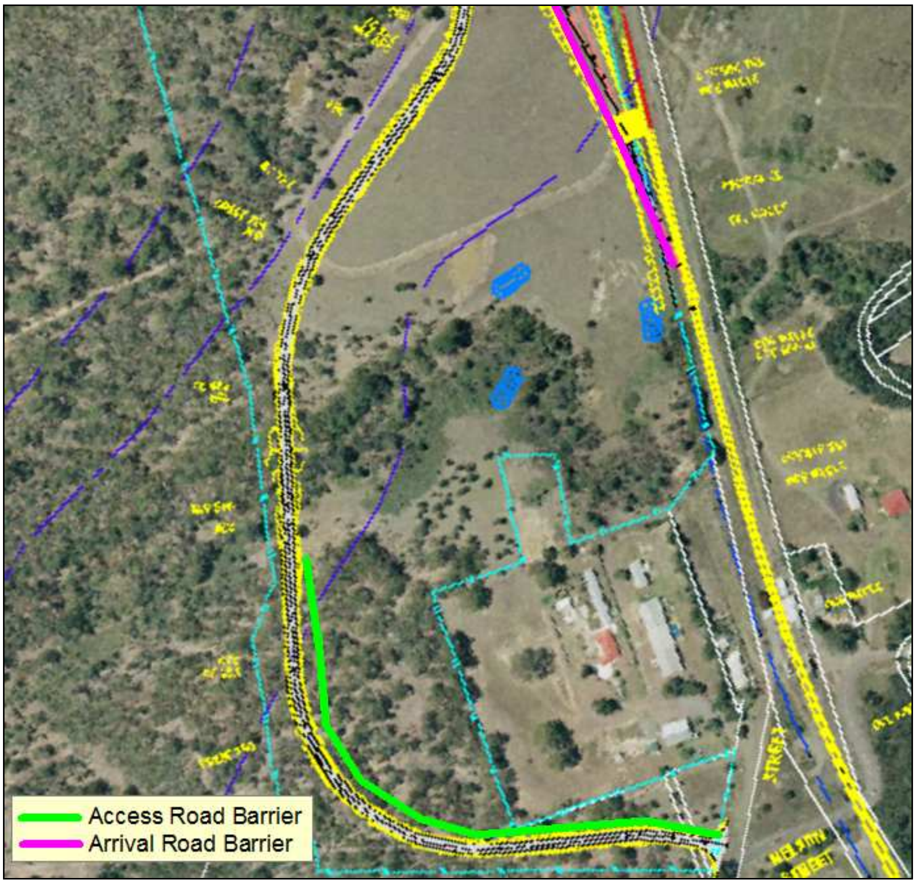


Figure 22: Concept design for noise barriers

It should be noted that design of noise barriers was undertaken as part of this assessment and for the purposes of understanding source to receiver interactions at the site access. The barrier specifications provided are in concept only. Detailed assessment of the most suitable barrier configuration should be undertaken prior to construction and following consultation with the affected receivers and the NSW Department of Environment, Climate Change and Water (DECCW).

11.2 Operational Noise Management

Impact predictions presented in **Section 6** and **Section 7** represent expected worst case operational impacts, with all of sources in the facility operating 100% of the time. This scenario is unlikely to present on a regular basis, particularly during the night period when ancillary site operations such as fuel delivery and peak vehicle movements would not be typical. However, due to the transient nature of noise likely to be generated by site activities and the potential for exceedence of the PSNL, a number of operational controls are recommended for the management of noise impacts:

- restricting heavy vehicle movements during the night period;
- not scheduling noise generating maintenance activities during the night period;
- utilising operational controls during coupling, take off and stopping of trains to minimise the generation of impulsive noise associated with impact between empty wagons; and
- ensuring locomotives and wagons are maintained such that they do not generate excessive levels of noise.

11.3 Construction Noise Management

Impact predictions associated with the construction stage of the proposed development indicate significant exceedences may be observed at receivers near the site access on Mansfield Road. Noise impacts at this location are expected to approach the *highly affected* management level during construction of the internal access road and noise barrier.

Review of specific mitigation strategies presented in **Section 8.7** indicates construction noise impacts may be reduced, but are likely to remain significant due to the small separation distances between construction plant and adjacent receivers. While these works will exceed the construction noise criteria, the intent (to provide a long term solution for the mitigation of noise from site operations) and temporary nature of the works should be considered in evaluating the impact.

It is recommended a Construction Noise Management Plan (CNMP) be developed in conjunction with the detailed construction program such that operational controls may be implemented to minimise potential noise impacts during the construction stage. The *Interim Construction Noise Guideline* (DECC, 2009) provides recommendations for the management of noise from construction works and examples of common mitigation techniques, and should be referenced during preparation of a CNMP.

Following discussion presented in **Section 8.7**, specific measures that may be implemented to reduce construction noise impacts may include:

- consult potentially impacted receivers at an early stage and engage effective communication strategies;
- maintain and operate noise generating equipment in an efficient manner;
- educate plant operators as to on-site noise management obligations;
- locate site compounds and receiving areas away from sensitive receivers;
- strictly adhere to standard work hours, and schedule noisier activities during less sensitive times of the day (e.g. 9am to 12pm and 2pm to 5pm);
- schedule respite periods for high impact activities;
- avoid clustering and minimise the number of plant working at any one time to limit cumulative impacts;

- turn off, or reduce idle speeds on stationary equipment when not in use;
- in the case of directional noise (eg cooling fans, mufflers), orient the source such as to direct the greatest noise emission away from adjacent receivers;
- avoid dropping materials from height; and
- undertaking monitoring during early stages of high impact works to understand realised noise impacts, and use this information to guide future noise management.

Importantly, a CNMP should detail the communication strategy between the construction contractor and potentially affected residents, and should also provide a system for receiving, managing and responding to complaints.

12. CONCLUSION

Pacific National proposes to construct and operate a maintenance facility at Greta to provide support to its coal haulage business in the Hunter Valley. The site is located between the existing Northern Railway and the approved Hunter Expressway extension to Branxton. The purpose of this assessment was to undertake detailed assessment of potential noise impacts associated with the construction and operation of the facility and identify conflicts with the existing noise environment.

The results of attended and unattended background monitoring indicate that the existing noise environment is dominated by road and rail traffic on the New England Highway and main northern railway. The contribution from these noise sources is unlikely to decrease in the future as increasing traffic volumes utilise these major transportation corridors. The character of the noise environment at this location is likely to experience change following extension of the F3 freeway to Branxton and construction of a third track in the main northern railway corridor.

Review of attended monitoring results indicates the receiving noise environments adjacent to the proposed development are characterised by a mix of Urban, Suburban and Rural receiver types, dependent upon the proximity to transportation corridors. The PSNL were ultimately established on the basis of the intrusiveness criterion due to the distribution of observed background noise levels.

Assessment of potential noise impacts presented in **Section 6** and **Section 7** indicate the following receiving environments will experience negligible noise impacts:

- Tuckers lane (south of the development);
- North Rothbury (west of the development); and
- Branxton (north-west of the development).

The large separation distances between site operations and these receiving environments and intervening topography means the proposed development is likely to be inaudible at these locations except under certain operational and meteorological conditions. In instances where operations may be audible the impact will be below the PSNL at these locations.

Review of modelling results indicates noise impacts will comply with the amenity criteria in all receiving environments adjacent to the TSF. Potential noise impacts above the intrusiveness criteria were observed in the following receiving environments:

- Greta (north-east of the development);
- existing receivers in Illalong (south-west of the development); and
- receivers on the New England Highway (north of the development).

Detailed review of modelling results indicates that, in all cases, exceedence of the intrusiveness criteria is generated by trains accessing the facility and approaching the provisioning shed. These rail pass-by events currently impact on the amenity of the receiving noise environment and would continue to do so in the absence of the TSF. It is therefore considered that these pass-by events do not represent an additional noise impact generated by the TSF, and were excluded from further assessment against the PSNL.

Following the exclusion of these sources, modelling results indicate new noise impacts generated within the TSF will comply with the day, evening and night period PSNL. Analysis also indicates noise impacts will comply with the PSNL for all non-residential sensitive receivers adjacent to the proposed development when these facilities are in use.

Vehicular access to the facility via the site access road was also identified as a significant noise impact due to the small separation distances between the proposed access point and adjacent sensitive receivers off Mansfield Road. Several amendments to the development were proposed to mitigate these impacts, including an alternative alignment for the site access road to maximise separation distances, and construction of a barrier to reduce noise propagation.

Assessment of various mitigation options indicates the impact may be reduced to a level below that of the PSNL, however environmental and engineering constraints in this part of the site are likely to place restrictions on the disturbance area and footprint available for construction of the noise barrier. While exceedence of the day period intrusiveness criteria may be observed with the passage of heavy vehicles, construction of a 2m barrier adjacent to the site access road will reduce operational night period impacts to a level below the PSNL at all existing receivers adjacent to the site access.

Short term noise events associated with transient site activities may exceed the sleep disturbance criteria at:

- receivers in Greta (L_{A1} noise levels may approach 50 dB(A) during periods of south-westerly winds);
- receivers in Illalong (L_{A1} noise levels may approach 50 dB(A) during periods of temperature inversion); and
- receivers to the north of the site on the New England Highway(L_{A1} noise levels may approach 55 dB(A) under inversion conditions).

It should be noted that these results provide an assessment of *95th percentile* L_{A1} noise levels, and compliance with the criteria is likely under all meteorological conditions during periods of *average* L_{A1} impacts.

Assessment of ambient noise levels indicates predicted impacts will be consistent with the character of existing transportation sources. While the contribution from proposed TSF operations is likely to be masked by ambient road and rail noise, a number of controls are recommended to mitigate noise generated by transient noise sources:

- construction of a noise barrier adjacent to the site access;
- utilising operational controls during coupling, take off and stopping of trains to minimise the generation of impulsive noise associated with impact between empty wagons;
- restricting heavy vehicle movements during the night period;
- not scheduling noise generating maintenance activities during the night period; and
- ensuring locomotives and wagons are maintained such that they do not generate excessive levels of noise.

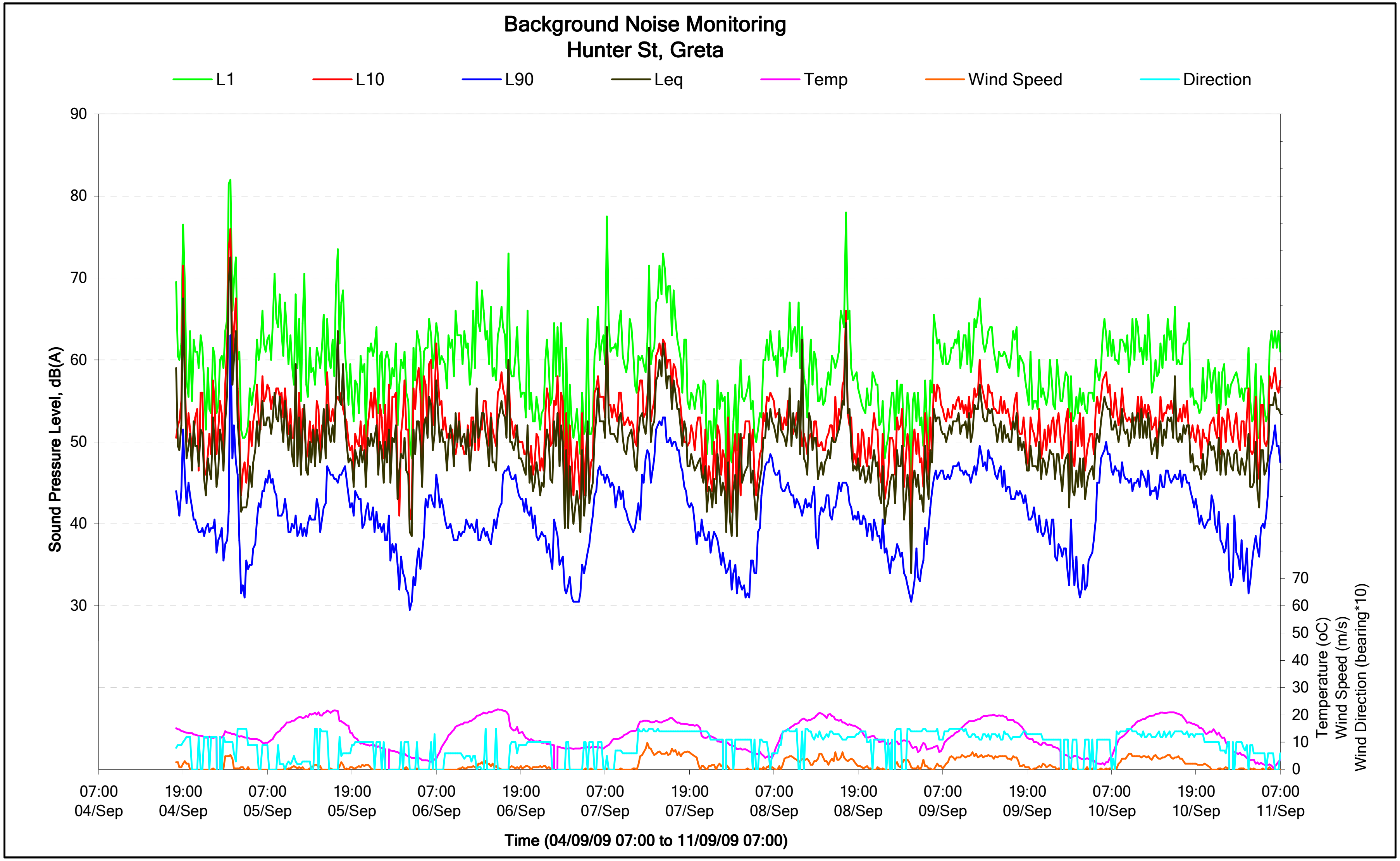
Noise generated during the construction phase of the development is likely to exceed the construction noise criteria in the Greta and Illalong receiving environments and management of potential impacts should be undertaken by development of a construction noise management plan as part of detailed construction planning. Consultation should be undertaken at an early stage of the development to establish clear communications strategies between potentially affected receivers and the proponent and their contractors.

Assessment of cumulative noise impacts indicates that $L_{Aeq,period}$ noise levels in receiving environments around Greta and Illalong may increase due to proposed changes to transportation infrastructure, however the contribution from TSF operations is negligible in comparison to the contribution from proposed transportation sources.

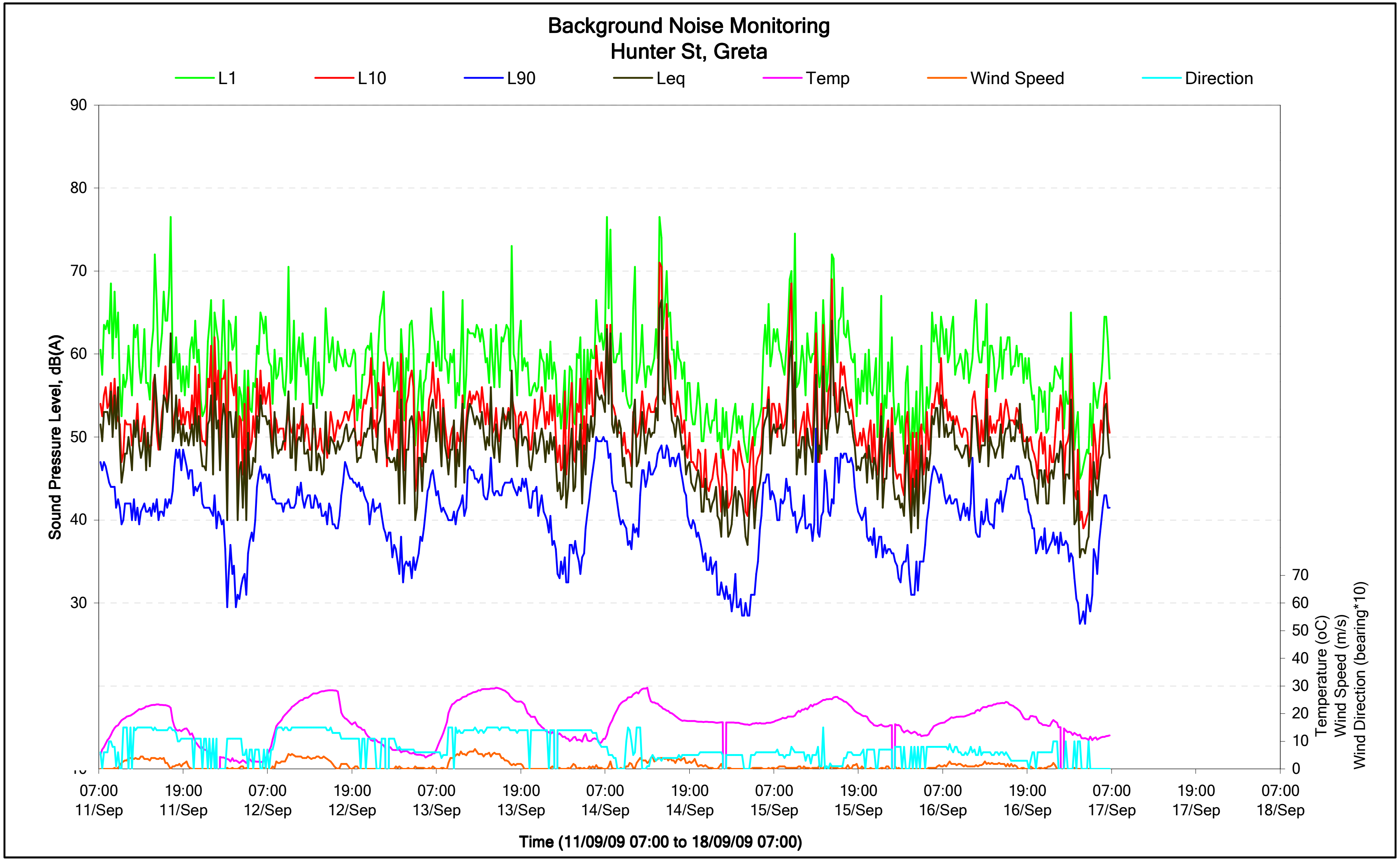
While operations may be audible at times, the character of noise impacts generated by the TSF is considered to be consistent with the character of the existing noise environment at Greta.

Appendix I

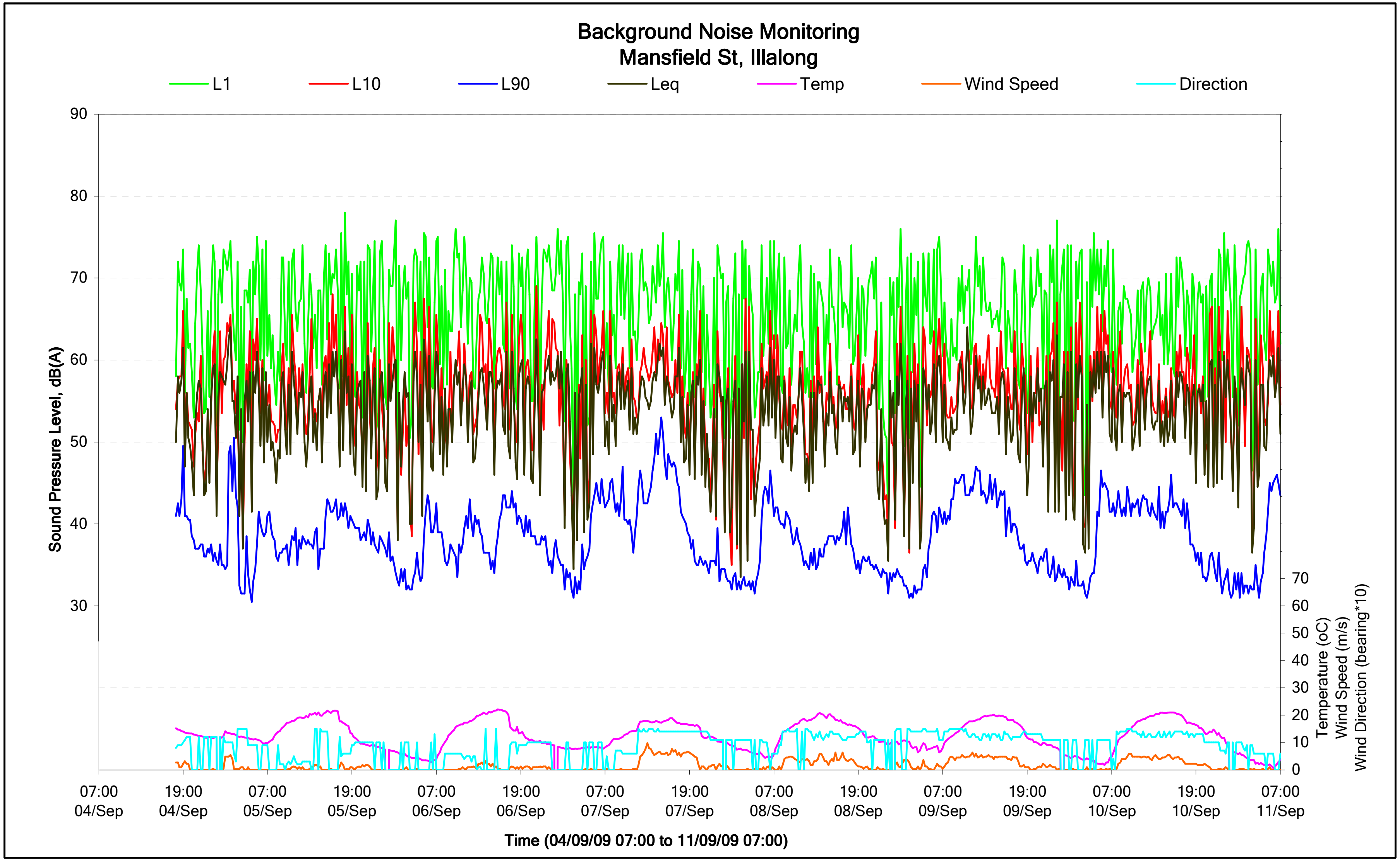
Background Monitoring:
Logger Results

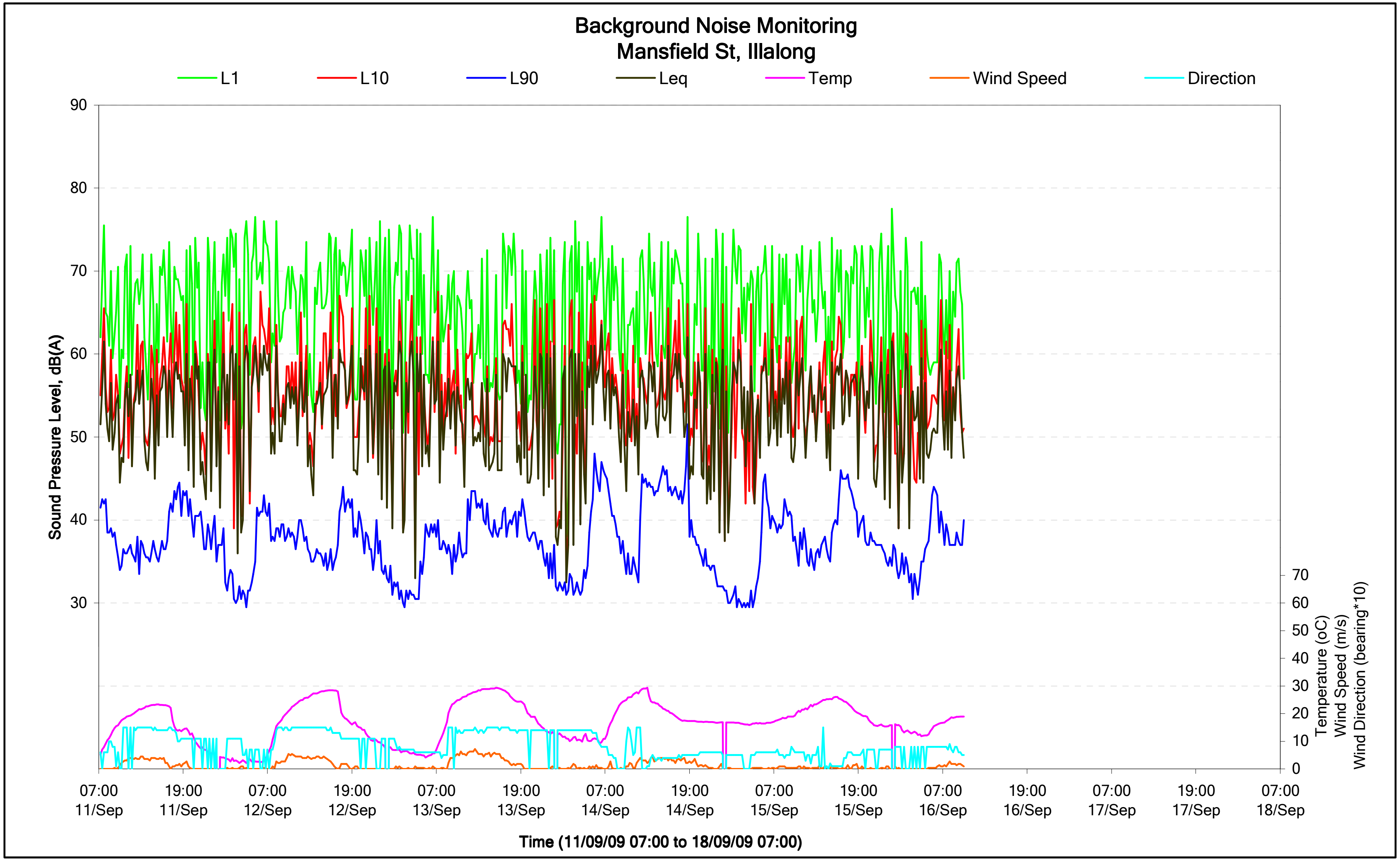


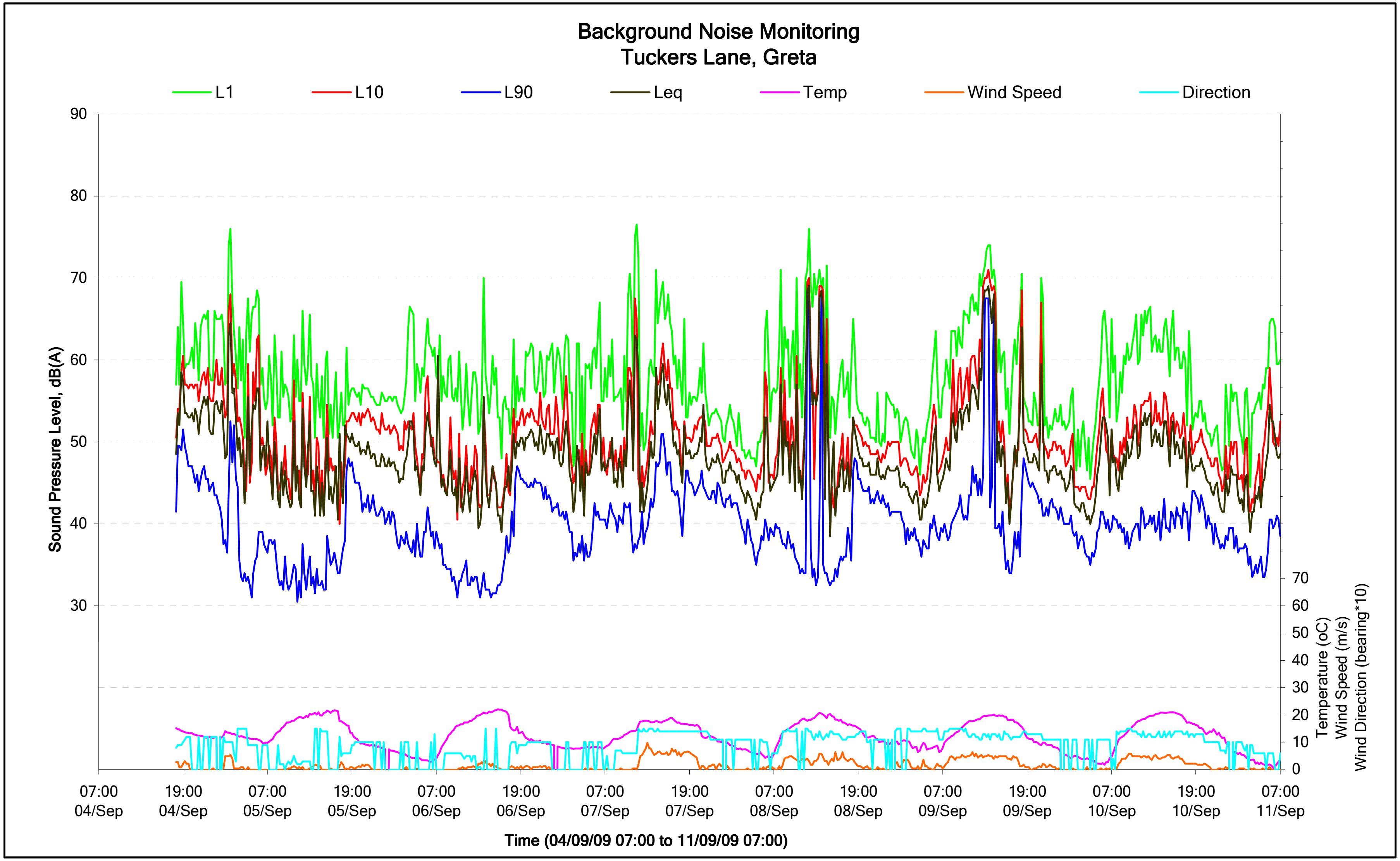
Background Noise Monitoring
Hunter St, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)



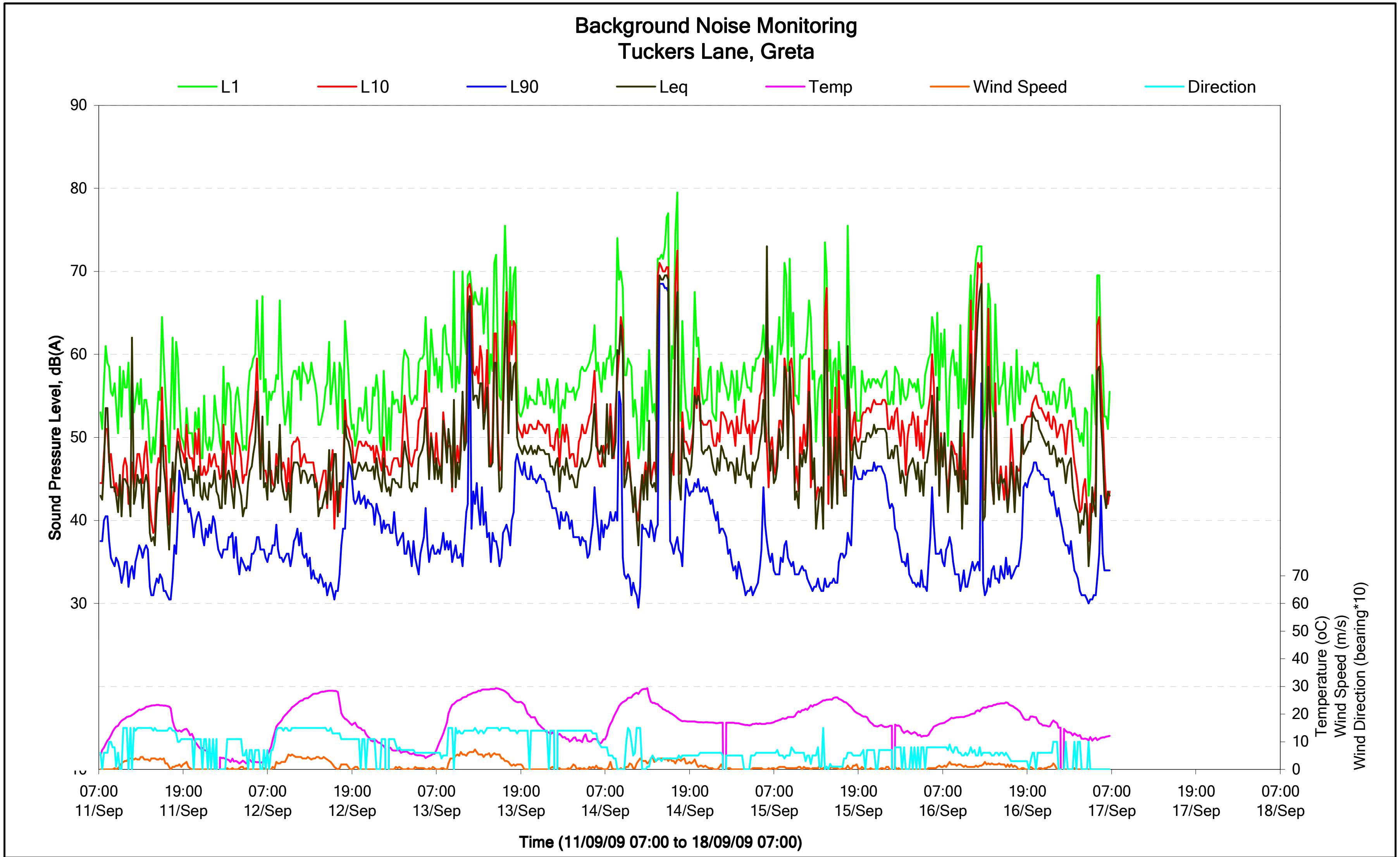
Background Noise Monitoring
Hunter St, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)


Background Noise Monitoring
Mansfield St, Illalong
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)

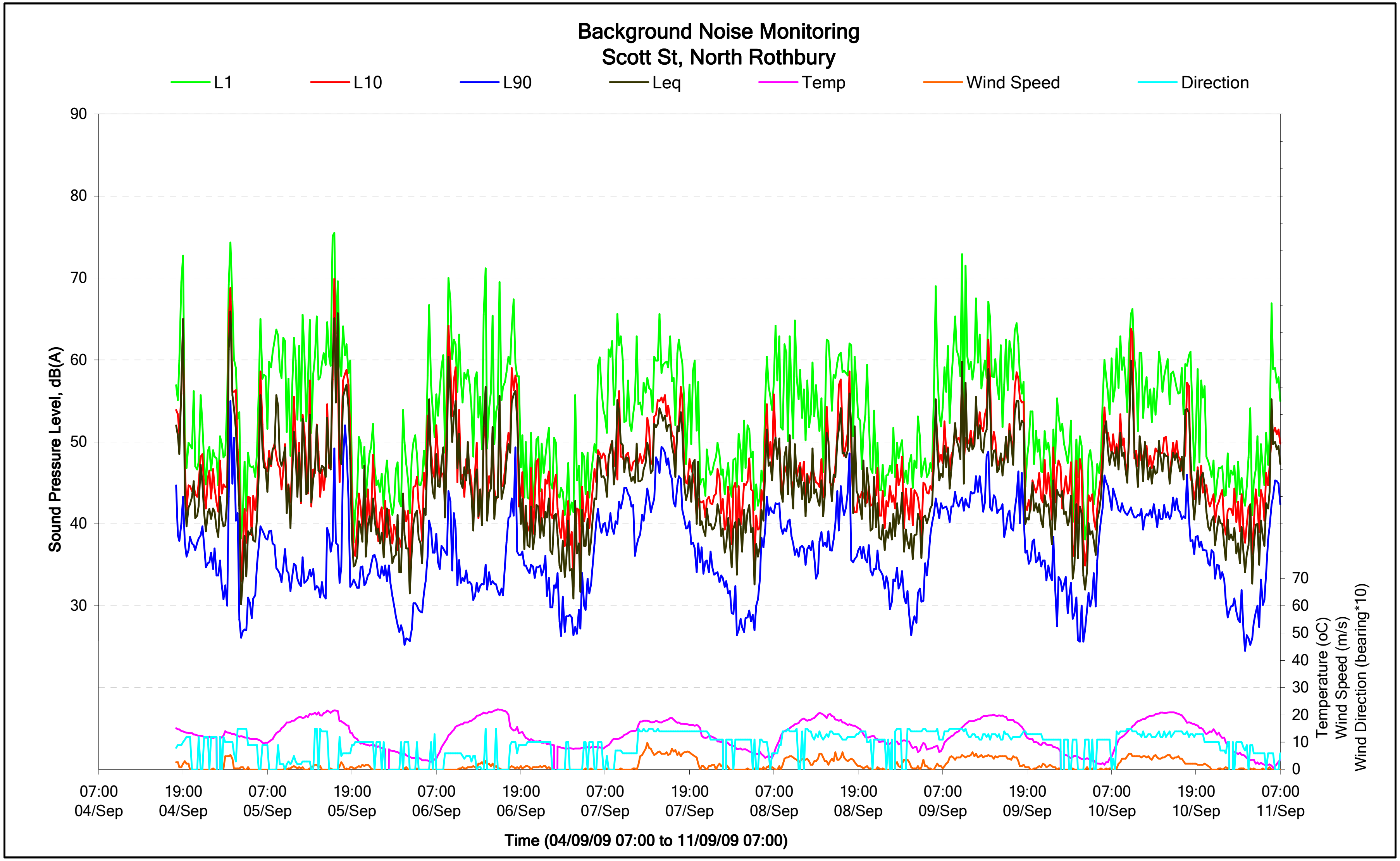

Background Noise Monitoring
Mansfield St, Illalong
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)



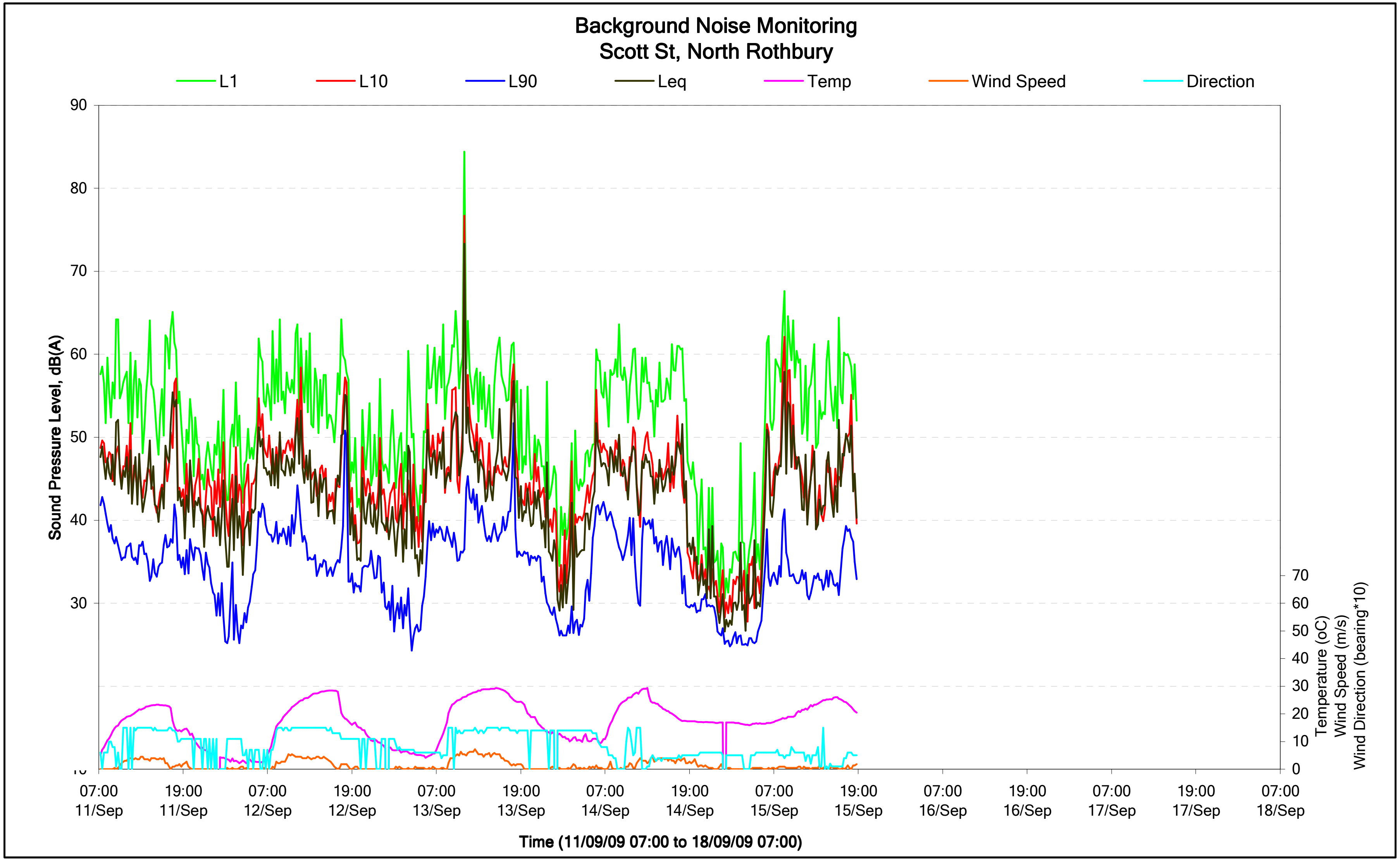
Background Noise Monitoring
Tuckers Lane, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)

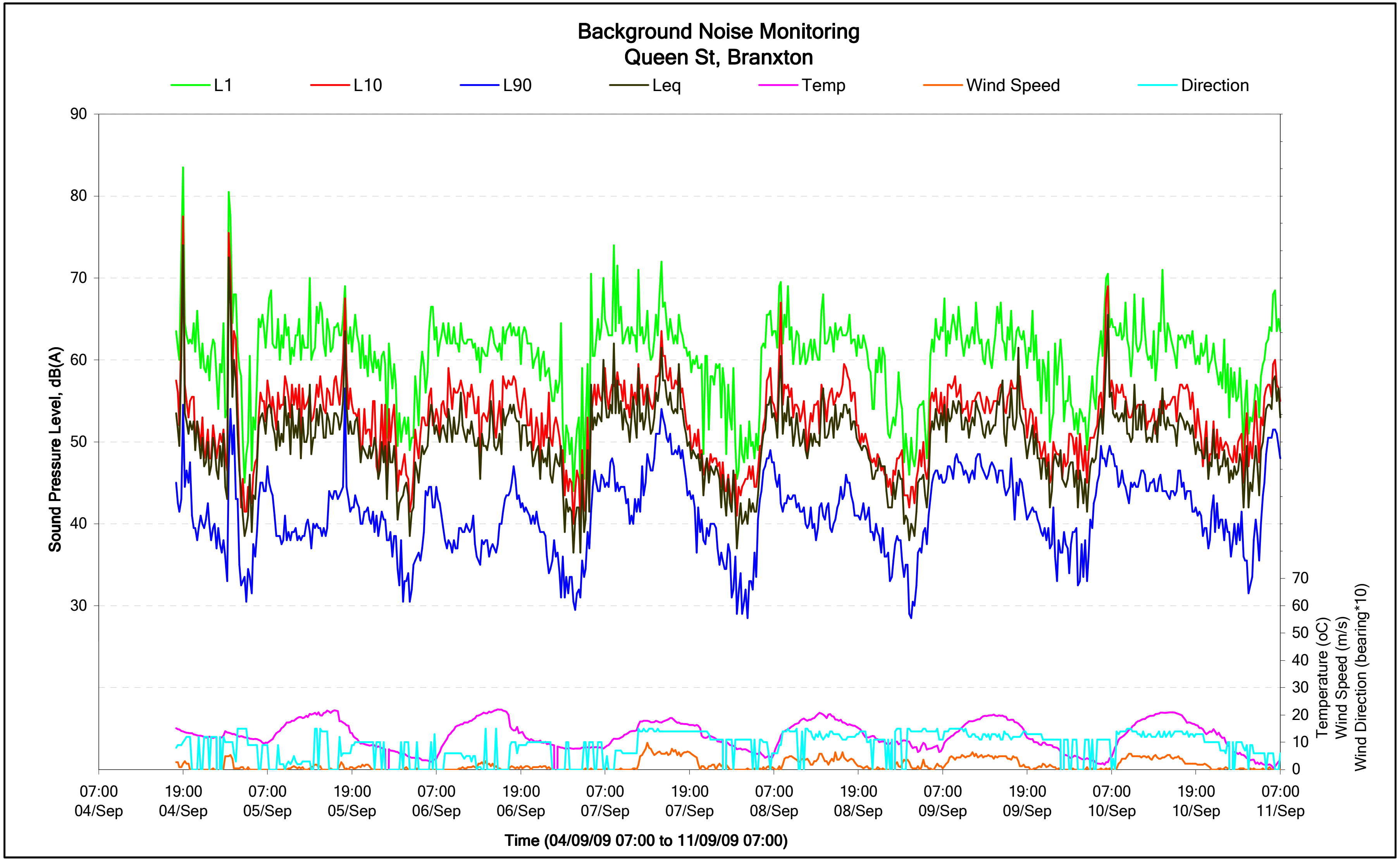


Background Noise Monitoring
Tuckers Lane, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)

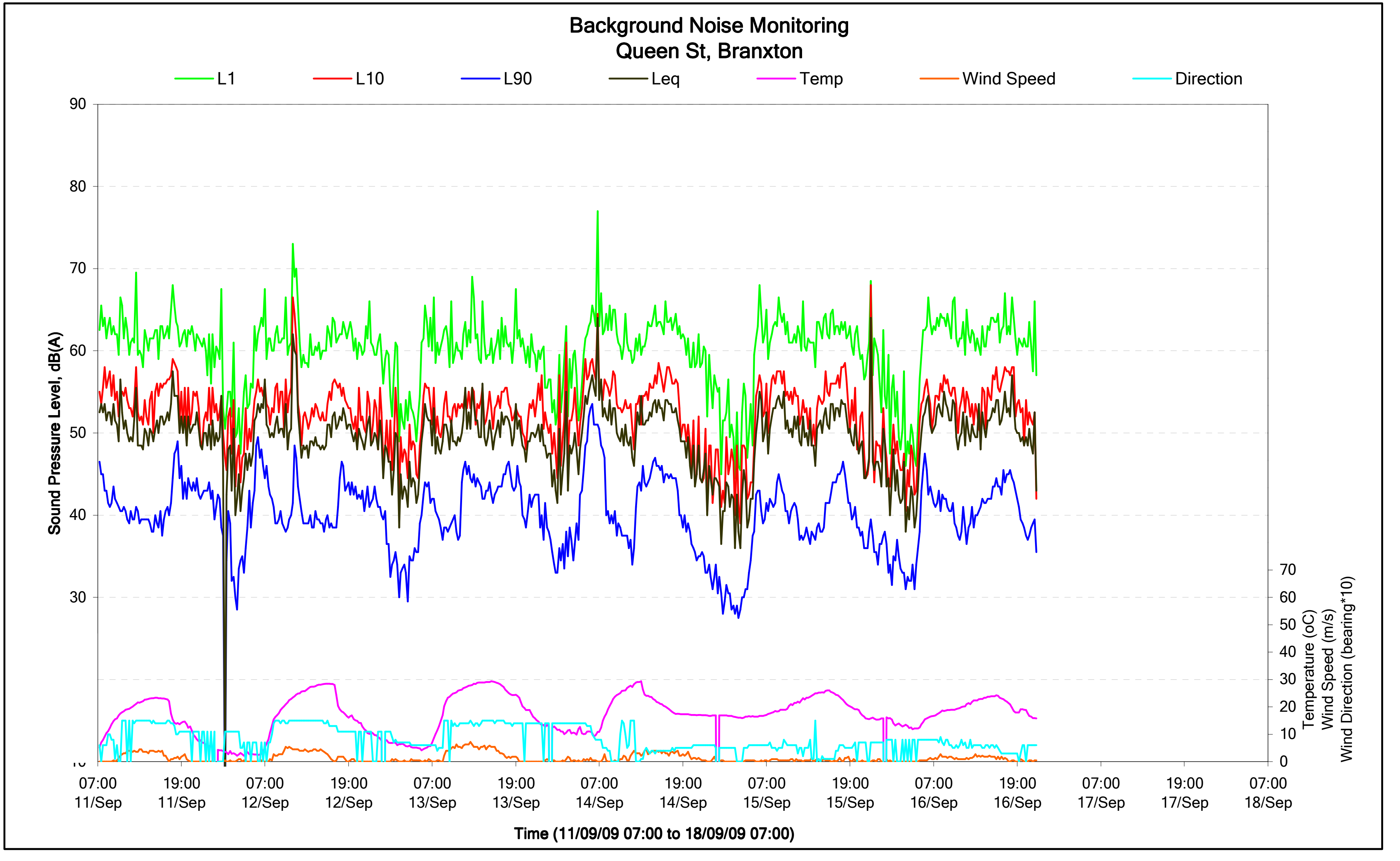


Background Noise Monitoring
Scott St, North Rothbury
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
70
60
50
40
30
20
10
0
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)

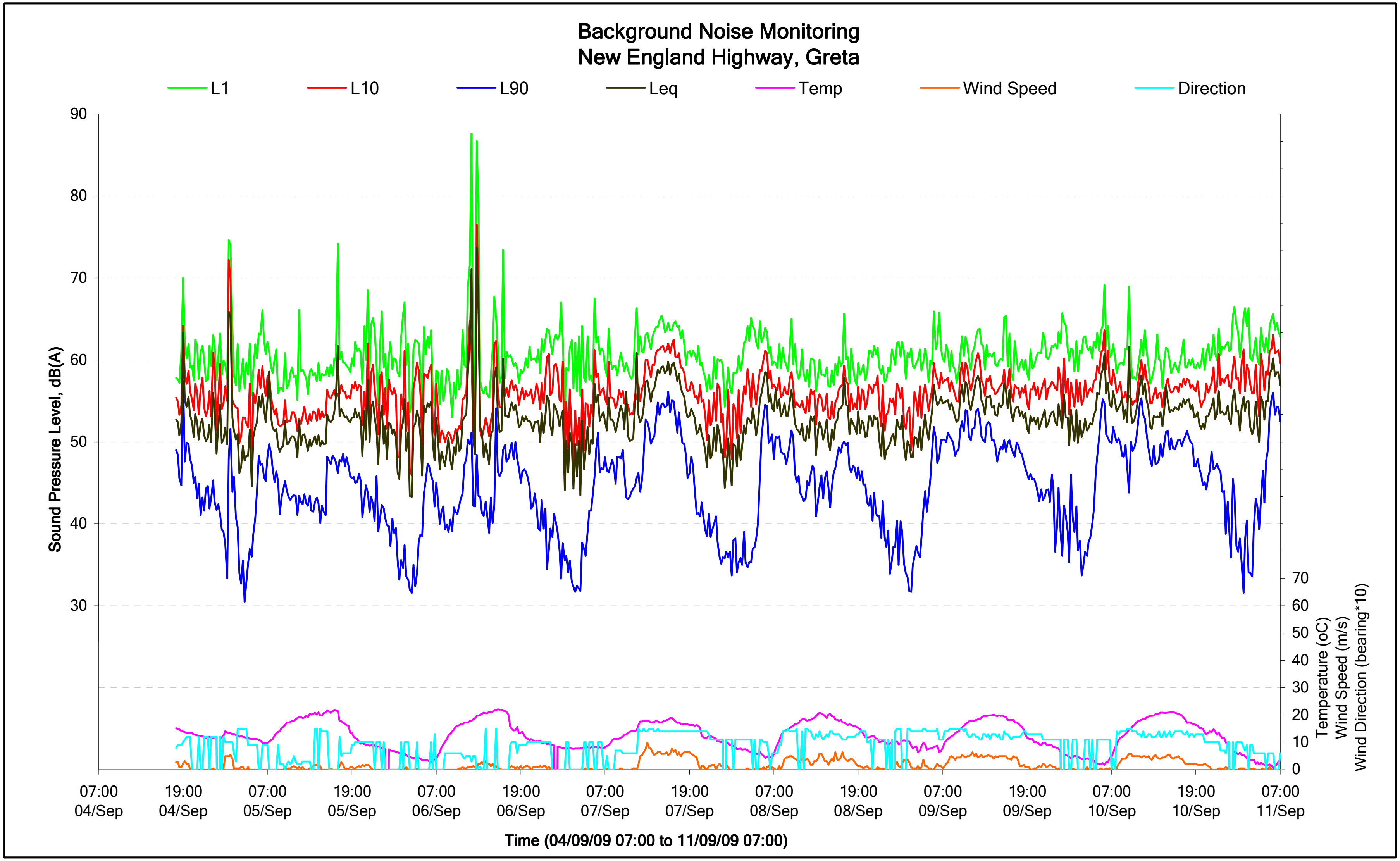

Background Noise Monitoring
Scott St, North Rothbury
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)



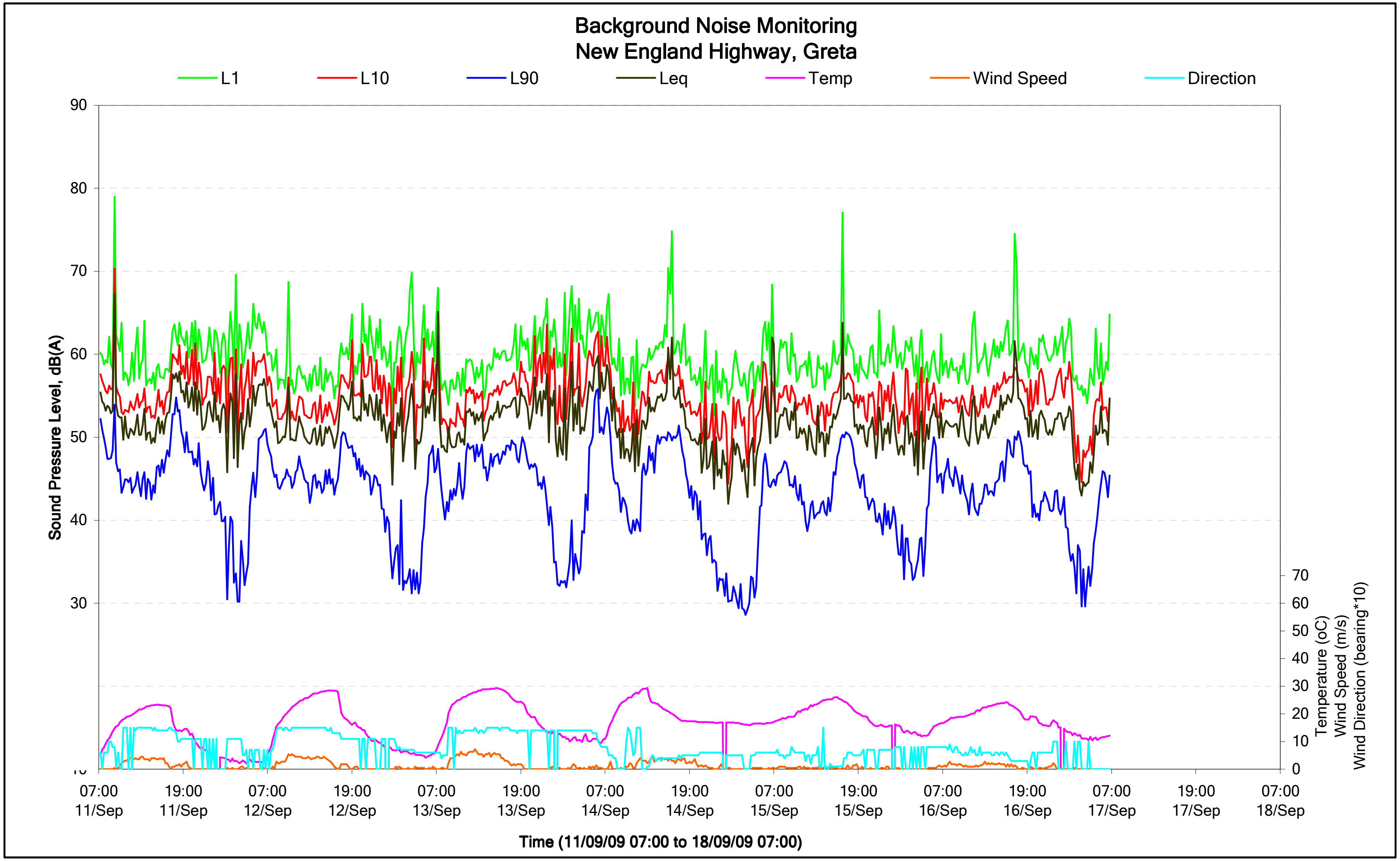
Background Noise Monitoring
Queen St, Branxton
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)



Background Noise Monitoring
Queen St, Branxton
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
70
60
50
40
30
20
10
0
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)



Background Noise Monitoring
New England Highway, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
70
60
50
40
30
20
10
0
07:00 04/Sep
19:00 04/Sep
07:00 05/Sep
19:00 05/Sep
07:00 06/Sep
19:00 06/Sep
07:00 07/Sep
19:00 07/Sep
07:00 08/Sep
19:00 08/Sep
07:00 09/Sep
19:00 09/Sep
07:00 10/Sep
19:00 10/Sep
07:00 11/Sep
Time (04/09/09 07:00 to 11/09/09 07:00)

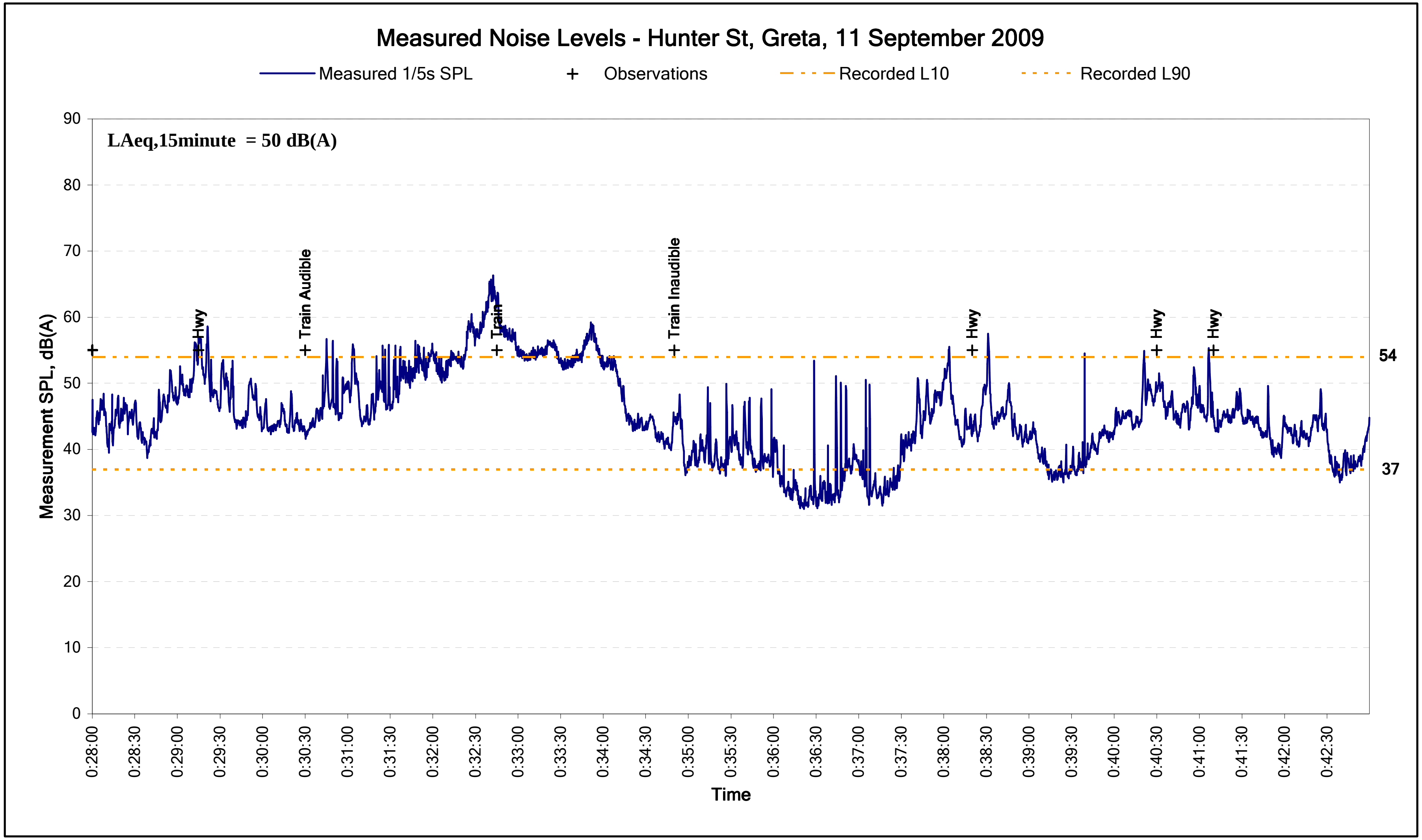

Background Noise Monitoring
New England Highway, Greta
L1
L10
L90
Leq
Temp
Wind Speed
Direction
Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
Temperature (oC)
Wind Speed (m/s)
Wind Direction (bearing*10)
70
60
50
40
30
20
10
0
07:00 11/Sep
19:00 11/Sep
07:00 12/Sep
19:00 12/Sep
07:00 13/Sep
19:00 13/Sep
07:00 14/Sep
19:00 14/Sep
07:00 15/Sep
19:00 15/Sep
07:00 16/Sep
19:00 16/Sep
07:00 17/Sep
19:00 17/Sep
07:00 18/Sep
Time (11/09/09 07:00 to 18/09/09 07:00)

Appendix II

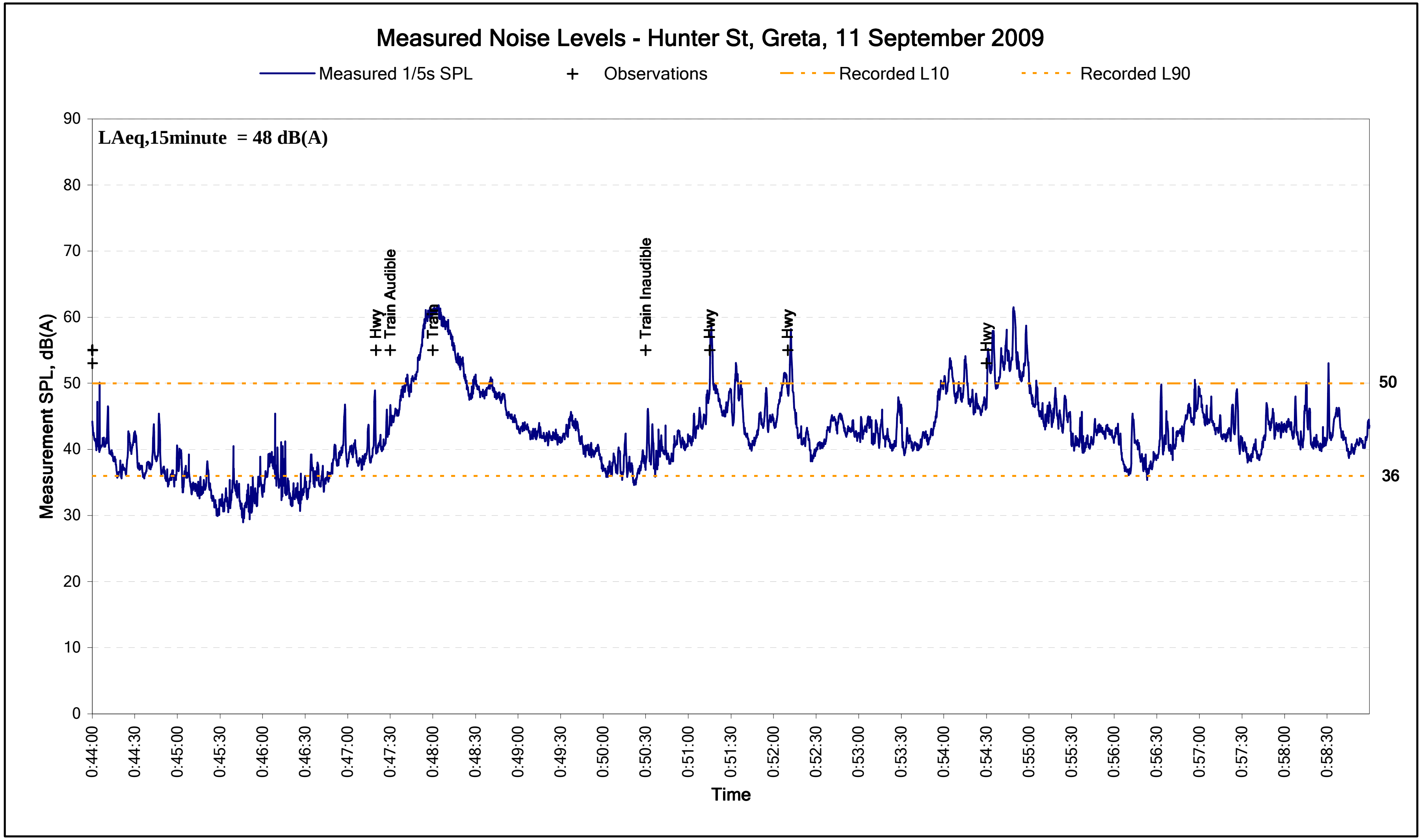
Attended Monitoring
Run Charts

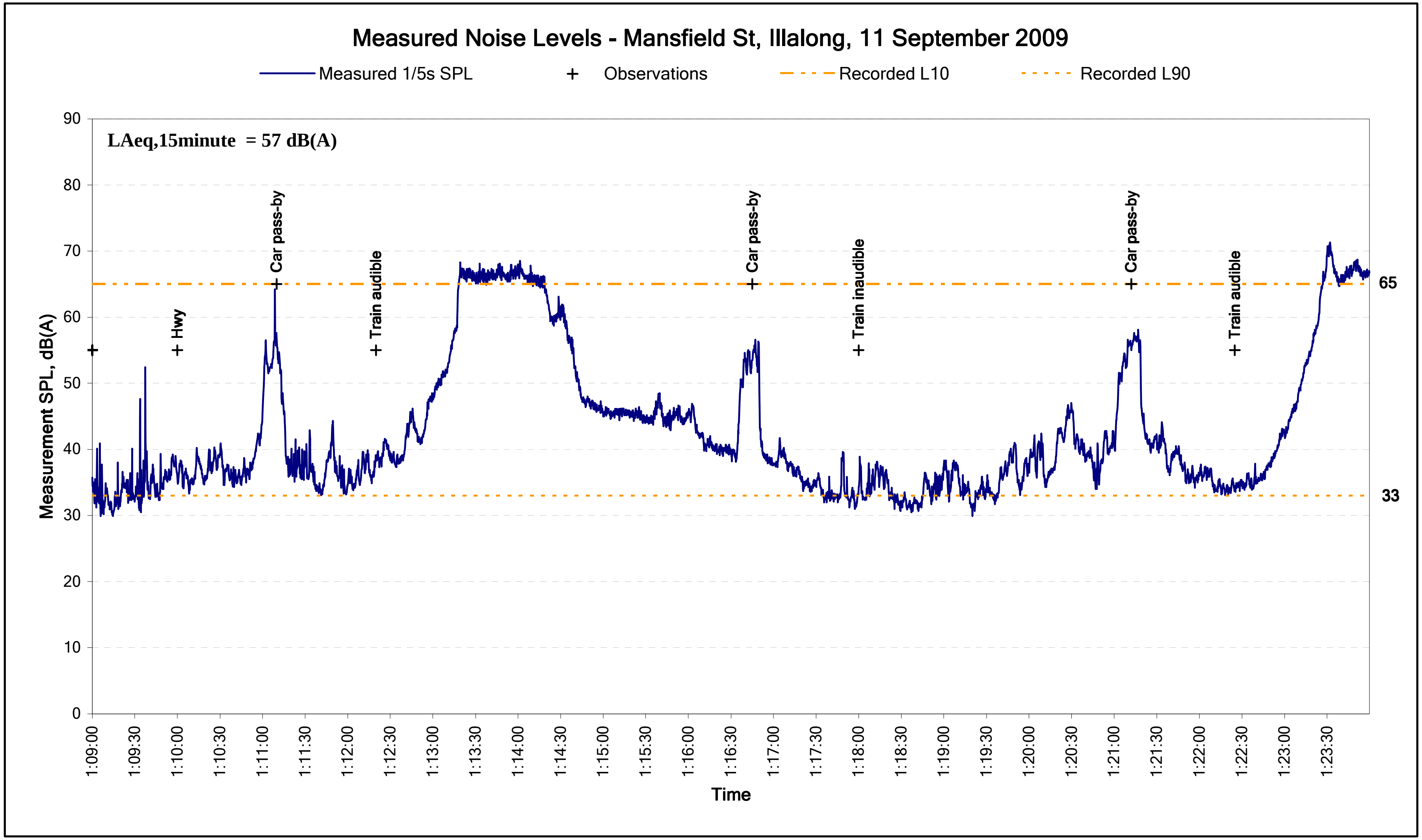
Table A1: Attended monitoring results

Location	Time	Measured SPL, dB(A) L_{A1}	L_{A90}	L_{Aeq}	Description of noise environment
Hunter St, Greta	00:28	61	38	50	Contribution from highway and rail noise is dominant, with L_{Aeq} noise levels controlled by contribution from highway. Background noise sources include barking dogs and insect noise. One train pass-by observed in each measurement.
	00:43	60	36	48	
Mansfield St, Illalong	1:09	68	33	57	Contribution from rail pass-by is dominant source at this location. Passage of vehicles on New England Highway is audible on occasion. Background noise sources predominantly insects. One train pass-by in first measurement, 3 trains in second.
	1:24	71	33	60	
Tuckers Lane	1:49	58	31	54	Background noise sources are dominant at this location, with continuous insect and bird noise observed throughout the measurement. Highway noise remains audible however very distant. Trains travelling toward Newcastle (south (s)) are audibly louder at this location with longer resident times. Two trains were observed in each measurement period.
	2:04	44	30	37	
Scott St, North Rothbury	2:55	44	26	36	Road noise from the New England Highway and Wine Country Drive (WCD) is dominant at this location. Background noise sources include barking dogs and insect noise toward the perimeter of the urban area. One train was observed (travelling to Newcastle) in the 3:15 measurement.
	3:15	46	29	39	
Queen St, Branxton	3:56	51	39	45	Road noise is the dominant source at this location, masking contribution from environmental sources. Contribution from rail corridor was dominant during pass-by, however road noise was still audible. Two trains were observed in the 4:12 measurement.
	4:12	60	43	52	
New England Highway, Greta	4:57	64	50	57	Road noise is the dominant source at this location. Local environmental source including barking dogs, birds and insect noise were also audible. The passage of trains makes a significant contribution at this location; however the Highway remains the dominant noise source. Two trains were observed during the 5:14 measurement.
	5:14	65	55	60	



Measured Noise Levels - Hunter St, Greta, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 50 dB(A)
Hwy
Train Audible
Train
Train Inaudible
Hwy
Hwy
Hwy
54
37
Measurement SPL, dB(A)
Time


Measured Noise Levels - Hunter St, Greta, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 48 dB(A)
Measurement SPL, dB(A)
90
80
70
60
50
40
30
20
10
0
Hwy
Train Audible
Train
Train Inaudible
Hwy
Hwy
Hwy
50
36
0:44:00
0:44:30
0:45:00
0:45:30
0:46:00
0:46:30
0:47:00
0:47:30
0:48:00
0:48:30
0:49:00
0:49:30
0:50:00
0:50:30
0:51:00
0:51:30
0:52:00
0:52:30
0:53:00
0:53:30
0:54:00
0:54:30
0:55:00
0:55:30
0:56:00
0:56:30
0:57:00
0:57:30
0:58:00
0:58:30
Time


Measured Noise Levels - Mansfield St, Illalong, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 57 dB(A)
Measurement SPL, dB(A)
Time
Hwy
Car pass-by
Train audible
Car pass-by
Train inaudible
Car pass-by
Train audible
65
33
90
80
70
60
50
40
30
20
10
0
1:09:00
1:09:30
1:10:00
1:10:30
1:11:00
1:11:30
1:12:00
1:12:30
1:13:00
1:13:30
1:14:00
1:14:30
1:15:00
1:15:30
1:16:00
1:16:30
1:17:00
1:17:30
1:18:00
1:18:30
1:19:00
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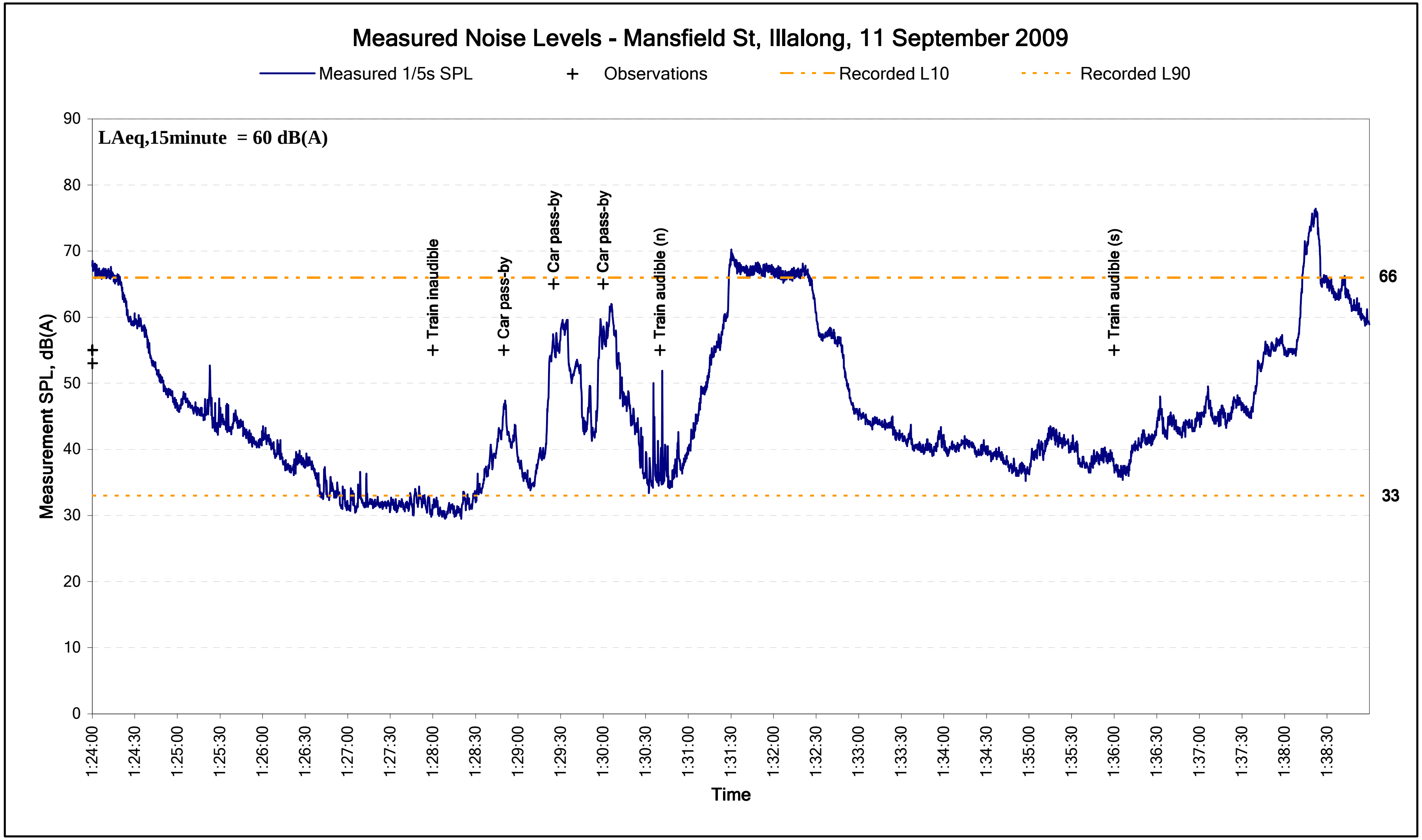
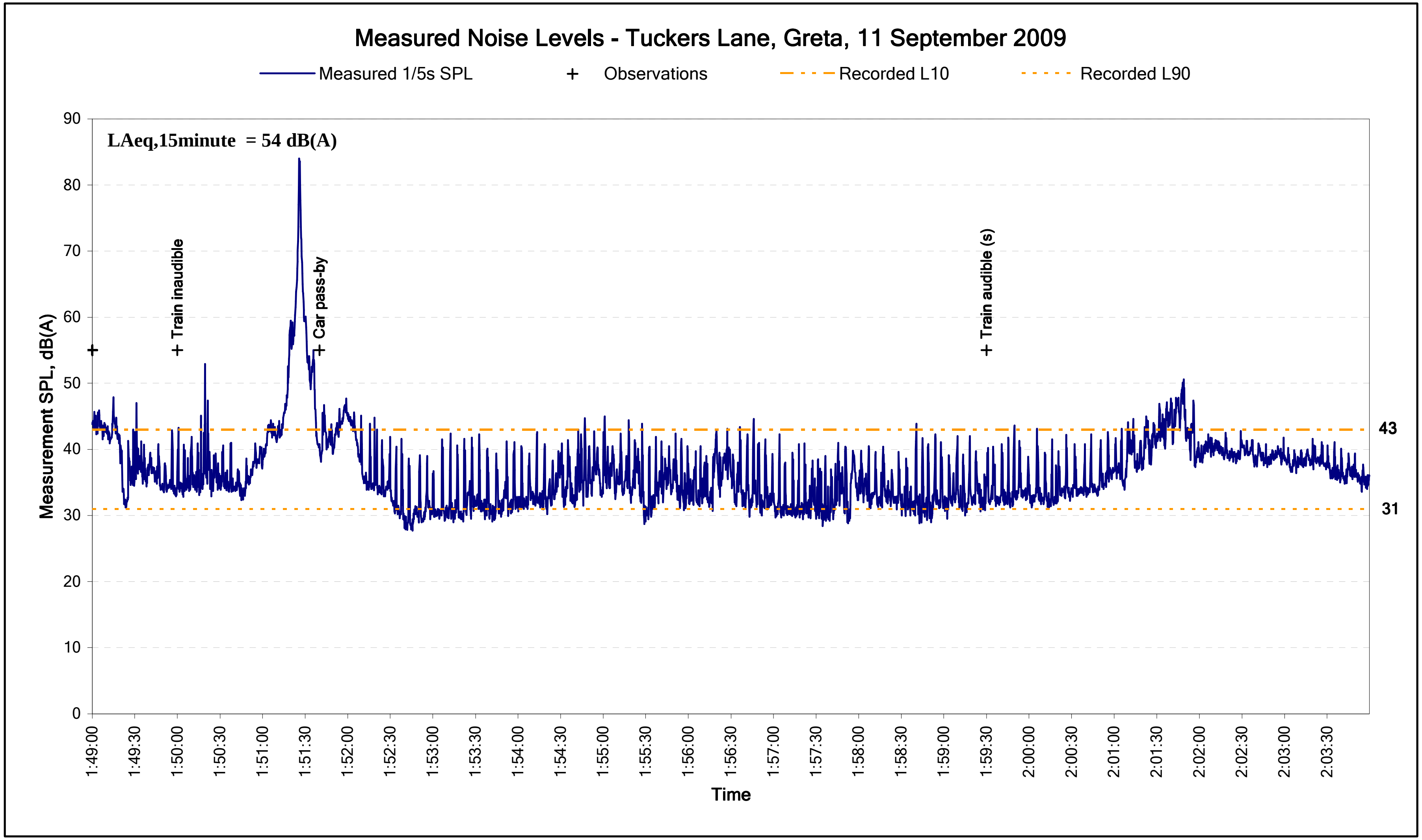
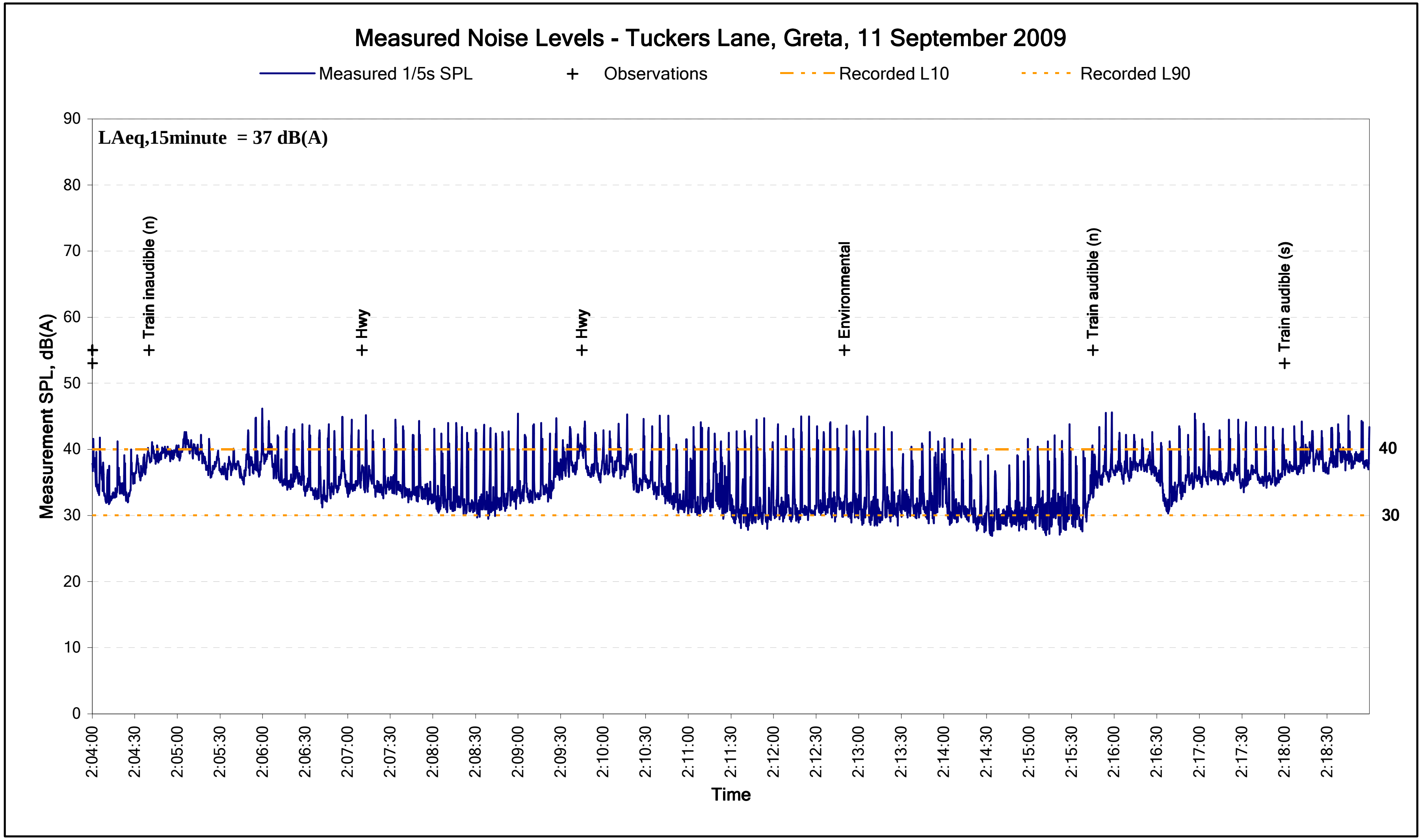
1:23:00
1:23:30

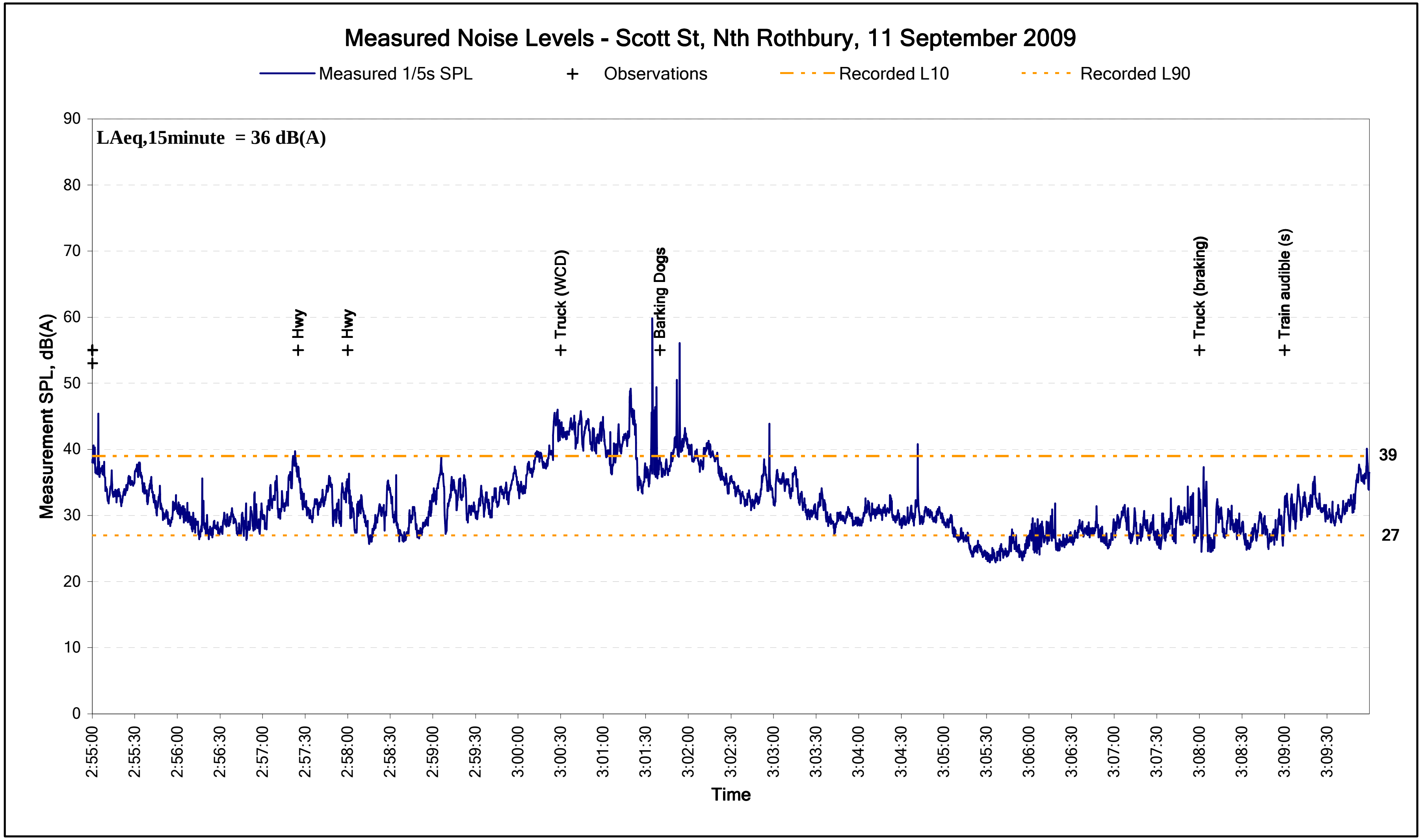


Measured Noise Levels - Mansfield St, Illalong, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 60 dB(A)
Measurement SPL, dB(A)
Time
Train inaudible
Car pass-by
Car pass-by
Car pass-by
Train audible (n)
Train audible (s)
66
33

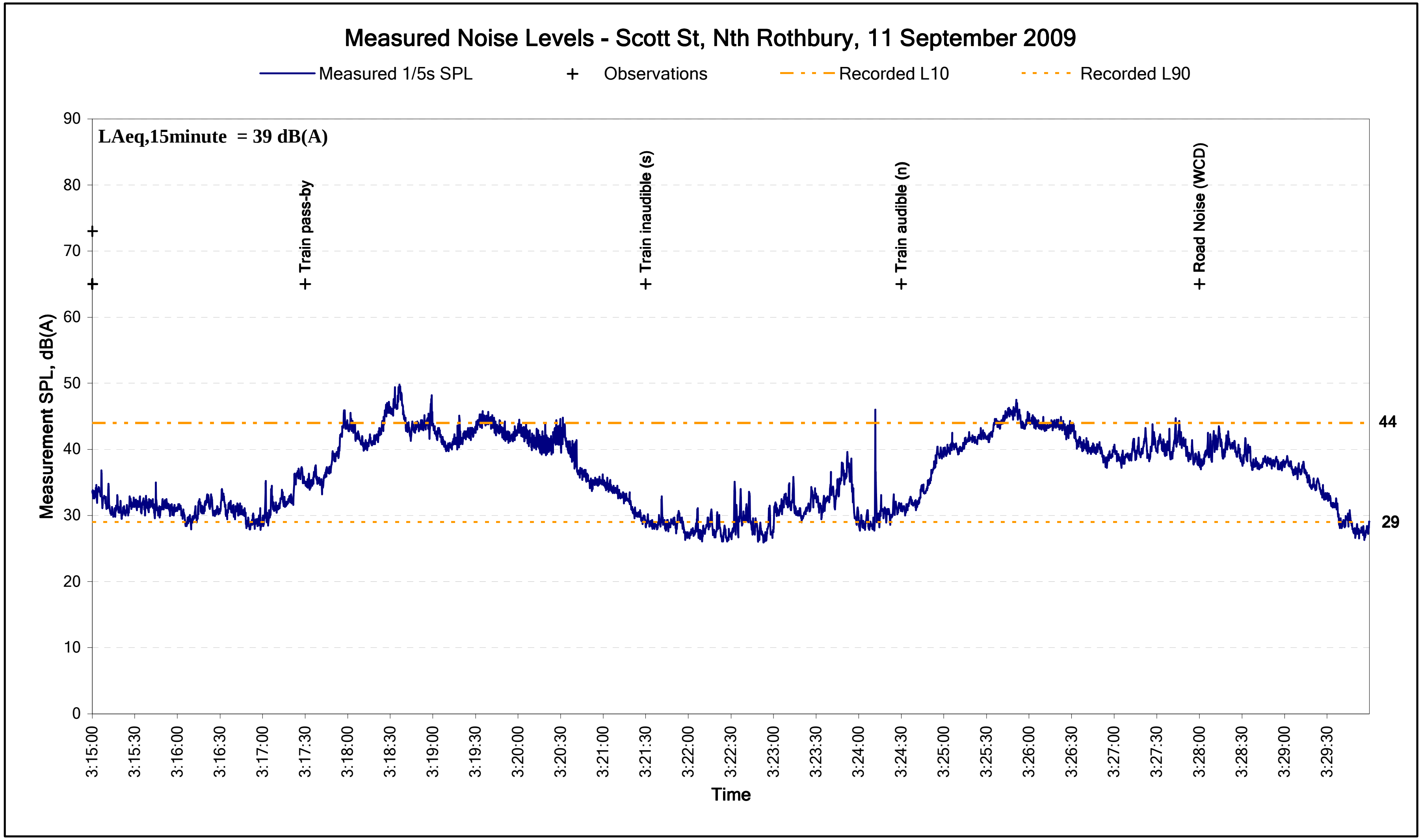


Measured Noise Levels - Tuckers Lane, Greta, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 54 dB(A)
Train inaudible
Car pass-by
Train audible (s)
Measurement SPL, dB(A)
90
80
70
60
50
40
30
20
10
0
43
31
1:49:00
1:49:30
1:50:00
1:50:30
1:51:00
1:51:30
1:52:00
1:52:30
1:53:00
1:53:30
1:54:00
1:54:30
1:55:00
1:55:30
1:56:00
1:56:30
1:57:00
1:57:30
1:58:00
1:58:30
1:59:00
1:59:30
2:00:00
2:00:30
2:01:00
2:01:30
2:02:00
2:02:30
2:03:00
2:03:30
Time


Measured Noise Levels - Tuckers Lane, Greta, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 37 dB(A)
Measurement SPL, dB(A)
Time
Train inaudible (n)
Hwy
Hwy
Environmental
Train audible (n)
Train audible (s)
40
30



Measured Noise Levels - Scott St, Nth Rothbury, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 36 dB(A)
Measurement SPL, dB(A)
Time
Hwy
Hwy
Truck (WCD)
Barking Dogs
Truck (braking)
Train audible (s)
39
27


Measured Noise Levels - Scott St, Nth Rothbury, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 39 dB(A)
Train pass-by
Train inaudible (s)
Train audible (n)
Road Noise (WCD)
44
29
Measurement SPL, dB(A)
Time
0
10
20
30
40
50
60
70
80
90
3:15:00
3:15:30
3:16:00
3:16:30
3:17:00
3:17:30
3:18:00
3:18:30
3:19:00
3:19:30
3:20:00
3:20:30
3:21:00
3:21:30
3:22:00
3:22:30
3:23:00
3:23:30
3:24:00
3:24:30
3:25:00
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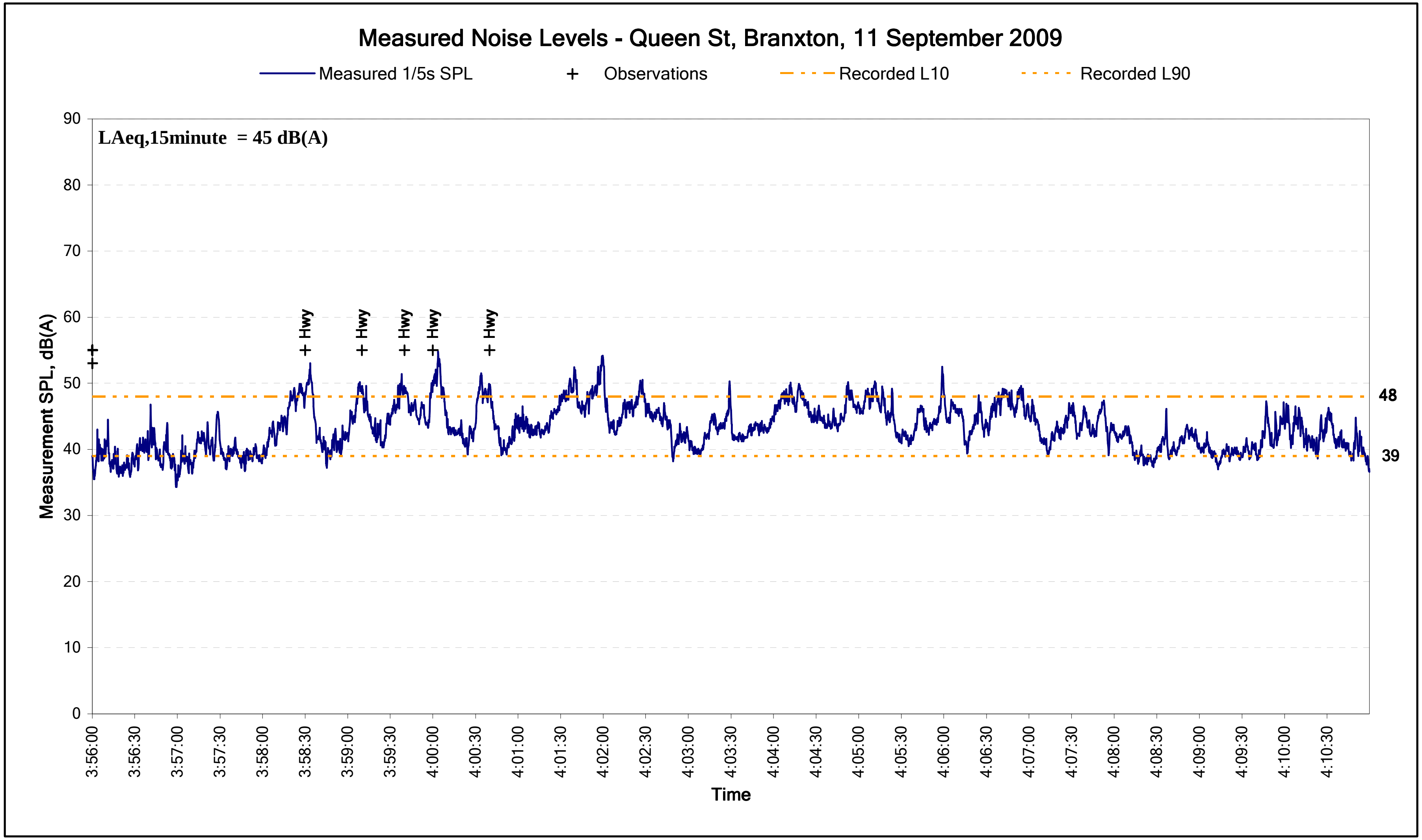
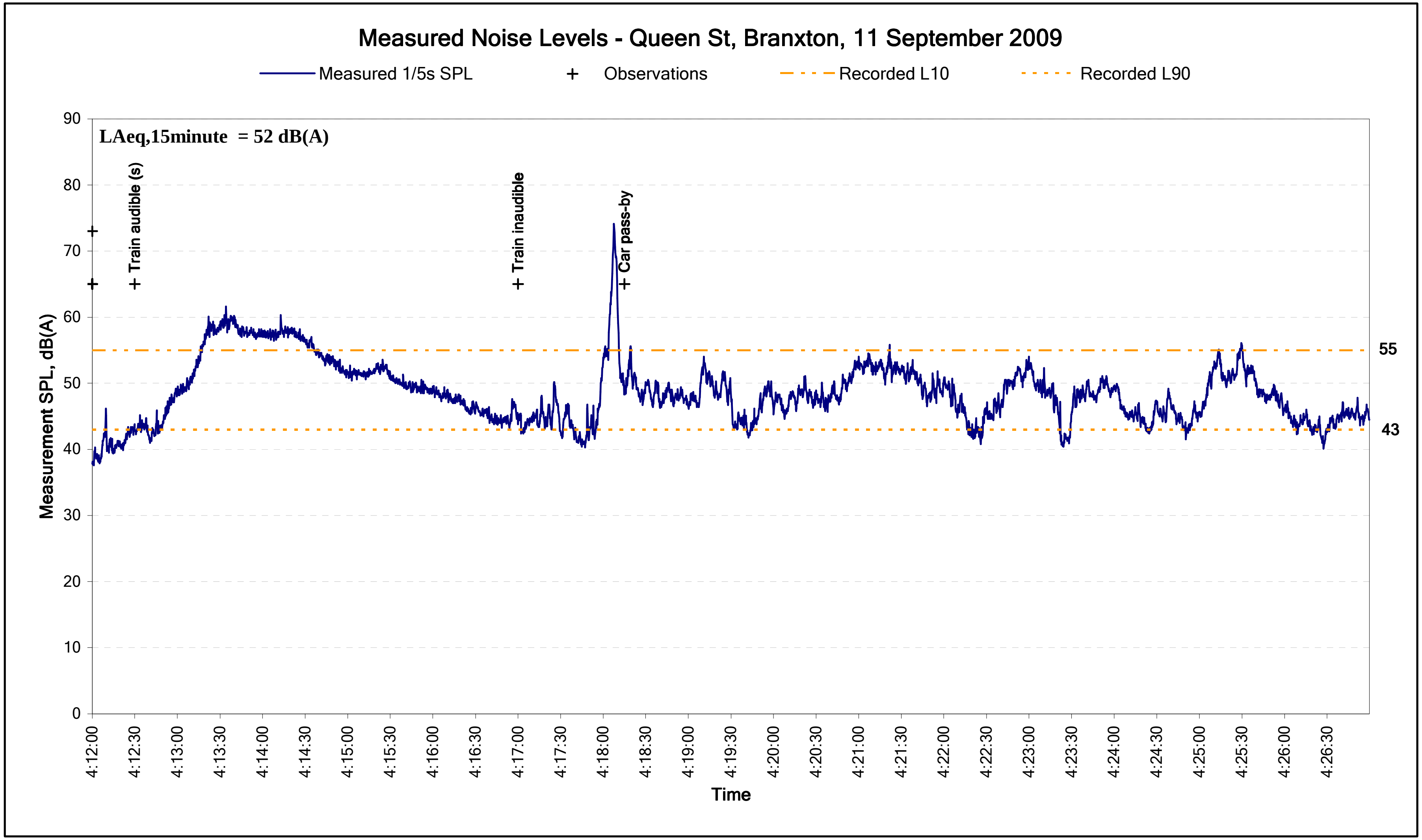
3:29:00
3:29:30



Measured Noise Levels - Queen St, Branxton, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 45 dB(A)
Measurement SPL, dB(A)
90
80
70
60
50
40
30
20
10
0
Hwy
Hwy
Hwy
Hwy
Hwy
48
39
3:56:00
3:56:30
3:57:00
3:57:30
3:58:00
3:58:30
3:59:00
3:59:30
4:00:00
4:00:30
4:01:00
4:01:30
4:02:00
4:02:30
4:03:00
4:03:30
4:04:00
4:04:30
4:05:00
4:05:30
4:06:00
4:06:30
4:07:00
4:07:30
4:08:00
4:08:30
4:09:00
4:09:30
4:10:00
4:10:30
Time


Measured Noise Levels - Queen St, Branxton, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 52 dB(A)
Train audible (s)
Train inaudible
Car pass-by
55
43
Measurement SPL, dB(A)
90
80
70
60
50
40
30
20
10
0
4:12:00
4:12:30
4:13:00
4:13:30
4:14:00
4:14:30
4:15:00
4:15:30
4:16:00
4:16:30
4:17:00
4:17:30
4:18:00
4:18:30
4:19:00
4:19:30
4:20:00
4:20:30
4:21:00
4:21:30
4:22:00
4:22:30
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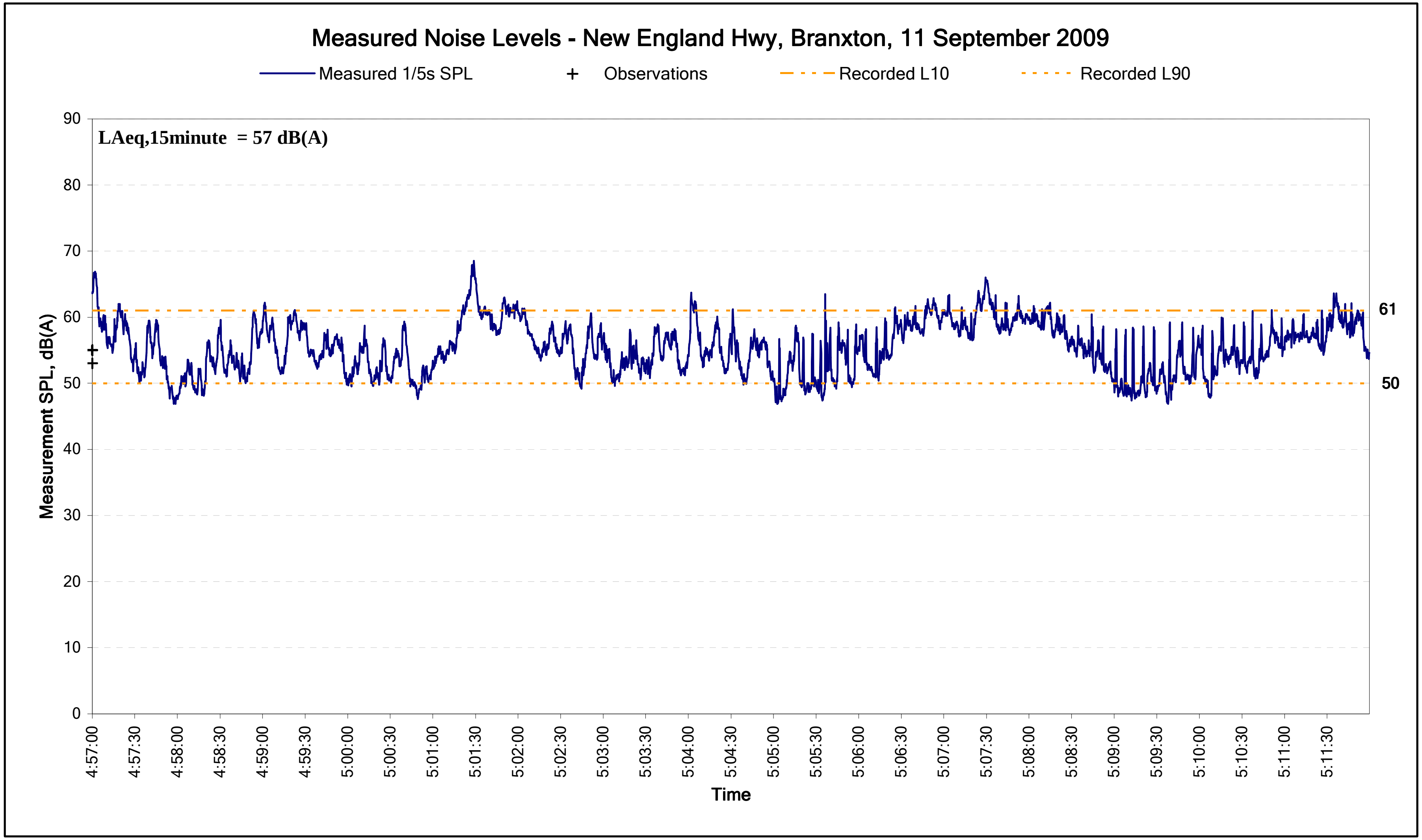
4:26:00
4:26:30
Time



Measured Noise Levels - New England Hwy, Branxton, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 57 dB(A)
Measurement SPL, dB(A)
90
80
70
60
50
40
30
20
10
0
61
50
4:57:00
4:57:30
4:58:00
4:58:30
4:59:00
4:59:30
5:00:00
5:00:30
5:01:00
5:01:30
5:02:00
5:02:30
5:03:00
5:03:30
5:04:00
5:04:30
5:05:00
5:05:30
5:06:00
5:06:30
5:07:00
5:07:30
5:08:00
5:08:30
5:09:00
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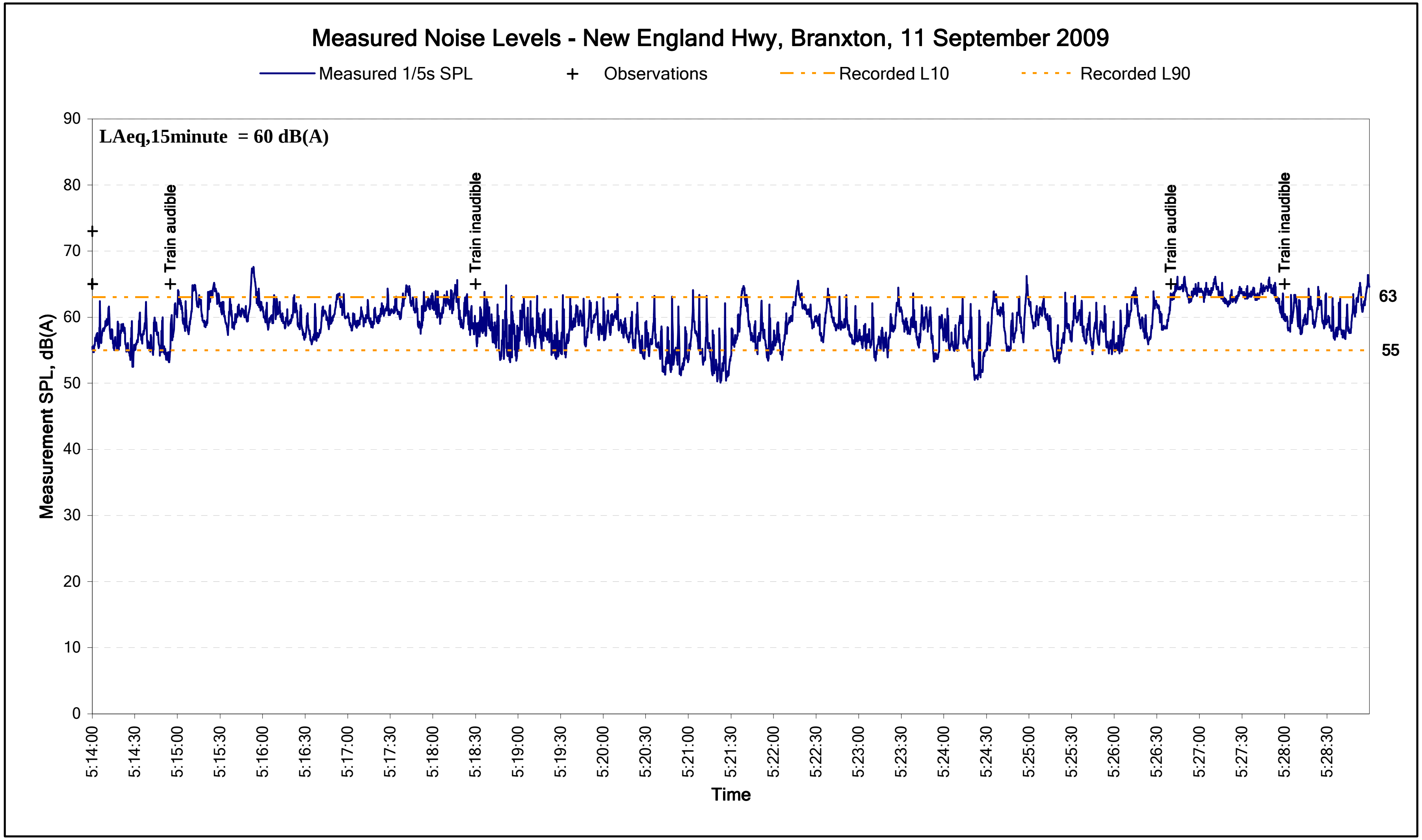

Measured Noise Levels - New England Hwy, Branxton, 11 September 2009
Measured 1/5s SPL
Observations
Recorded L10
Recorded L90
LAeq,15minute = 60 dB(A)
Train audible
Train inaudible
Train audible
Train inaudible
63
55
Measurement SPL, dB(A)
Time
90
80
70
60
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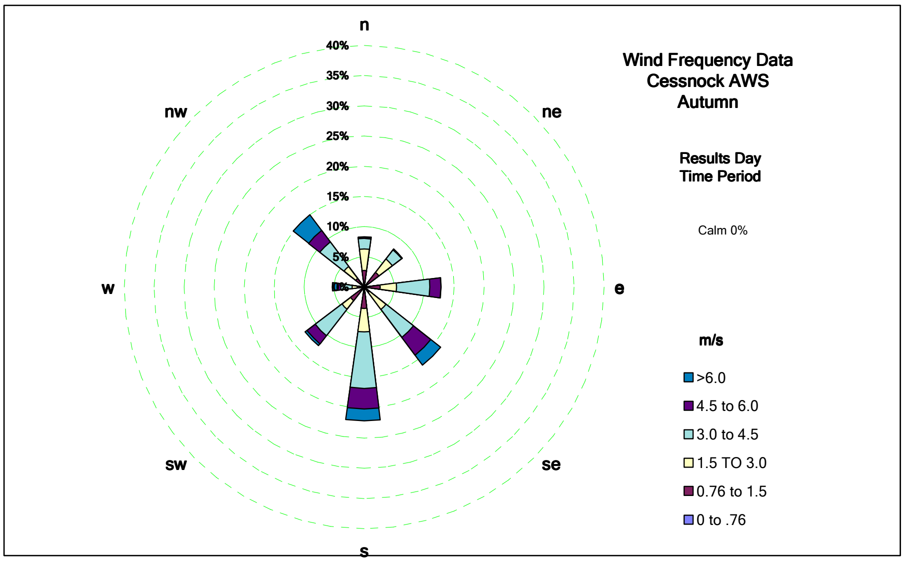
Appendix III

Seasonal Windroses
Cessnock AWS


Wind Frequency Data
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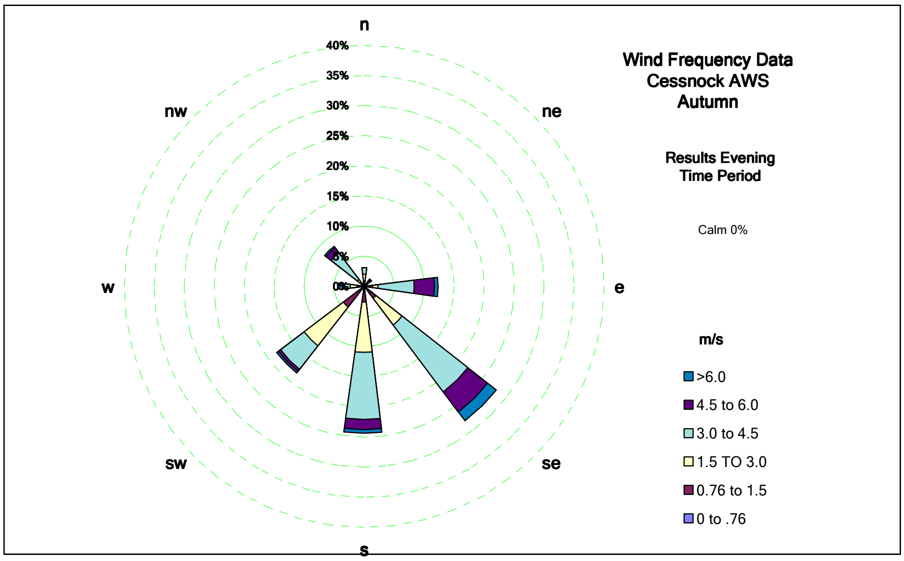
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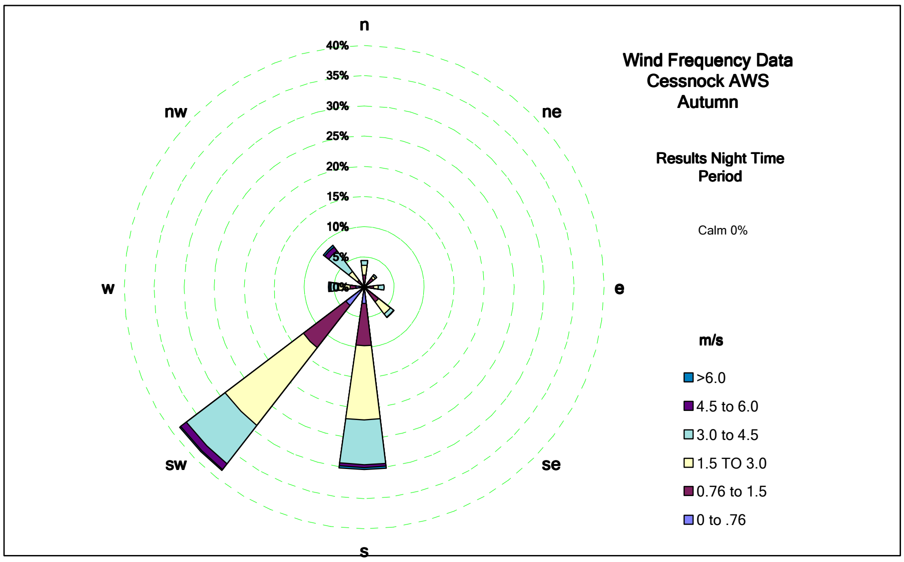
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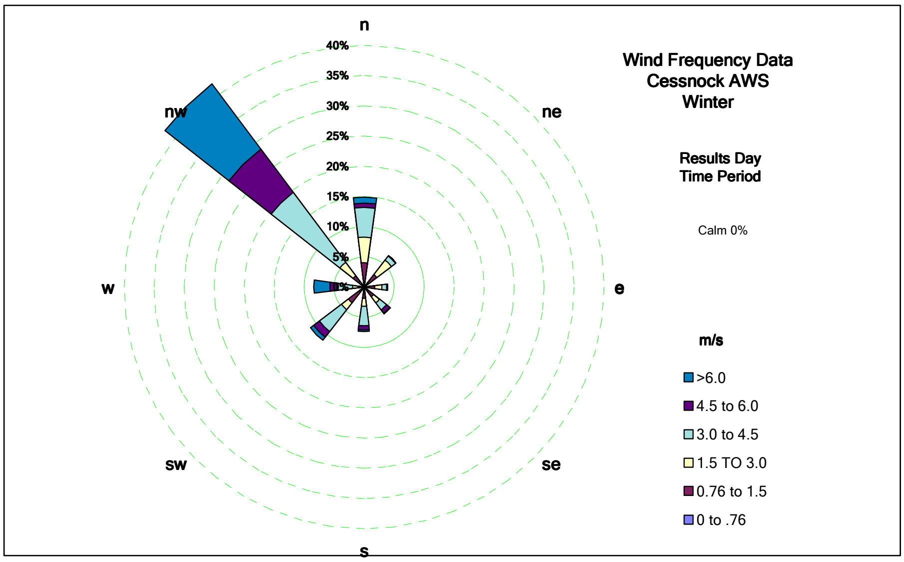
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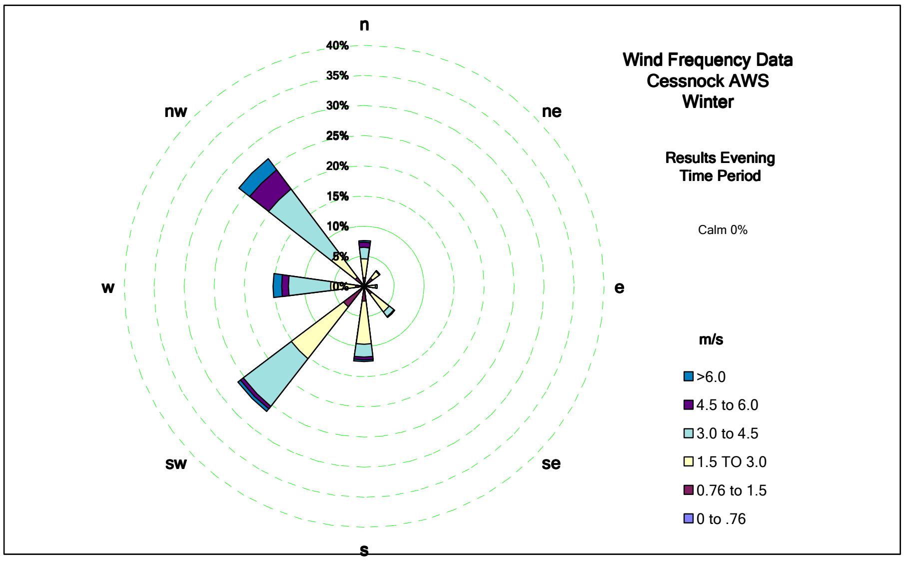
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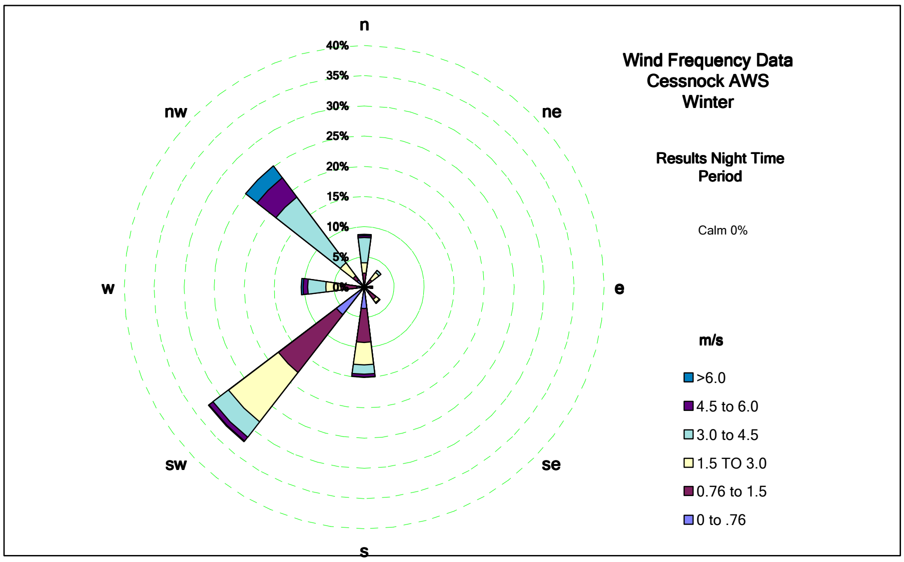
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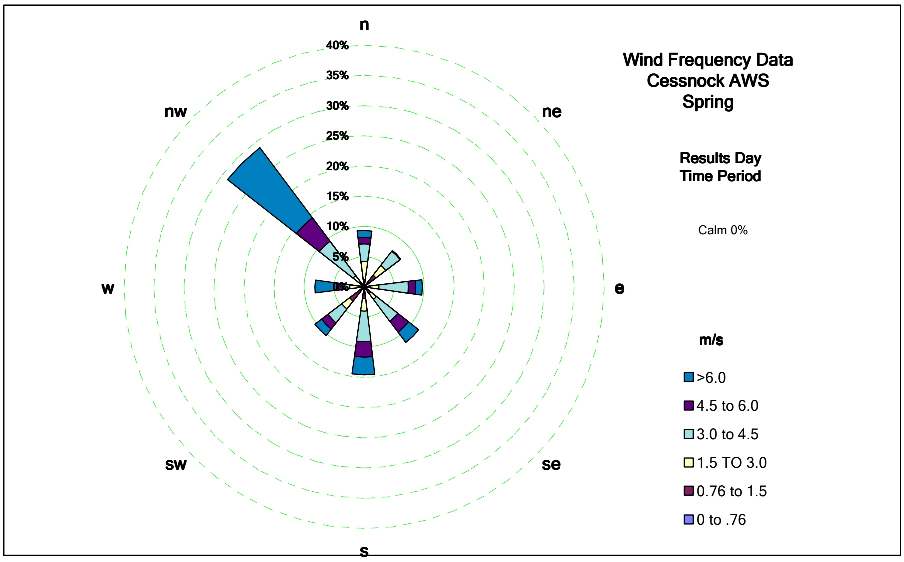
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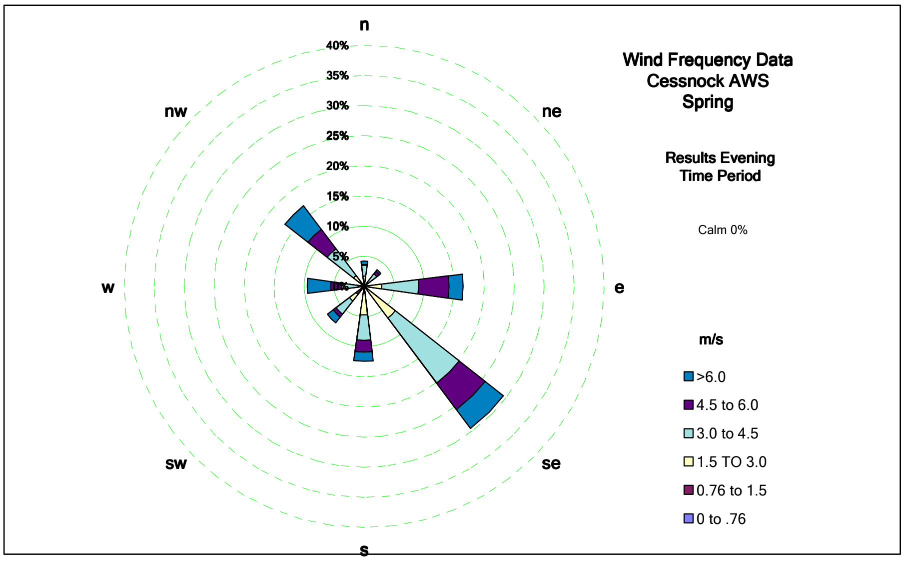
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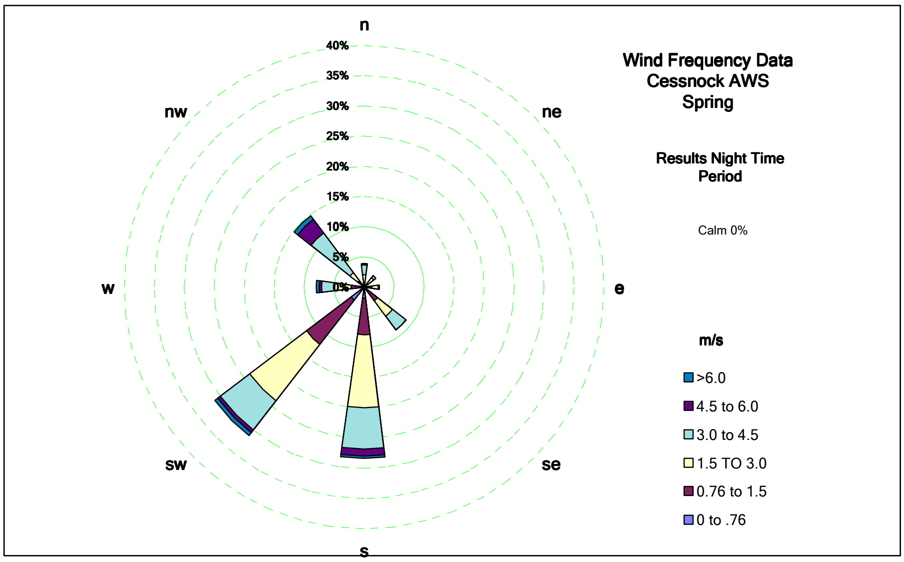
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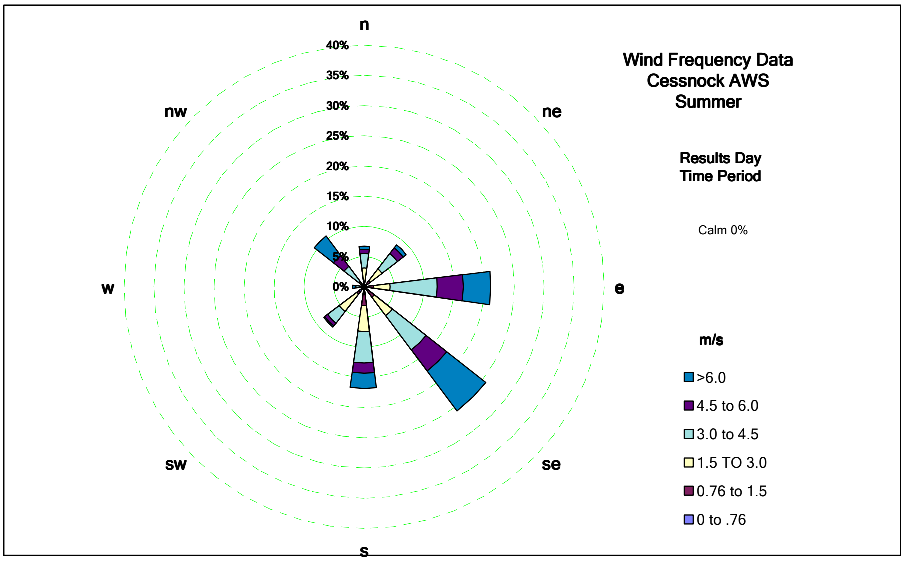

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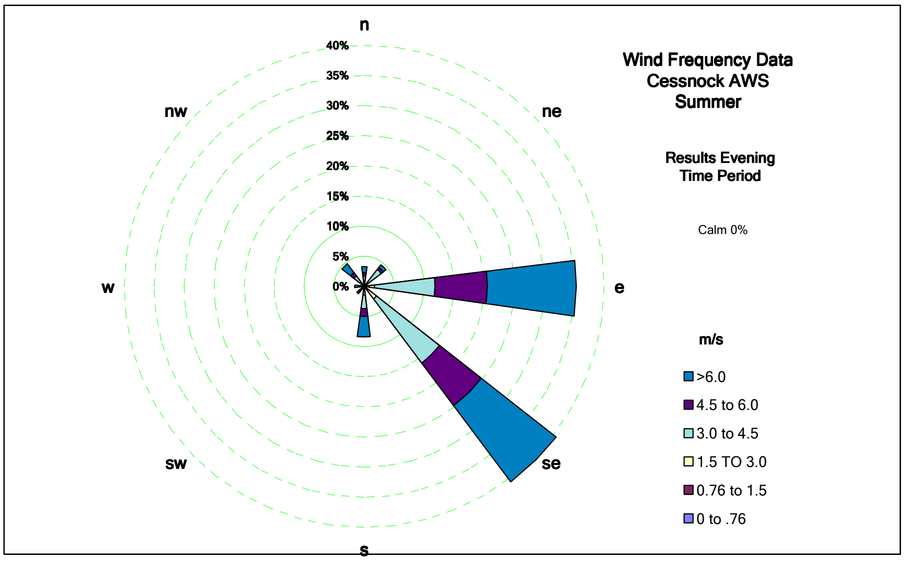

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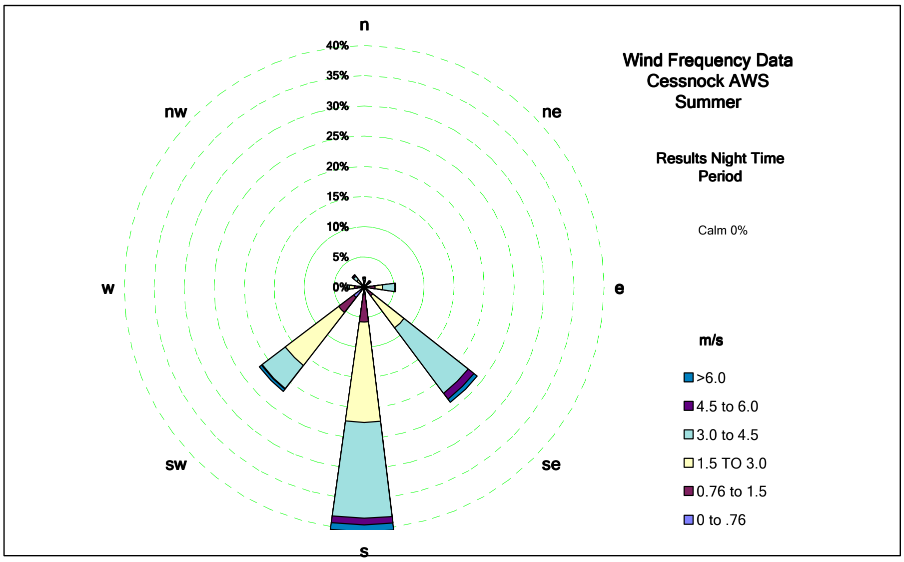

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6.2 TRAFFIC IMPACT ASSESSMENT

Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

Proposed Train Support Facility, Mansfield Street, Greta, NSW

Traffic Impact Assessment

November 2010

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Contents

Document History and Status

Issue	Rev.	Issued To	Qty	Date	Reviewed	Approved
Draft	01	Stephen Barr ï Monteath & Powys	1	20th December 2009	C Thomas	M Waugh
Rev	02	Stephen Barr ï Monteath & Powys	1	3rd February 2010	C Thomas	M Waugh
Final	03	Stephen Barr ï Monteath & Powys	1	23rd February 2010	C Thomas	M Waugh
Final	04	Stephen Barr ï Monteath & Powys	1	30th April 2010	C Thomas	M Waugh
Final	05	Stephen Barr ï Monteath & Powys	1	11th May 2010	C Thomas	M Waugh
Final	06	Stephen Barr ï Monteath & Powys	1	18th June 2010	C Thomas	M Waugh
Final	07	Stephen Barr ï Monteath & Powys	1	13th October 2010	C Thomas	M Waugh
Final	08	Stephen Barr ï Monteath & Powys	1	21st October 2010	C Thomas	M Waugh

Printed: 11 November 2010

Last Saved: 11 November 2010

File Name: P0643 Train Support Facility Greta TIA Final Rev08- Nov 2010

Author: Sean Morgan

Name of Organisation: Pacific National

Name of Project: Proposed Train Support Facility, Mansfield Street Greta NSW

Name of Document: Traffic Impact Statement

Document Version: Final

Project Number: P0643

1. Executive Summary

The proposal is to provide a train support facility to the west of the township of Greta, with road access via a new access off Mansfield Street, located west of Greta. The facility will require minimal staffing levels. There will be a requirement for delivery vehicles to service the site with materials including fuel supplies via semi trailers. The impact of the development has been assessed on the current road network and it can be seen from the study work that with appropriate mitigation methods, the development occurs with an acceptable impact upon the local road network.

The key intersection in the immediate vicinity of the subject site is the give way controlled intersection of the New England Highway and Nelson Street. Whilst the RTA have recently upgraded this intersection, these upgrade works do not provide any benefit for the traffic wishing to turn right out of Nelson Street onto the New England Highway. The Sidra analysis for this intersection indicates that the intersection is currently operating near to capacity and has minimal capacity for additional turning traffic movements out of Nelson Street. With the construction of the F3 to Branxton (Hunter Expressway) the traffic flows along this length of the New England Highway will be significantly reduced (by some 30%) and this intersection will then operate to an acceptable level of service and have capacity for increased vehicle flows from the side roads.

During the construction phase of the development, there will be an average of 80 vehicles associated with the workers on the site per day during the peak activities, with lower construction numbers atthe beginning and end of the activities. It is acknowledged that this temporary traffic flow will have an impact upon the operation of the intersection of the New England Highway and Nelson Street and as such, it is proposed to control the traffic movements out of the site during the construction stage of the development. Maitland bound traffic will be directed to turn right out of the site onto Mansfield Street to head south along Camp Road / Lovedale Road / Allandale Road as no vehicles will be permitted to turn right out of Nelson Street. This access arrangement during construction will be controlled and managed through on-site OH&S mechanisms.

For delivery of materials during the construction stage, all vehicles will access the site via Camp Road and Mansfield Street, due to the poor alignment of Nelson Street at the bridge over the Main Northern railway line. It has also been assumed that the proposed upgrade of Nelson Street / Mansfield Street over the railway line will not be provided prior to the commencement of construction on site. Traffic will use Allandale Road and Lovedale Road to access the New England Highway, whilst tall traffic (greater than 4.5 metres) will need to access the site via Kurri and/ or Cessnock due to the existing height restriction on Allandale Road.

Allowing for these controls over vehicles exiting the site during the construction periods, there will be no impact on the critical intersection of the New England Highway and Nelson Street during the construction period.

Post construction, the operations on site will be developed over three stages, with a gradual increase in traffic movements in and out of the site. The number of permanent workers on the site will remain constant, with increased casual staff, visitors and potentially driver changes occurring on the site and increasing the traffic movements accordingly. The operations on site will occur over a 24 hour day, 7 days a week with staggered shift change times. In this way, the traffic flows in and out of the site will be managed to reduce the impacts. For the ultimate Stage 3 of the development, the majority of the inbound traffic movements (17) will occur before 6.30 AM and the majority will leave at 4.30 or 6.30 PM (7 and 10 respectively). Prior to the opening of the

Hunter Expressway, Stage 1 of the development will be operational only and the traffic flows will be nearer 50% of the flows identified.

Post opening of the Hunter Expressway, the intersection of the New England Highway and Nelson Street will operate well with minimal delays for the traffic turning in and out of Nelson Street. The additional traffic associated with the development for the full development to Stage 3 will not have a significant impact upon this intersection. The delivery vehicles associated with the future development on the site will access the site via Mansfield Street / Camp Road / Lovedale Road / Allandale Road due to the poor alignment of the Nelson Street Bridge.

Overall, it can be seen that the traffic flows associated with the subject development are very low and will have a minimal impact upon the operation of the local road network. The development will not be fully utilised before the Hunter Expressway is opened and once this road link is operational, the flows along the New England Highway will reduce significantly and there will be significant spare capacity at the intersection of the New England Highway and Nelson Street to accommodate the flows associated with the subject development.

2. Introduction

Background
Better Transport Futures has been commissioned by Monteath & Powys on behalf of Pacific National to prepare a Traffic Impact Assessment for the proposed new Train Support Facility off Mansfield Street Greta, NSW. This work is required to support the Environmental Assessment for the proposal.

Scope of Report
The scope of this report is to review the traffic, access and parking implications for the proposed development. The development will provide for a train support facility with all road based access via Mansfield Street. The report will also provide advice on access issues, internal site layout and issues relating to construction and service vehicles. Site plans are shown in Appendix B.

Issues and Objectives of the study
The issues relevant to the proposal are:

- Assess impact on the arterial and local road network due to the additional traffic flows including relevant intersections
- Assess the impact of the additional parking generated by the proposed development;
- Review the access arrangements for the development including access to, from and within the site (for all modes and needs);
- Review the service arrangement for the development;
- Access interaction and integration with existing and planned transport infrastructure and services, including development of the Hunter Expressway and the Hunter Valley (Rail) Corridor Capacity Strategy (ARTC,2009) and
- Assess any other transport impacts associated with the development.

The objective of the report is to document the impacts of the proposed development and provide advice on any infrastructure work required as part of the development.

Planning Context
In preparing this document, the following guides and publications were used:

- RTA Guide to Traffic Generating Developments, Version 2.2 Dated October 2002;
- Cessnock City Council DCP2 for off-street vehicular parking (dated September 2001);
- Australian / New Zealand Standard ï Parking Facilities Part 1 : off-street car parking (AS2890.1:2004);

3. Existing Situation

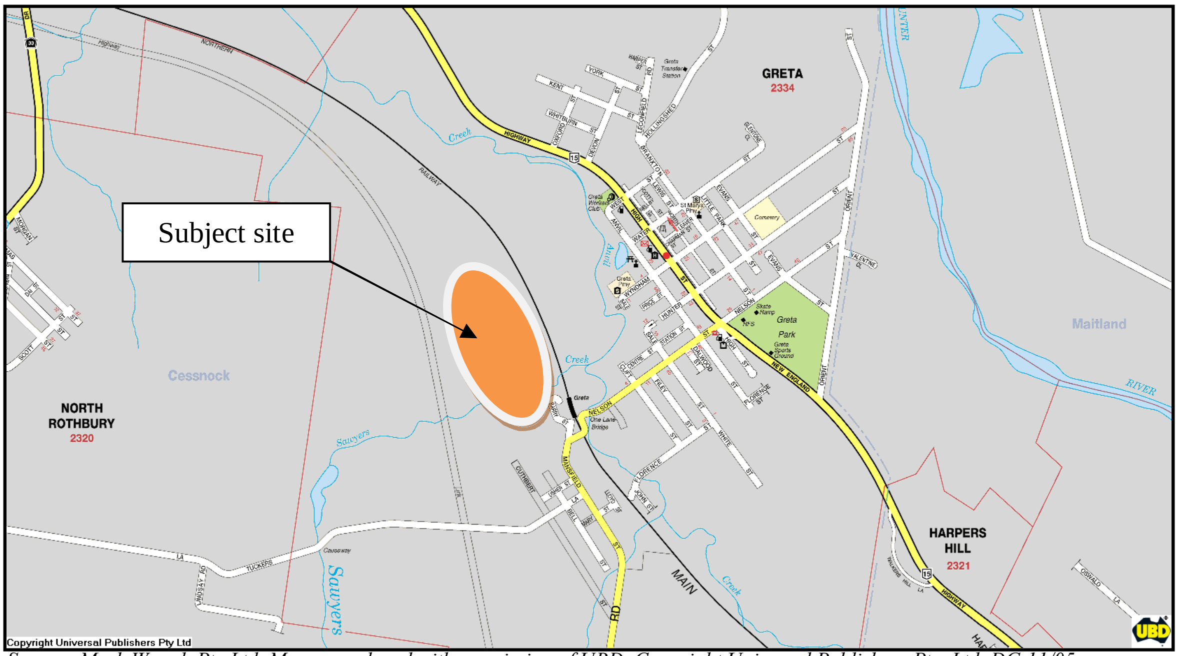
3.1 Site Description and Proposed Activity

3.1.1 Site Location and Access

The subject site is located on a parcel of land off Mansfield Street, Greta, NSW. All road based vehicle and pedestrian access will be via Mansfield Street only. Mansfield Street is accessed off Nelson Street to the east, which intersects with the New England Highway. Mansfield Street connects to Camp Road to the south, which then provides access to the New England Highway to the east via Allandale Road or south towards Lovedale / Kurri Kurri.

To the east of the site is the existing township of Greta. The site is bounded by the Main Northern Railway line along its eastern boundary and by the corridor for the Hunter Expressway (Hunter Expressway) on its western boundary.

The location of the site is shown below in **Figure 3-1.**



Source: Mark Waugh Pty Ltd. Map reproduced with permission of UBD. Copyright Universal Publishers Pty. Ltd. DG 11/05

■ **Figure 3-1 - Site Location**

3.2 Existing Traffic Conditions

3.2.1 Road Hierarchy

The New England Highway
The New England Highway is the main road through the locality and it provides the major connection between Greta and onwards to Newcastle via Maitland, and Singleton to the west. It also provides an important connection between the Lower Hunter region located along the Golden Highway to the west and connections to the F3 and Sydney to the east. The New England Highway forms part of the National Highway system and is controlled by the Roads and Traffic Authority of NSW (RTA). It is classified as State Highway number H9.

The New England Highway through Greta provides a single lane of travel in both directions, with a parking lane along the westbound lane. A sealed shoulder is marked for cyclists along the eastbound lane. There are limited turn lanes and there is a signal controlled pedestrian crossing just to the west of Wyndham Street. The posted speed limit through Greta is 60 km/h.

- **Photo 1 View to east showing typical cross section for the New England Highway**

There are a number of existing driveways and intersections located along this length of the New England Highway however there is adequate width to accommodate through traffic movements. Each carriageway is in the order of 3.5 metres wide, with a sealed shoulder on the northern edge in the order of 1.5 to 2.0 metres wide. On the southern edge of the road, there is a 1.5 metre wide cycleway and a 2.5 metre wide parking lane. In the vicinity of the site, the New England Highway provides a straight alignment with good forward visibility in both directions. There are street lights provided along both sides of the road.

Nelson Street
Nelson Street is a local road under the control of Council. It provides access between the centre of Greta (New England Highway) and runs south-west through to Mansfield Street and north-east through to Orient Street. There are a number of residents with direct access to Nelson Street as well as a number of minor residential roads connecting to it. It provides a single lane of travel in each direction with an overall width in the order of 12.5 metres with a marked parking lane to both sides. Nelson Street flows into Mansfield Street and Camp Road where it narrows in width to around 9 metres with no parking lanes. There are no footpaths or sealed shoulders along its length. It operates under a speed limit of 60 km/h.

Nelson Street passes over Anvil Creek to the east of the railway line on an old wooden bridge. There is no posted weight limit for this bridge which indicates that the limit for this bridge is 42.5 tonnes. Observations on site show that currently 19.0 metre semi trailers do use this route and travel over this bridge. The bridge provides a narrow alignment generally restricting traffic to one-way movements only.

Further to the west of this location, Nelson Street passes over the Main Northern railway line. The alignment up and over the railway line is very poor and large vehicles have to use both sides of the road when crossing over this bridge.

- **Photo 2 View south-west along Nelson Street showing typical cross section**

Mansfield Street / Camp Road

Mansfield Street is the local street running through Greta to the west of the Main Northern Railway line and at its southern end runs into Camp Road. It provides a single lane of travel in both directions and through Greta it provides a posted speed limit of 60 km/h. There are no footpaths or kerbs provided within Greta and there is a single lane of travel in both directions. Outside of Greta, the speed limit increases to 90 km/h with unsealed shoulders to both sides.

- **Photo 3 – View west along Mansfield Street showing typical cross section.**

Lovedale Road/Allandale Road

At the southern end of Camp Road, it connects with Lovedale Road which travelling east becomes Allandale Road. Camp Road connects via a give way controlled intersection. Lovedale and then Allandale Road provides a single lane of travel in both directions with an overall width in the order of 6.5 metres. It operates under a posted speed limit of 90 km/h with unsealed shoulders to both sides.

To the north of the intersection of Lovedale Road and Camp Road, Lovedale/Allandale Road passes under the Main Northern Railway line. There is a height restriction of 4.5 metres at this location limiting the size of vehicles that can use this route.

3.2.2 Roadworks

The project of significance to the general locality is the planned extension of the F3 Freeway from Seahampton to Branxton. This will significantly reduce travel times between Singleton and Newcastle to Sydney and beyond. The Hunter Expressway will connect with the New England Highway to the west of Branxton and will significantly reduce the volume of traffic using the New England Highway through Branxton. Advice from the RTA indicates that the modelling work completed to date indicates that the through traffic movements along the New England Highway will be reduced in the order of 30% or more over the current flows.

From the site survey work together with the traffic data collected by Better Transport Futures, it can be seen that the current traffic flows along this section of the New England Highway currently suffer from delays and operate at a poor level of service. The existing level of service during the morning peak period for westbound traffic is E. This level of service is not desirable, hence the reason why the road authority has identified the fact that a significant road upgrade is required in the form of the Hunter Expressway. However, until this upgrade is provided, the road authority and road users will have to accept the poor level of service and associated delays. The RTA has been working on this project for a number of years and funding has now been committed to this project. Advice from the RTA indicates that this link will be operational by 2014.

Advice from the study team also indicates that ARTC are proposing to upgrade Nelson Street in the vicinity of the subject site to remove the current poor alignment over the railway line. The proposed road upgrade will be constructed as part of the development of the third railway track and includes a new road bridge over the railway line. The road re-alignment will improve the existing situation and remove the two existing tight bends over the railway line as well as replace the current narrow road bridge over Anvil Creek. It will also include pedestrian and cycle facilities to meet current RTA standards.

It is understood that there are no other major road network improvements planned in the vicinity of the subject site, apart from normal road maintenance performed by Council and the RTA.

3.2.3 Traffic Management Works

There are currently no traffic management works planned in the vicinity of the site, as observations on site indicate the network is currently working to a good level of service for the majority of the length of Nelson Street with minimal delays and congestion during peak periods.

3.2.4 Pedestrian and Cycling Facilities

Cycling facilities are limited and inconsistent in their built form. For the majority of the length of the New England Highway there are no cycle lanes marked, nor is there an off road footpath or shared path. In the vicinity of the site access there are no cycle lanes however within Greta cyclists can use the parking lanes where provided.

There are no pedestrian paths provided on Nelson Street and limited paths on the side of the New England Highway. It is understood that the upgrade of the Nelson Street rail overpass will include pedestrian and cycle facilities to meet current RTA standards.

3.2.5 Public Transport

Public transport in the vicinity of the site is limited. School buses provide access for school children but there are no regular buses for general public use in this locality.

The only direct train from Newcastle to Greta in the morning peak leaves Newcastle at 8.12am and arrives at Greta at 8.59am. Alternate train/bus combinations can take from 1 hour and 20mins to 2 1/4 hours depending upon train and bus connectionsô times and locations. Similarly there is one direct train from Greta to Newcastle in the am peak, otherwise again travel involves lengthy bus/train combinations.

Similarly the evening peak trip from Greta to Newcastle after 4pm is not available until 6pm and requires a bus/train combination. The peak travel options from Newcastle to Greta however are more frequent with a 4.10pm (direct) a 4.20pm (train/bus) and a 5.55pm (direct).

The area is serviced by Hunter Valley Buses. Route 181/182 from Greenhills to Singleton offers an hourly service in the morning peak from Maitland to Singleton via Greta as well as from Greta to Maitland. A less regular service however is offered in the afternoon and evening peak.

3.3 Traffic Flows

The proposed development of the site will allow for the provision of a train support facility. During construction phase there will be a number of light vehicles associated with construction employees as well as heavy vehicles for materials delivery etc. Once the facility is constructed, there will be light vehicle movements associated with staff movements in and out of the site. There will also be traffic movements in and out of the site associated with delivery vehicles (including fuel deliveries) to the site once it is operational.

The key roads affected by the development will be Nelson Street and the New England Highway as well as the intersection of these two roads. As well Mansfield Street, Camp Road and Allandale Road and the intersection of Allendale Road and the New England Highway are also affected. The impact for the construction work (whilst temporary) will also need to be assessed due to the local connection issues with the New England Highway.

3.3.1 Daily Traffic Flows

Traffic volume data for the project has been collected during a survey of traffic movements at the give way controlled intersection of Nelson Street and the New England Highway. These surveys were completed on Tuesday 1st September 2009 and provided data for both the morning and afternoon peak periods associated with normal peak hour operations.

The results from the traffic survey indicate that during the surveyed morning peak period (7.30 to 8.30 AM) the two-way traffic flow along the New England Highway directly to the east of Nelson Street was in the order of 1553 vehicles per hour. The majority of vehicles were light vehicles, with a reasonably high percentage of heavy goods vehicles observed during this peak period. The traffic flow was split between 590 eastbound (38%) and 963 westbound movements (62%). This shows a strong bias for traffic to head west, towards Singleton.

The corresponding traffic survey during the afternoon peak period shows that between 16.15 and 17.15 PM the corresponding two-way flow was 2,032 vehicles per hour. Again, the majority of traffic was light traffic with a reasonable level of heavy goods vehicles observed during the surveyed peak period. The traffic flows were less evenly split, with 1422 vehicles (70%) eastbound and 610 westbound (30%). This shows a strong bias for return trips eastbound from Singleton and the mining areas to the west via the New England Highway. The traffic surveys completed show that the flows are reasonable high from between around 15.15 through to 18.30 PM.

The survey also recorded the traffic flows in and out of Nelson Street. These flows are much lower than on the New England Highway. During the AM peak the 2-way flow was in the order of 252 vehicles whilst in the PM peak was in the order of 312 vehicles.

The results of the survey are summarised in **Table 3-1** below, with full details of the survey provided in Appendix A of this report.

- **Table 3-1ï** Traffic Volumes

Road	Location	Direction	AM Peak (1)	PM Peak (1)	Mid-Block Road Capacity[2]	Level of Service (AM/PM)	Volume / Capacity AM	Volume / Capacity PM
New England Highway	East of Nelson Street	Eastbound	590	1422	1400	C / E	0.421	1.016
New England Highway	East of Nelson Street	Westbound	963	610	1400	E / D	0.687	0.436
Nelson Street	South of New England Highway	Northbound	144	121	900 [3]	A / A	0.160	0.134
Nelson Street	South of New England Highway	Southbound	108	191	900 [3]	A / A	0.120	0.212

Notes: 1. Peak flow from September 2009 traffic survey results by Mark Waugh Pty Ltd
2 -RTA Guide to Traffic Generating Development mid-block capacity for 2 lane undivided and one lane two way.
3. RTA Guide to Traffic Generating Development, mid block capacity 2 lane urban arterial road

Table 3-1 demonstrates that whilst Nelson Street is currently operating well within its technical and functional capacity levels, the New England Highway is operating at a poor level of service (E) which will create delays and congestion for road users. Observations on site show that traffic is very heavy through Greta for the peak direction of flows with a near constant line of traffic.

Urban road peak hour flows per direction

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Source: RTA Guide to Traffic Generating Developments, version 2.2 dated October 2002.

Traffic data has also been obtained from the RTA, indicating that the Annual Average Daily Traffic flow (AADT) in 2007 was in the order of 16,722 vehicles per day to the west of Branxton at Black Creek Bridge (approximately 1.7 kms west of Nelson Street) on the New England Highway. The data from the RTA count indicates that the AADT at this location has decreased slightly since 2001 at this location (17,098 in 2001).

Traffic volume data for the project has also been collected during a survey of traffic movements at the give way controlled intersection of Allendale Road and the New England Highway. These surveys were completed on Thursday 28th October 2010 (1.00PM-2.00PM) and Friday 29th October 2010 (9.30AM-10.30AM) and provided data for both the morning and afternoon off-peak periods associated with normal off-peak hour operations. This data indicated that the two-way traffic flow along Allandale Road was 129 vehicles in the morning period and 95 in the afternoon. Over 90% of all movements had a destination/origin to the east with the flow evenly spread between outbound and inbound movements.

3.3.2 Daily Traffic Flow Distribution

There is limited data available from Council and the RTA regarding daily traffic flow distribution. However, the New England Highway carries a significant volume of interstate and regional traffic movements and weekend flows can be significant. The New England Highway also carries high traffic volumes during school holidays.

3.3.3 Vehicle Speeds

Vehicle speeds have been observed during the site visit, and it is considered that the majority of traffic appears to travel close to the posted speed limit of 60 km/h. This is in the main due to the high traffic flows during the peak periods. Traffic speed on Nelson Street appears to travel at the posted speed limit at its northern end towards the New England Highway but towards the site at the southern end of Nelson Street the speeds are currently much lower, due to the poor road alignment over the railway line.

3.3.4 Existing Site Flows

The subject site is currently vacant therefore there are very limited traffic flows in or out of the existing site.

3.3.5 Heavy Vehicle Flows

The New England Highway carries a significant volume of interstate transport as well as regional transport, which includes a large number of heavy vehicles. The New England Highway also carries a large number of B-doubles in this location.

There is minimal heavy vehicle usage of Nelson Street. There would be some use by Council garbage collection vehicles and limited access for local deliveries etc.

Traffic surveys conducted during the off-peak period at the intersection of Allendale Road and the New England Highway indicated that heavy vehicles constituted 20% of traffic flows.

3.3.6 Current Road Network Operation

Observations on site show that during the peak periods traffic flows along the New England Highway suffer from some delay due to the high volume of traffic. Due to the width of the New England Highway, through traffic movements can continue past traffic waiting to turn right into the various side roads however this causes some delays for the road movements.

Observations on site show that traffic turning right out of the side roads can suffer from delays, but that with some platooning effect behind large vehicles this side road traffic can enter the flow on the New England Highway. It would also appear that drivers accept a smaller gap that normal in recognition of the high flows. Whilst this potentially could create a safety issue, the accident crash data from the RTA does not indicate a high level of accidents at this location.

3.4 Traffic Safety and Accident History

The New England Highway provides a straight alignment with good visibility on the approach to the intersection with Nelson Street from both directions allowing drivers to observe the intersection operations and adjust their speed or stop accordingly. There is no dedicated turning lane for the right turn movement into Nelson Street but the width of the road at this location allows drivers to manoeuvre their vehicles past traffic waiting to turn right, thereby reducing the delays for the through traffic movements. There is a dedicated left turn lane for westbound traffic movements. There are also street lights provided on both the New England Highway and Nelson Street in this location. These street lights continue along Nelson Street but stop at the edge of the existing urban limit before the subject site.

A review of the RTA accident data for the last 5 years shows that there have been two recorded accidents close to the intersection of the New England Highway and Nelson Street. Both involved rear end accidents relating to traffic flows on the New England Highway. Overall the accident rate in this location is relatively low.

The recent work completed by the RTA at this location provides a sheltered right turn lane in the centre of the New England Highway for traffic approaching Nelson Street from both directions. This treatment has been provided to eliminate the rear end type accidents that have been recorded at this location. Note that this intersection upgrade will not however improve the right turn capacity for traffic from the side road.

3.5 Parking Supply and Demand

3.5.1 On-street Parking Provision

On street parking is available along much of the length of Nelson Street within Greta however closer to the subject site there is limited parking, due to the reduced road width. The existing alignment of the road over the railway line does not permit parking due the narrow width and lack of shoulders.

3.5.2 Off-Street Parking Provision

There would be no off-street parking available within other sites adjacent to the subject site in the area for use by the subject development.

3.5.3 Parking Demand and Utilisation

There was limited on-street parking within Greta during the site visit and no parking on-street adjacent to the subject site. It is considered that there would be little if any demand for parking in this locality, as there are no business users in the locality and the majority of residential development has off-street parking areas to satisfy the demand.

3.5.4 Set down or pick up areas

There are no dedicated bus stops in the general vicinity of the subject site.

3.6 Public Transport

3.6.1 Rail Station Locations

Greta Railway Station is located adjacent to the subject site and provides a limited service to Newcastle and beyond as well as a service to Singleton.

The only direct train from Newcastle to Greta in the morning peak leaves Newcastle at 8.12am and arrives at Greta at 8.59am. Alternate train/bus combinations can take from 1 hour and 20mins to 2 1/4 hours depending upon train and bus connectionsô times and locations. Similarly there is one direct train from Greta to Newcastle in the am peak, otherwise again travel involves lengthy bus/train combinations.

Similarly the evening peak trip from Greta to Newcastle after 4pm is not available until 6pm and requires a bus/train combination. The peak travel options from Newcastle to Greta however are more frequent with a 4.10pm (direct) a 4.20pm (train/bus) and a 5.55pm (direct). Again this trip takes more than hour to complete between Greta station and Newcastle.

Given the low frequency of trains serving this station, it is considered that there will be no demand from the subject site for train access for work trips. Census data shows that as a whole, the percentage of public transport use for trips to work in the Lower Hunter are very low (around10%) and it is considered that this rate would be even lower in the location of the subject site for work trips. It is therefore considered that all of the future employees on the site will travel by private vehicle to the subject site.

3.6.2 Bus Stops and Associated Facilities

There are no bus stops in the immediate vicinity of the subject site. The area is serviced by Hunter Valley Buses. Route 181/182 from Greenhills to Singleton offers an hourly service in the morning peak from Maitland to Singleton via Greta as well as from Greta to Maitland. A less regular service however is offered in the afternoon and evening peak. This service takes around 40 minutes to complete by bus.

Similarly, given the very infrequent bus service to the locality and the length of journey time, it is considered that no one will use the bus to access the subject site for work trips. It is considered that all the future workers on the site will travel by private vehicle to the site.

From the low services for both trains and buses to the locality, it has been assumed that all of the employees will travel to the site by private vehicle.

3.6.3 Pedestrians

There are no footpaths provided on Nelson Street adjacent to the subject site. It is also noted that there is no footpath provided along Nelson Street within Greta. It can be seen that the pedestrian demands are very low and pedestrians can use the adjacent verges as required. However, it is understood that as part of the realignment of the Nelson Street overpass, there will be pedestrian and cyclistôs facilities provided to meet current RTA standards.

3.7 Other Proposed Developments

There are a number of developments occurring in and around Greta including residential subdivisions. Additionally, in the immediate vicinity of the site there are a number of infrastructure developments occurring including the RTA Hunter Expressway and ARTCôs third track. It is understood that currently there are no other major developments proposed in the immediate vicinity of the subject site.

Advice from Cessnock City Council has been provided that indicates the proposed development known as Anvil Creek has planning approval only. The staged development consent for this site indicates that the site, when fully developed, will provide the following facilities:

* An 18 hole international standard golf course; comprising an area of around 110 ha;
* A golf clubhouse/hotel building comprising 3300sqm of floor area (if developed over 1 level) including up to 150 hotel rooms;
* up to 85 detached and attached tourist accommodation buildings;

* Permanent residential development of up to 1364 dwellings comprised of 276 detached houses; 217 villas; 515 townhouses and 356 duplex apartments;
* A 'gateway' retail area adjacent to the new freeway interchange aimed at servicing tourists and promoting tourism in the region and providing up to 7,550sqm of floor space and 1,200sqm of outdoor eating area (if developed over 1 level);
* An education precinct providing up to 15,700sqm of floor space (if developed over 1 level)
* A commercial vineyard of around 20 ha;
* A village centre with up to 2,100sqm of floor space (if developed over 1 level) including a mix of uses to serve residents and visitors to the site.
* An extensive network of public and private open space (around 160ha) with a further 110ha of golf course. The open space incorporates remnants of the former Army and Migrant Camp, substantial areas of existing vegetation and bushfire asset protection zones. It also includes a ôHeritage Parkö of 6.5ha to be dedicated to Council for public use as required by the VPA that has been agreed by the applicant and Council;
* Infrastructure including a road, pedestrian and cycle network, noise barriers, stormwater management and essential services and

Stage 1of the above concept proposal comprises subdivision of the Land into eleven (11) lots and the rehabilitation of the existing main road entry from Camp Road.

It is noted that Stage 1 of the development only has consent which allows for subdivision of the land into eleven (11) lots only. It can be seen that prior to the approval and subsequent construction of the development a detailed traffic assessment will be required to review the impact of this development upon the local road network. It can be seen that this site will generate a high volume of traffic, especially the permanent residential development i.e. 1364 dwellings, at standard RTA rate of 0.85 trips per lot in the peak hour indicates some 1,159 vehicle movements during the critical morning and afternoon peak periods. With 9 trips per lot per day this would generate some 12,276 trips per day. In addition, there will be traffic movements associated with the other elements of the proposed development. Overall, the scale of this development, together with the associated traffic flows is far greater than those that will be associated with the subject site.

4. Proposed Development

4.1 The Development

The proposed development is for a Train Support Facility. This facility will provide a low key centre, with 30 permanent staff on site associated with work at the facility for the full development by Stage Three. In addition, there will be up to 15 contractors working on site per day as required. There will be up to 10 delivery vehicles accessing the site per day between the hours of 6am and 10pm, predominantly for fuel (19 metres semi trailer) but also for materials such as sand, oil and maintenance spares as well as removal of waste. Total daily volumes of vehicle movements at Stage 3 of the development will thus be a maximum of 55 inbound and 55 outbound movements per day spread over a number of hours including the staff movements due to shift work. It is important to note that the development will have 24 hour working, 7 days a week.

These traffic flows have been obtained from transport records for the similar facility operated by the applicant in Muswellbrook. It is recognised that the type of development is unique in many ways and the RTA Guide to Traffic Generating Developments does not provide any guidance for this type of specific use. This guide does however indicate that survey of a similar type of development should be completed to obtain traffic flows in and out of sites. This has been applied in this instance.

A preliminary plan for the development has been included in **Appendix B** to this report.

4.1.1 Nature of Development

The proposed development is to provide a new train support facility. This type of development allows for the vast majority of the work to be completed on site with minimal off-site interaction. There will be staff movements in and out of the site and occasional delivery vehicles including 19 metre fuel trucks. The facility would operate 24 hours a day and 7 days a week as required.

4.1.2 Access and Circulation Requirements

The development will need to accommodate light vehicle access for employee vehicles as well as larger vehicles (19.0 metre semi trailer) associated with deliveries. Vehicles will be able to turn around within the site to allow for entry and egress in a forward direction.

4.2 Access

4.2.1 Driveway Location

All vehicle access to the development will be via a new access located on the corner of Mansfield Street and Nelson Street. The site access will form a 4th leg to the existing 3-way intersection. The existing road alignment provides priority for traffic along Mansfield Street (south) and Nelson Street with the 3rd leg being the access to the existing residential development off Mansfield Street as well as access to the existing railway station. The existing traffic flows along this short section of Mansfield Street to the existing railway station are very low.

As part of the assessment for the access to the site, an Autoturn simulation has been prepared for a 19.0m semi trailer accessing the subject site off Mansfield Street to the south of the site (**Appendix B**). The 19.0m semi trailer is the largest vehicles that can access the site as access is not permitted for vehicles longer than this (B-double ï Restricted Access Vehicles). The swept path analysis demonstrates that these delivery vehicles can safely enter and exit the site within normal road rules and will not impact upon the overall road safety at this location.

As part of the construction of the third track by ARTC it is proposed to upgrade Nelson Street with a new alignment and railway crossing. This will remove the existing poor alignment over the railway line and ensure good visibility for vehicles entering and exiting the site. The new alignment of the road and bridge will require the site access to be altered to ensure that a safe and appropriate design is provided and to ensure adequate visibility is available for vehicles entering and exiting the site. This future road upgrade and site access will require approval from Council and will be designed in accordance with the RTA Road Design Guide.

There is no fixed timetable for the upgrade of this bridge and road and for the purposes of this assessment it has been assumed that this upgrade will not be available during the construction phase of the development.

4.2.2 Sight Distances

The access for the development will be via the new access off Mansfield Street. Sight lines for this access will need to cater for the traffic speed at this location. Whilst the posted speed limit is 60 km/h at this location, observations on site indicate that actual vehicle speeds are lower than this length of road as the alignment over the railway bridge is very poor. This poor alignment limits vehicles speeds from the east in particular. Sight lines have been measured on site and the visibility distance available to the right for vehicles exiting the site is approximately 110 metres. To the left, the visibility available is in the order of 80-90 metres, the distance available to the edge of the road bridge. With regard to the RTA Road Design Guide, the visibility requirements for a intersection are 105 metres as a minimum for the posted speed limit of 60 km/h. This visibility requirement is provided for the splay to the right whilst to the left, the visibility available (80-90 metres) equates to a design speed of 50 km/h. Given the current poor alignment over the railway bridge and associated low traffic speed, the visibility splay available is considered sufficient for the proposed site access at this location. This access layout will be designed in accordance with Council and RTA requirements.

The upgrade of Nelson Street (by others) will be designed in accordance with the RTA Road Design Guide and will allow for adequate sight distances to be provided in both directions for vehicles entering and exiting the site. This design and upgrade will be completed in the future when ARTC complete the re-alignment of Nelson Street over the railway line.

The majority of operational light vehicle access will be via the give way controlled intersection of Nelson Street and the New England Highway. This intersection is located within a 60 km/h speed zone. For the posted speed limit of 60 km/h, the sight distance requirements are 105 metres for Safe Intersection Sight Distance and 60 metres for Approach Sight Distance. The sight distances have been checked on site and exceed 150 metres in both directions.

- **Photo 4 Right visibility splay along New England Highway from Nelson Street**

- **Photo 5 Left visibility splay from Nelson Street**

4.2.3 Service Vehicle Access

All service vehicle access will be provided via the new access on Mansfield Street to be built as part of this development. The new access will be designed in accordance with normal Council requirements. All service vehicles will able to enter and exit the site in a forward direction. Given the overall size of the subject site it can be seen that the internal site layout will allow for the movement of large vehicles and as such will allow for ease of manoeuvring within the site.

It is proposed that ultimately Tri-axle semi trailers and/or B-Doubles larger than 19metres could deliver fuel to the site for operations on the site. As such the fuel farm has been designed with suitable access for B-doubles and the facility has been designed to provide access both to and within the site for these larger vehicles.

There is currently no access for restricted access vehicles (Vehicle combinations longer than 19.0 metres, some B-doubles, road trains and low loader combinations etc) to the site. The designation of Nelson Street and/or Camp Road as a B-Double route allowing access to these restricted vehicles would be progressed through a separate application to Council and the NSW RTA. As a consequence, all fuel and deliveries to the site will occur via a semi trailer with a maximum length of 19.0 meters and maximum weight of 42.5tonnes as per normal road requirements, until any separate agreement can be obtained from the RTA and Council for use by B-doubles greater than this in size or weight.

Due to the poor alignment of Nelson Street over the railway line, it is proposed that all service vehicles will access the site via Mansfield Street and Camp Road. The majority of service vehicles will be less than 4.5 metres high and can thus use Allandale Road to connect to the New England Highway. For any service vehicles over 4.5 metres high, access will be from the south via Kurri Kurri.

All service vehicles will turn left into the site off Mansfield Street to enter the site and then turn right out of the site onto Mansfield Street from the site and proceed along Camp Road.

4.2.4 Queuing at entrance to site

Both Nelson Street and Mansfield Street currently operate well within their operational limits. Using the RTA guide to Traffic Generating Developments, it can be seen that the maximum flow along roads of this type is in the order of 500 vehicles per hour (Collector Street, environmental capacity on residential streets). The traffic surveys (**Table 3-1**) show that the current two-way flow is in the order of 312 vehicles in the PM peak (252 in the AM peak) at the eastern end of Nelson Street near the New England Highway. It is considered that a significant portion of the traffic would have an origin / destination within Greta and the flows would be substantially lower adjacent to the subject site.

Given the low flows on Mansfield Street together with the very low flows associated with the subject development, it is considered that there will be minimal queuing at the site access. As traffic will turn left into the site there will be no queuing required on Mansfield Street. Any queue for traffic leaving the site will be contained within the site and will not impact upon the operation of Mansfield Street.

4.2.5 Comparison with existing site access

The existing site is vacant so generates negligible traffic flows. The existing site access is located on a tight bend with limited visibility and it is considered that the rail upgrade to be constructed as part of the third track will improve the access considerably over the existing situation in accordance with normal road design standards.

4.2.6 Access to Public Transport

It is considered that no additional access will be required for public transport. The site is adjacent to the existing Greta train station which could be used by the future employees on the site. Additionally, the Hunter Valley Buses network services Greta via the New England Highway approximately 1 km from the site.

4.3 Circulation

4.3.1 Pattern of circulation

All vehicles will be able to enter and exit the site in a forward direction.

4.3.2 Road width

The width of the new roads within the site will be in accordance with Councilsô Design Guide. The roadways will allow for access by a B-double vehicle up to 25 metres.

4.3.3 Internal Bus Movements

No internal bus movements will be required.

4.3.4 Service Area Layout

There will be a number of hard stand areas within the site for dedicated servicing within the development including waste disposal. Access for larger B-doubles (if and when approved) will be provided and stand over areas will be provided within the site to allow for these vehicles. Areas will be provided across the site as required by the specialist nature of the project.

4.4 Parking

4.4.1 Proposed Supply

The development will provide off-street parking for employees. There will be a dedicated staff car park as well as hardstand areas suitable for parking. The parking area can cater for some 79 formal spaces in total spread over the entire site. Given the unique nature of the development, the parking provision has been provided based upon the operational requirements and associated staffing requirements.

The parking supply has been determined based upon the future staff numbers for the facility. For the full development (Stage 3) the peak staff demands will be in the order of 30 per day over three shifts plus additional staff levels as required for train crew changeovers and other maintenance activities. The day shift also has a variation in start and finish times, which reduces the peak parking demand.

The proposed parking supply is for 71 spaces for the admin offices, 5 for the train provisioning facility and 3 for the loco maintenance centre giving 79 overall. This parking provision has been derived from the analysis of future staff demands and will cater for the future parking demands associated with the development. This parking provision allows for visitor parking, contractors and deliveries etc.

4.4.2 Authority Parking Requirements

RTA Parking Requirements

The RTA Guide to Traffic Generating Development does not provide any guidance for parking demands for Rail Support Facilities. The guide advises surveys of similar types of development, but this is not applicable for this facility due to the lack of directly comparable sites. It is therefore considered appropriate to review the parking demands against the staffing numbers.

Cessnock City Council Parking Requirements

The Cessnock City Council DCP does not provide any advice for this type of development. It is therefore considered appropriate to review the parking demands against the staffing numbers.

4.4.3 Parking Layout

The parking on site will be designed and constructed in accordance with the Australian Standard (AS2890.1). This requires a space width of 2.4 metres and a length of 5.4 metres and an aisle width of 6.2 metres to allow for two-way movements. Disabled parking spaces will be provided adjacent to the main buildings in accordance with the Australian Standard.

4.4.4 Parking Demand

The peak parking demand for the development will occur during the normal working day. With typical staffing requirements of 30 permanent workers over 3 shifts maximum, it is considered that a parking provision of 79 spaces will be sufficient for employees as well as visitors and contract staff as well as train driver vehicles. There will also be hardstand areas that will allow for additional parking associated with deliveries and additional contract staff requirements as and when required.

4.4.5 Service Vehicle Parking

No dedicated service vehicle parking is required. Service vehicles will be able to park in a number of locations around the site as required for access to specific areas or buildings.

4.4.6 Pedestrian and Bicycle Facilities

No external pedestrian or cycle facilities will be provided as part of the development. Pedestrian paths will be provided within the site to allow for pedestrian movements between the various buildings and structures. Given the low staffing requirements it is considered that no additional facilities will be required. It is noted that as part of the upgrade of Nelson Street the facilities for pedestrians and cyclists will be improved over the existing situation in accordance with normal RTA requirements.

Bicycle facilities would be provided internally in accordance with the recommendations of the sustainability report.

5 Impact of Proposed Development

5.1 Traffic Generation

5.1.1 Daily and Seasonal Factors

The nature of the development will lead to typical morning and afternoon peak traffic generation, primarily associated with administration and activities on site. Additional traffic movements will occur at maintenance shift change over and also train crew change over times. It is considered that there are minimal seasonal factors.

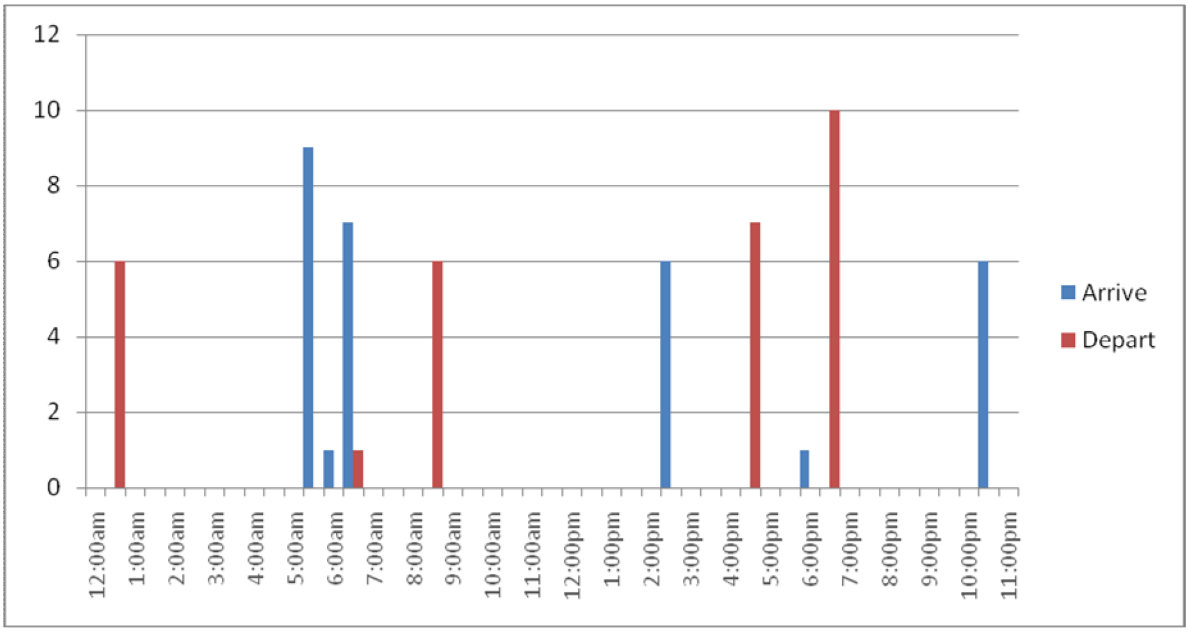
The level of traffic generated by the proposed development has been determined based upon the future staffing levels on site. Advice from the study team indicates that the site operations will typically require a workforce in the order of 45 per day maximum (based on 30 permanent staff and up to 15 contract staff) and will operate over a 24hour period. The volume of traffic entering and exiting the facility associated with staff is shown below **(Figure 5-1),** for the three stages. The movements are spread over a number of hours, due to staggered work hours and shift times.

The information provided below has been provided by the study team and is based upon the detailed proposed operations on the site. The recorded transport operations for the site operated by the applicant at Muswellbrook have also been used, to assess the movement of vehicles in and out of the site. An important item is the spread of traffic to and from the site, due to the staggered work shifts on site and the overlap between arrival and departures. This stagger in shifts means that the impacts during the peaks is reduced from an absolute peak that is normally observed at an industrial type development when all staff start and finish at the same time. This staggered work shift has been implemented by the applicant to reduce the absolute peak flows created by the development.

When considering the traffic movements for Stage Three, it is important to note that this stage will not occur for at least two years after the completion of Stage Two and is expected to occur post January 2014. At this point, the Hunter Expressway will be opened and the traffic flows along the New England Highway through Greta will be some 30% lower than the current flows.

It is considered that there will be minimal daily and seasonally variance in flows, although additional staffing may be required on occasion for specific work requirements e.g. major maintenance work.

- **Figure 5-1– Permanent Staff Movements- Stage 3**



- Between the hours of 10pm and 5am there is 12 movements
- In addition to the above there will be an increase in traffic associated with miscellaneous traffic movements associated with contractor visits, Train driver changeovers and deliveries. Due to the nature of these matters they will be random and dispersed throughout the day. It is anticipated that at the final stage 3 operation level there will be an additional 30 traffic movements (that is 15 arrivals and 15 departures) dispersed throughout the day over a 24 hour period with these trips being generated predominately during the day. To recognise this traffic, it would be expected that the peaks represented above would increase by a single traffic movement.
- Due to the change over processes at shift time frames the traffic leaving and entering the site at these times will be dispersed. It is estimated that a maximum of 4 vehicles per 15 minutes will enter or leave the site at these times.

Operational Daily Heavy vehicle movements at Stage 3;

- Between the hours of 6am and 10 pm - 9 fuel deliveries (average of 1 delivery per 1.5 hours). Fuel delivered by semi trailer (**NOT** B-Double-RAV).
- Between the hours of 9am and 3pm - 1 wheel set delivery
- Total of 10 regular daily deliveries ï Generating 20 heavy vehicle movements per day between 6am and 10pm.
- In addition,
  - 1 weekly delivery of sand and 1 weekly delivery of stores represents 4 movements per week.
  - 1 monthly delivery of Oil, representing 2 movements per month.
- All deliveries will be semi trailers or smaller, with NO B-double (RAV) use.
- No heavy vehicle will use Nelson Street due to bridge and intersection constraints

5.1.2 Pedestrian Movements

Given the site location it is considered that there will be little if any pedestrian movement to and from the subject site. However, internal pedestrian movements are expected between the various buildings and structures and a network of internal footpaths will be provided.

5.1.3 Origin / destinations assignment

Whilst the majority of the future workers will access the site via the intersection of the New England Highway and Nelson Street, advice provided by a local manpower supply company indicates that some 32% of the work force could come from the Cessnock / Kurri Kurri area to the south-east and as such would travel to the site via Camp Road and would not impact upon the intersection of the New England Highway and Nelson Street. It is also predicted that 19% of the workforce would be from the north-west towards Singleton with 49% from the south-east towards Maitland.

Thus, some 68% of the traffic associated with the development on the site will have an origin / destination towards the New England Highway. The remaining 32% would head south east from the site and would not impact upon the New England Highway in this location.

5.2 Impact on Road Safety

The additional traffic flows predicted to be generated by this development will have a minimal impact upon traffic safety in the surrounding roads as the flows are well within acceptable limits on the adjacent road network.

It can be seen that the major impact will be at the intersection of the New England Highway and Nelson Street. Whilst the additional turning movements are low, there is limited capacity for additional turning movements at this location due to the high traffic demands during the extended peak periods. During the morning period the majority of traffic movements will involve a left turn off the New England Highway into Nelson Street. This will have little impact upon the safety at this intersection.

However, during the afternoon some 49% of the traffic associated with the proposed development will involve traffic turning right out of Nelson Street onto the New England Highway. This movement currently suffers from some delay at times and drivers are often forced to accept smaller gaps in traffic movements. This could lead to safety issues.

Outside of the peak hours, when the background traffic flows along the New England Highway are lower, the impact of the development traffic will be reduced. It can be seen from **Figure 5-1** above that the traffic movements associated with the development will be dispersed over a number of hours, with staggered start and finish times. Advice from the study team indicates that Stage Two of the development will be some 5 years after the Stage One is completed and opened, indicating this will occur post 2014 when the Hunter Expressway is open.

From the information provided for Stage 3 (full development), there will be some 9 staff entering the facility for a 6.00 AM start as well as 7 for a 7.00 AM start. During this period, there will be 6 staff leaving at 8.30 AM. As the arrival will in the main involve traffic turning left in, off the New England Highway this will have little if any impact upon the road safety in the locality. The 6 vehicles leaving in the morning period will be over a 1 hour period and again, will have minimal impact upon overall road safety.

For the afternoon peak period, between around 3.00 and 6.00 PM, there will be some 6 inbound trips at 2.30 PM and 7 outbound trips at around 4.30 PM. The major impact will be created by the outbound trips, but it is important to note that these trips will be spread over a 1 hour period, with typically 3 trips per 15 minute time segment. The remaining movements are spread an hour apart, due to the staggered shift start / finish times. There will be 10 people departing the site at 6.30 PM when the traffic flows on the New England Highway have decreased considerably. It is considered that this will mean that the development flows will again have a minimal impact upon the overall traffic safety in the locality.

It can be seen that some 68% of the traffic associated with the operations side of the development would travel to and from the New England Highway to the north-east of the site. In this way, the impact upon Mansfield Street would be minimal. It is considered that just 32% of the traffic associated with the development will access the site from the south via Mansfield Street. The information above indicates the flows to the south along Mansfield Street will be in the order of 2 or 3 vehicles per hour during the afternoon peak and less during the morning peak. This volume of traffic will have a negligible impact upon the operation of Mansfield Street.

5.3 Impact of Generated Traffic

5.3.1 Impact on daily Traffic Flows

The additional traffic flows generated by the development are considered to be very low. The typical staffing levels on the site will be in the order of 45 per day maximum, with some additional delivery vehicles. The development will increase the flows on Nelson Street by 2-3 vehicles during the peak hours for Stage One, 5-6 in Stage Two and 7-8 vehicles in Stage Three and considerably less outside of the peaks.

As a local collector road, the environmental limit for Nelson Street is 500 vehicles per hour two-way. The current peak flows at the northern end is 312 vehicles per hour. The additional 7-8 trips in the final stage of the development would increase this to some 320 vehicle movements, still well within the environmental limit of 500 vehicles per hour.

Whilst the New England Highway is currently operating close to its capacity, the additional traffic movements associated with the development represent a minor increase over the existing flows. The existing westbound flow in the AM peak is in the order of 963 vehicles per hour. The additional trips (as a worst case scenario assuming all traffic to/from Maitland area) would increase this flow by around 1%. Similarly, the existing eastbound flow in the PM peak of 1422 would increase by less than 1%.

Outside of the peak there would be minimal impact created by the proposed development. Overall, it is considered that the development will have a minimal impact upon the daily traffic flows along the New England Highway.

The development will operate 7 days a week. During the weekend, the traffic flows along the New England Highway are much lower than during the morning weekday. Traffic data from the automatic count station to the west of the site towards Singleton (Station number 05.003) demonstrates that the average weekday flow in 2004 was in the order of 6575 whilst the average weekend flow was in the order of 4881, a reduction of 25%. Thus, the operational traffic during the weekend would have a lower impact than during the normal working week.

At the completion of the development it will be necessary for heavy vehicles to access the site from the south via Mansfield Street / Camp Road. It can be seen that even the 9 to 13 trucks per day associated with operations on site during stage 3 would still have a minimal impact upon the operation of this road. At its northern end adjacent to the New England Highway, Nelson Street (that runs into Mansfield Street / Camp Road) is carrying less than 300 vehicles per hour during the morning peaks in the week. Weekend flows would be much lower than this, showing that the operation of Camp Road would remain well within an acceptable level of service to the south of the site.

5.3.2 Peak Hour Impacts on Intersections

Intersection of Nelson Street and New England Highway

To assess the impact of the development upon the intersection of the New England Highway and Nelson Street, the computer program Sidra has been used. Sidra is a traffic analysis tool developed originally by the Australian Road Research Board. It calculates the amount of delay to vehicles using an intersection, and gives a level of service rating which indicates the relative performance of the nominated intersection treatment. Levels of service of A to C are considered to be satisfactory, a level of service of D is acceptable, and levels of E and F are considered unsatisfactory. Sidra also calculates the degree of saturation, which indicates the amount of spare capacity available.

A traffic count for the intersection between Nelson Street and the New England Highway was conducted in September 2009 and has been used for the basis of this analysis.

The operation of the existing give way controlled intersection of Nelson Street and the New England Highway together with the additional peak hour traffic flows associated with the development has been assessed, and a summary of the results from the Sidra analysis is presented below:

- **Table 5-1Sidra Analysis for Existing Situation – New England Highway / Nelson Street, AM / PM peak 2009**

Approach	LoS	Delay (seconds)	95th percentile queue (metres)
Nelson Street south	D / D (F for right turn)	45.9 / 46.7	27 / 17
New England Highway east	A / A	0.1 / 1.1	0 / 3
Nelson Street north	B (D for right turn) / F	20.1 (42.9 for right turn) / 106.7	0 / 1
New England Highway west	A / A	2.4 / 1.2	7 / 7
Overall	A / A	4.8 / 3.7	27 / 17

Notes AM / PM peak results

The above results confirm the site observations that there are no delays for through movements. However, whilst the Sidra analysis shows considerable delays and queues for the turning movements (and in particular the right turn movements into the side roads off the New England Highway) observations on site indicate that the delays / queues are slightly lower.

It is considered that this is due to a combination of platooning and reduced gap acceptance by drivers. Observations on site indicate that platooning of vehicles occurs, with vehicles travelling in a line behind a slower moving vehicle e.g. large truck. Whilst this creates no gaps in the traffic behind the slower vehicle, there are generally much larger gaps available in front of these slower vehicles. These larger gaps often allow a number of vehicles to exit the side roads in a group. It is also considered that drivers accept a smaller gap in traffic and drivers adjust their approach speed on the New England Highway to the intersection to coincide with an acceptable gap in the on-coming traffic movement when completing a right hand turn.

The same analysis was completed for the morning and afternoon peak periods, with the additional development flows added. For the purposes of this assessment, it was assumed an extra 9 vehicles would enter and exit Nelson Street from the east and an extra 1 vehicle would enter / exit Nelson Street from the west. The results for this analysis are presented in **Table 5-2** below.

- **Table 5-2 Sidra Analysis for Future Situation – New England Highway / Nelson Street, AM / PM peak 2009 base plus Stage One of the development**

Approach	LoS	Delay (seconds)	95th percentile queue (metres)
Nelson Street south	D / D	46.4 / 55.6	27 / 21
New England Highway east	A / A	0.1 / 1.1	0 / 3
Nelson Street north	B / F	20.2 / 106.8	0 / 1
New England Highway west	A / A	2.4 / 1.2	7 / 7
Overall	A / A	4.9 / 4.3	27 / 21

The above results confirm that the additional traffic flows associated with the subject development during the operational phase of the site will have a minimal impact upon the overall operation of the intersection of Nelson Street and the New England Highway. The analysis shows however that the critical right turn out of Nelson Street onto the New England Highway could deteriorate with delays increasing. The queue for this right turn movement could increase, although as discussed above, it is considered that the delays / queues will be less than those predicted by Sidra due to driver behaviour at this location.

Normal RTA requirements are for an assessment of the future operation allowing for a 10 year growth in background traffic flows. As part of the study, the RTA have provided data from the TransCAD model for the Lower Hunter that was established as part of the F3 to Branxton project (now known as the Hunter Expressway). The information provided by the RTA shows the following future daily two-way traffic flows along the New England Highway at Greta:

- 2016 ï 8,000 to 9,000 AADT
- 2026 ï 11,000 to 12,000 AADT
- 2031 ï 13,000 to 14,000 AADT

A review of the RTA count data shows that in 2004 the Annual Average Daily Traffic flow (AADT) on the New England Highway at eastern edge of Branxton was 18,325. Using the above data from the RTA, it can be seen that the traffic flows will reduce significantly with the construction of the Hunter Expressway. Advice from the RTA indicates that this road will be opened by 2014. This means that for Stage One of the proposal the traffic flows will remain as per the current situation. However, Stage Two will not be operational until 5 years after the opening of Stage One, meaning that by the time Stage Two opens the Hunter Expressway will have opened and the traffic flows along this section of the New England Highway will have reduced over the current situation.

It is therefore not necessary to complete the analysis for the future design year of 2019, as the traffic flows on the New England Highway will be lower than the current flows and the impact will therefore be less than the current predicted impact from the Sidra analysis. However, to confirm this a Sidra analysis has been completed for 2020, allowing for the through traffic movements on the New England Highway to reduce by some 8,000 vehicles per day or some 44% (18,500 current AADT and 10,000 AADT in 2020).
The results of this analysis are presented below:

- **Table 5-3 Sidra Analysis for Future Situation – New England Highway / Nelson Street, AM / PM peak 2020 base plus Stage Three development**

Approach	LoS	Delay (seconds)	95th percentile queue (metres)
Nelson Street south	B / B	15.3 / 14.5	8 / 5
New England Highway east	A / A	0.3 / 1.0	0 / 0
Nelson Street north	A / B	11.8 / 22.4	0 / 0
New England Highway west	A / A	2.5 / 1.7	4 / 6
Overall	A / A	3.1 / 2.7	8 / 6

The above analysis for the future design year of 2020 confirms that due to the significant reduction in traffic movements along the New England Highway post opening of the Hunter Expressway, the intersection of Nelson Street and the New England Highway will perform well with minimal delays for turning traffic and no delays for the through movements. The intersection layout modelled allows for the upgrade that the RTA has provided at this location, with the introduction of a type CHR intersection. This upgrade allows for sheltered right turn lanes to be provided on the New England Highway so that vehicles waiting to turn right into the side roads can prop outside the through traffic lane and improve safety for these vehicles. It should be noted however that the upgrade implemented by the RTA will NOT improve the situation for traffic turning right out of the side roads.

It is important to note that the traffic flows provided by the RTA from the traffic model allow for the future urban release areas that have been identified along the New England Highway corridor in the general vicinity of the subject site, as well as the development generally occurring in the Lower Hunter Valley. These would include the Anvil Creek site to the south of the location of the subject site.

Intersection of Nelson Street and Mansfield Street

It is useful to consider the Austroads threshold levels for intersection capacity under uninterrupted flow conditions. **Table 5.4** presents these thresholds. Where traffic flows fall within these limits intersection operation is essentially at no delay or interruption for approaching drivers other than to obey the requisite road rules and effectively operates at a level of service of A.

- **Table 5-4 Intersection Capacity – Uninterrupted Flow Conditions**

Road Type	Light Crossing or turning volumes Maximum Design Hour Volumes, Two-way (vph)		
Two Lane through Roadway	400	500	650
Cross Road	250	200	100
Four Lane through roadway	1000	1500	2000
Cross road	100	50	25

Source: Austroads Guide to Traffic Engineering Practice - Part 5, 1988

From **Table 3.1,** it can be seen that the two way flow on Nelson Street in the vicinity of the New England Highway is 252 vehicles in the AM peak and 312 vehicles in the PM peak. This would indicate that some 250 vehicles could use the side road with no delay to all road users. This is a worst case scenario as the flows on Nelson Street by the site access would be much lower, as a significant portion of the traffic on Nelson Street at its northern end has an origin / destination within the main

Greta Township to the north-east of the site and therefore turn off Nelson Street before Mansfield Street.

It can thus be seen that there is no requirement to complete any intersection modelling work at this intersection.

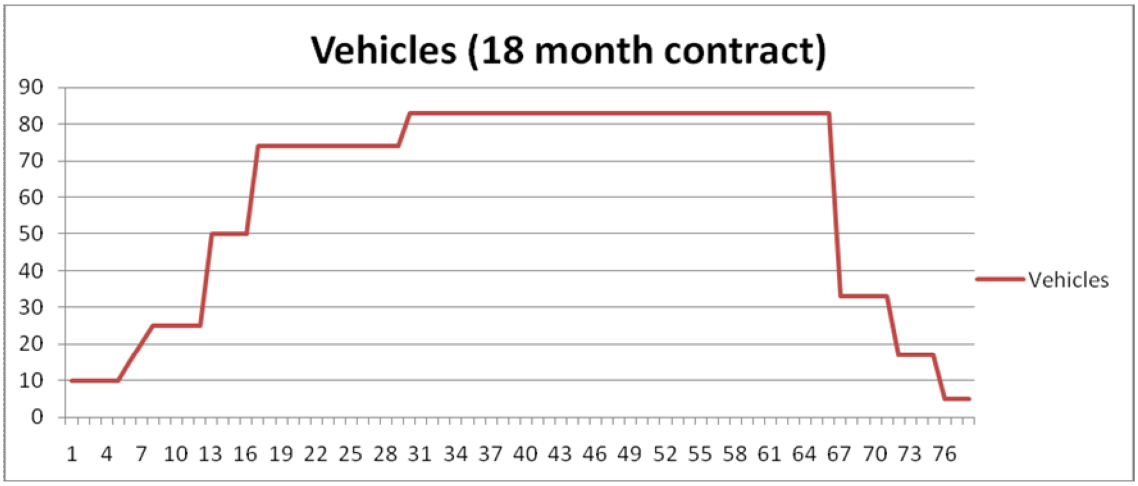
5.3.3 Impact of Construction Traffic

The impact of the construction work for the development would have a short term impact upon the intersection of the New England Highway and Nelson Street. A detailed assessment has been provided by Thiess (construction contractor) to provide advice on the volume of light vehicles associated with construction staff movements that would access the site during the construction period. The duration of the construction work could vary considerably, with an indicated timetable of between 12 and 18 months. With the amount of work required being constant, it can be seen that with an elongated construction period the volume of workers and associated vehicle movements would decrease i.e. be less intense.

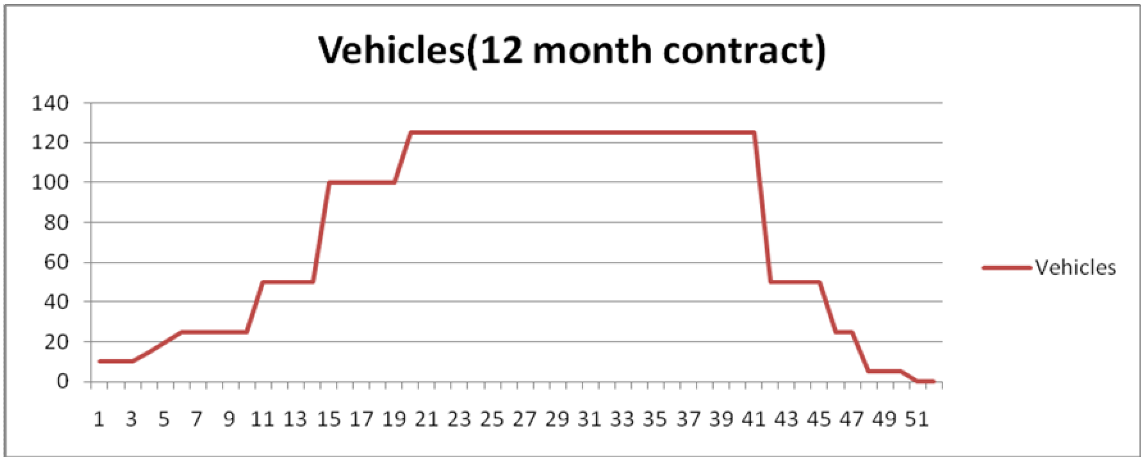
The review by Thiess has also provided details on the volume of truck movements expected per day, relating to the materials required on site throughout the construction works. The extent of import of materials is based upon adopting construction methods that minimise the demand for road deliveries. These methods include the recycling of excavated material on site, deliveries (where applicable) via rail transport and the utilisation of a grout batching plant on site.

During construction phase of the works, the number of workers and hence light vehicles on site can vary considerably. During the initial few weeks and towards the end of the project, there would be less than 30 vehicles on site associated with construction operations on site. For an 18 month contract period, there would on average be 53 vehicles on the site with a peak demand of 83 vehicles per day. If the construction work is condensed over a 12 month period, the average number of vehicles would be 80 per day with a peak of 125 vehicles.

A graph showing the typical daily light vehicle numbers is presented below:



- **Figure 5-2 Project Construction Staff Vehicles per day - 18 month construction phase**

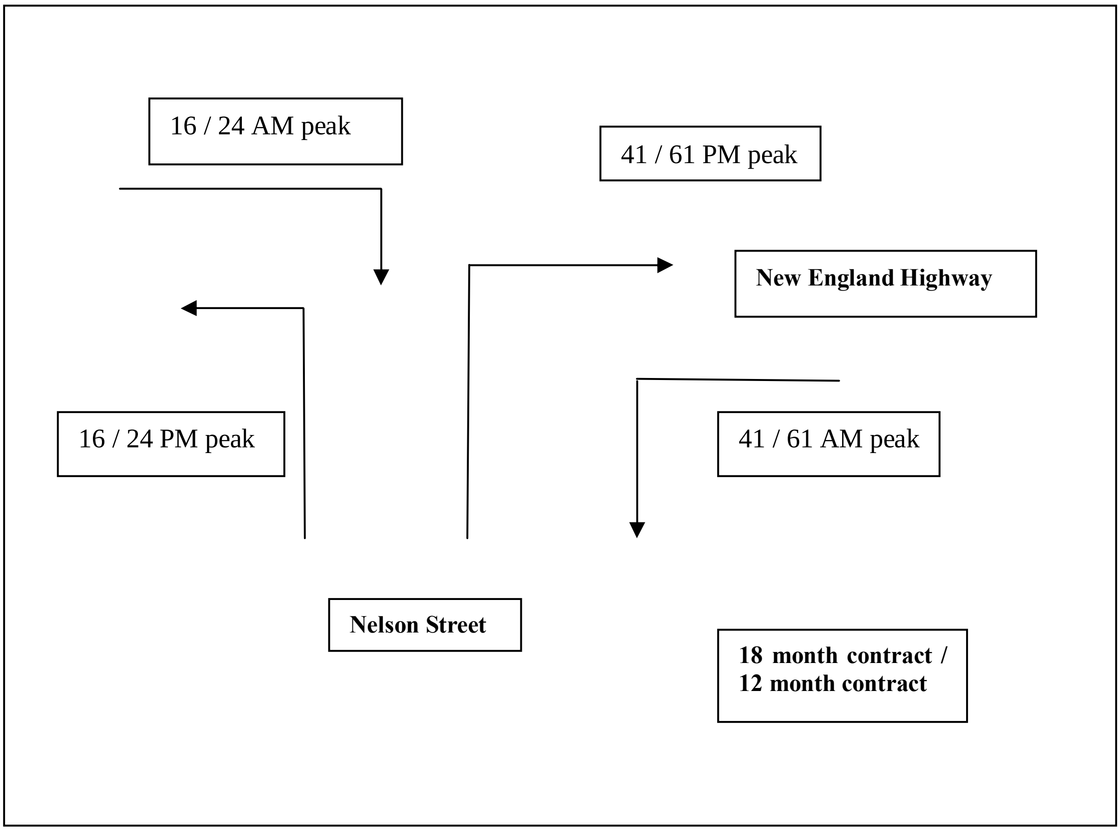


- **Figure 5-3 Projected Construction Staff Vehicles per day – 12 month construction phase**

Whilst the majority of these construction vehicles will access the site via the intersection of the New England Highway and Nelson Street, advice provided by a local manpower supply company indicates that some 32% of the work force would come from the Cessnock / Kurri Kurri area and as such would travel to the site via Camp Road and would not therefore impact upon the intersection of the New England Highway and Nelson Street. It is also predicted that 19% of the workforce would be from the north-west towards Singleton with 49% from the south-east towards Maitland.

Traffic with an origin / destination towards Singleton will turn right into Nelson Street in the morning and then left out of Nelson Street in the afternoon. For the traffic heading to Maitland, this will require a left turn into Nelson Street in the morning and a right turn out of Nelson Street in the afternoon.

Based on the above splits, the traffic movements at the intersection of Nelson Street and the New England Highway during the peak period of construction are shown below:

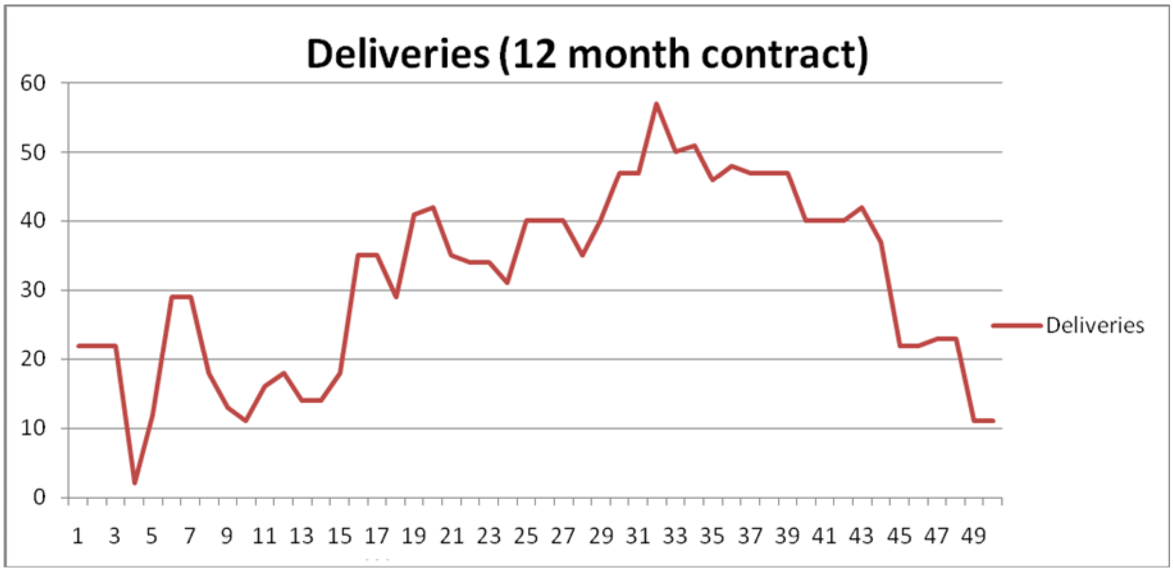


■ **Figure 5-4 Predicted Construction Staff Vehicle Movements during peak activities.**

The peak demand for construction workers will occur over the middle period of the construction phase, for about 4 or 5 months. Either side of this period, the number of workers and related vehicle movements will be much lower and will create much lower traffic demands. As a worst case scenario, it can be seen that at its peak, there could be some 83 vehicles associated with the construction workers (18 month contract) and 125 vehicles for the 12 month contract period.

It can be seen that the critical period will be in the afternoon, when the construction workers vehicles will wish to turn right out of Nelson Street to head towards Maitland and Newcastle. During the peak construction activities on site there would be 41 to 61 vehicles wishing to turn right out of Nelson Street at the end of the work day dependent upon the duration of the work on site.

To a lesser extent, there will also be a number of vehicles associated with materials delivery as well as specialist construction plant e.g. cranes, that could have an impact upon the local road network. Whilst these volumes will be considerably lower, their impact on road safety needs to be considered due to their size and associated slow moving speeds out of the side road. These numbers have been assessed by Thiess and are presented below:



■ **Figure 5-5 Projected number of delivery vehicles based on 12 month contract**

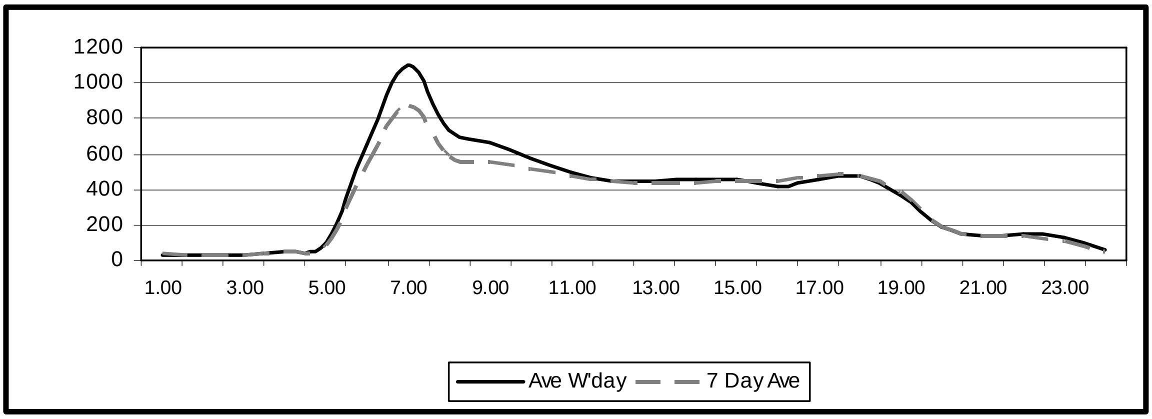
This graph shows the number of deliveries varying between a low of 2 a day to a high of 57 trucks a day. The average number of trucks entering and exiting the site per day will be 31. If the contract extends to 18 months then these values would reduce to 21 per day on average and 38 as a peak. Note that this peak demand of 57 trucks will occur for one week only.

An additional traffic survey has been reviewed which was completed over a one week period by Better Transport Futures to highlight hourly and daily variance in traffic flows for the New England Highway. These surveys were completed to the west of the site in Belford between the 13th and 19th May 2006 inclusive.

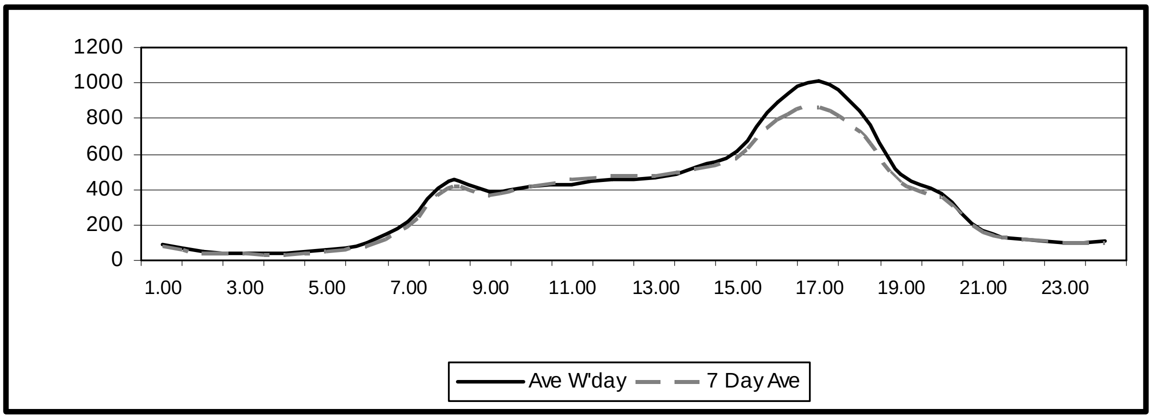
The results of these surveys are summarised below:

- The morning peak traffic demand was recorded between 6.00 and 7.00 am, with a two-way flow of 1,314. The dominant flow was westbound with 1,098 vehicles (83.5%).
- The afternoon peak hour was between 4.00 and 5.00 pm with a two-way flow of 1,466 vehicles per hour, with the peak being eastbound (1,014 vehicles or 69.2%).

The surveys from the weekǿs count in May 2006 also provide details on the hourly variation in traffic flows. The results of this survey are show below:

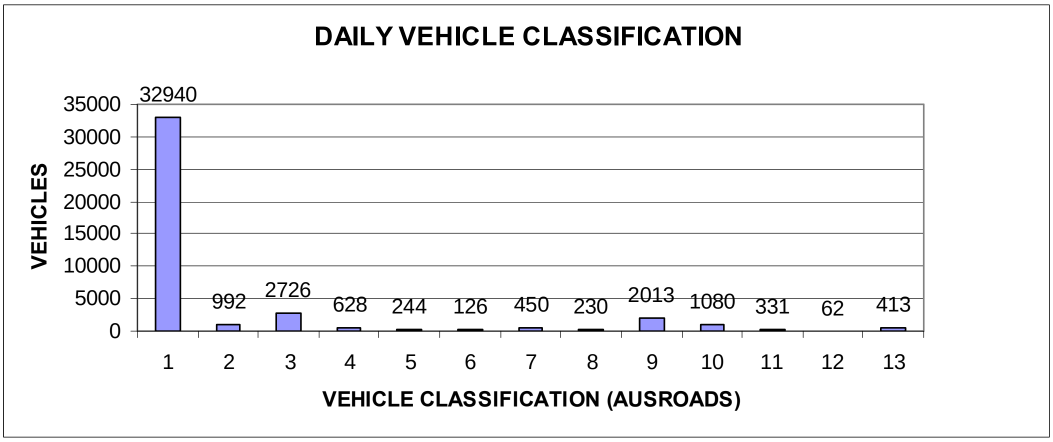


- **Figure 5-6** Westbound (towards Singleton) daily variation in traffic flows.

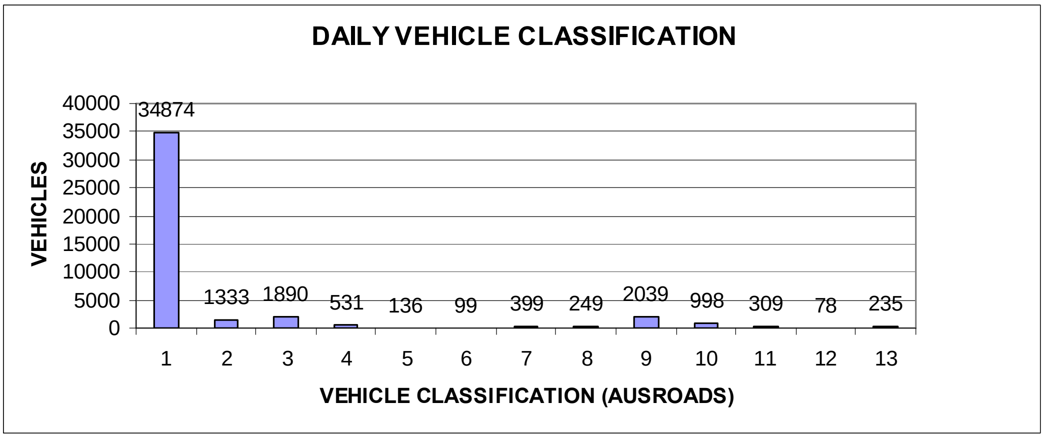


- **Figure 5-7** Eastbound (towards Branxton) daily variation on traffic flows.

The traffic survey from May 2006 also provides details on the vehicle classification. The variation in vehicle classification is shown below. Refer to **Appendix D** for details on vehicle classification.



- **Figure 5-8** Daily variation in vehicle classification, eastbound towards Branxton.



- **Figure 5-9** Daily variation in vehicle classification, westbound towards Singleton

The traffic data collected at the intersection of Nelson Street and the New England Highway shows that during the absolute peak period, the eastbound traffic movement is high and this creates considerable delay for vehicles turning right out of Nelson Street. However, the above data demonstrates that the traffic flow on the New England Highway drops off considerably outside of this afternoon peak period. The traffic data for the weekly survey shows that before 2.30 PM and after 6.00 PM the critical eastbound traffic flow reduces to 600 vehicles or less. This compares with the peak demand of 1,000 vehicles per hour.

During the peak demand for the eastbound traffic movement on the New England Highway, the westbound traffic movement is very low (at around 600 vehicles per hour) or less.

It can be seen that the major impact at the intersection of the New England Highway and Nelson Street will occur during the afternoon peak period, when there is limited capacity for the critical right turn out of Nelson Street. At this time, the left turn out of Nelson Street can occur with little if any impact upon the existing operation of this intersection. Some 49% of the construction traffic is predicted to turn right out of Nelson Street.

Similarly, during the morning peak period, 49% of the inbound traffic movements associated with the construction workers will be left turn in off the New England Highway into Nelson Street. Some 19% will be turning right into Nelson Street off the New England Highway whilst the remaining 32% will not use this intersection when accessing the site.

From the above survey numbers, it can be seen that the critical issue remains the demand created by traffic wishing to leave the site and then turn right onto the New England Highway during the afternoon period. To reduce the impact of the construction workers vehicles, the following arrangements are recommended:

- Workers travelling by private car are to exit the site and turn right on Mansfield Street and use the road to Lovedale to avoid using the critical junction with the New England Highway. This route is considered satisfactory and appropriate for many destinations further to the east such as Kurri Kurri, Lake Macquarie and Newcastle.
- Stagger the release of cars from the site that still need to use the New England Highway / Nelson Street intersection, say 5 cars every 5 minutes
- Ensure that cars leaving the site that use the Nelson Street intersection turn left before using intersections further west to turn around to head back to Maitland. (This arrangement has been previously recommended as a suitable temporary form of traffic management of the subject site.)
- Provide shuttle buses for construction workers to significantly reduce the volume of vehicles associated with construction workers entering and exiting the site.

In addition to the above the following could also assist in improving traffic management under the temporary conditions created during project construction;

- Employees cars could be identified say with a windscreen sticker combined with recording number plates and car details (if required).
- A traffic monitoring crew could be employed say between 3.30PM and ï 6PM.
- Monitors would ensure that cars leave the site at staggered time intervals, say 5 cars every 5 minutes. (based on an average of 53 vehicles per day on site at peak, this would spread the release of vehicles over 55 minutes)
- Monitor the intersection of Nelson Street and ensure that no vehicles identified from the PN site would be turning right out of Nelson Street.

The above control of employeesô vehicles would form part of the siteôs OH&S System and in particular the Construction Management Plan as a means of ensuring that people are educated regarding the purpose of controlling traffic movements after leaving the site. It would also provide a mechanism for issuing a non compliance under the OHS system or CMP if vehicles are identified turning right out of Nelson Street in the nominated PM peak period on the New England Highway.

In addition, the applicant will also encourage supporting the use of car pooling or the use of a daily shuttle bus for workers as a means of minimising the extent of private car use. While this cannot be enforced it would assist in reducing the extent of temporary impacts even further than the recommendations for traffic management as outlined above.

Prior to the commencement of construction work on site, a Construction Management Plan (CMP) will need to be prepared and submitted for review and approval by the RTA and Council. This CMP will be developed in accordance with RTA Guidelines and will need to take into account the CMP that will be designed and implemented for the construction of the Hunter Expressway. In this regard, the cumulative impact of the construction works in this locality will be managed to ensure minimal overlap. The CMP for the subject site and the Hunter Expressway will both be reviewed by the RTA and the cumulative impact will form part of the RTA review.

These options for reducing the impact of the construction traffic will need to be discussed and agreed with the road authority as part of the review process. The agreed work options will need to be approved and implemented through the Conditions of Consent. This would include a cap of 125 vehicles per day for the traffic associated with workers on site.

It has been assumed that the construction work on site will commence prior to ARTCôs realignment of Nelson Street, and that large construction vehicles would be required to access the site from the south, due to the poor alignment of Nelson Street over the railway line as well as a possible weight restriction on the wooden bridge over Anvil Creek. This will also require some of the heavy vehicles to access the site via Cessnock to the south, as there is a height restriction on Allandale Road of 4.5metres. Other delivery vehicles will be able to use Allandale Road to access the New England Highway.

The proposed inbound heavy vehicle route for deliveries to the site will be via Allandale Road and its intersection with the New England Highway, along Lovedale Road and then right into Camp Road to Mansfield Street and left into the site. The exit movement will be the reverse of this route. For any vehicles requiring access to the site that are taller than 4.5 metres, access will be via Lovedale Road to the south, then via Cessnock or Wine Country Drive. This is due to the existing height restriction on Allandale Road under the Main Northern railway line.

The materials will be delivered to the site throughout the normal work day, with the majority occurring outside the traditional peak times on the local road network. The intersection of Allandale Road and the New England Highway has been surveyed outside of the peak periods and the results show that the traffic flows are relatively low along Allandale Road and confirm that the delays for traffic turning right out of this intersection during these times are very low. During the morning survey between 9.30 and 10.30 AM, the two way flow along Allandale Road was 129 vehicles per hour and 95 between 1.00 and 2.00 PM.

Observations at this intersection show that the delays for the traffic turning right out of Allandale Road are typically very low, with the occasional higher delay. The observations on site show that there is a high degree of platooning of traffic, whereby vehicles are delayed behind slower moving vehicles. This was occurring in both directions, with large gaps in the traffic stream. A similar pattern occurred on Allandale Road, with 2 or sometimes 3 vehicles typically arriving at the intersection in convoy. The observations show that these arrival vehicles on Allandale Road were generally able to exit the side road immediately with little delay other than that associated with maneuvering through the intersection.

A Sidra analysis has been completed on this intersection for the morning and afternoon survey periods and the results of the Sidra analysis are presented below. Note that the gap acceptance value and follow up head way have been adjusted within Sidra, so that the Sidra simulation of this intersection replicates the observations on site. The Sidra computer program only allows for a constant flow (and hence gap) in traffic movements and does not allow for varied gaps observed on site due to the vehicle platoons. The altering of the gap acceptance and follow up head way has allowed the simulation of the intersection to accurately replicate the observations on site at this intersection.

- **Table 5-5 Sidra Analysis for Existing Situation – New England Highway / Allandale Road, 9.30-10.30AM / 1.00-2.00 PM**

Approach	LoS	Delay (seconds)	95th percentile queue (metres)
Allandale Road	C / D	37.5 / 47.8	14.9 / 12.8
New England Highway east	B / B	1.1 / 1.3	0.0 / 0.0
New England Highway west	B / A	0.1 / 0.1	0.5 / 0.2
Overall	A / A	2.4 / 2.3	14.9 / 12.8

It is also important to note the direction of arrival / departure for the vehicles associated with the material movements to the site. A proportion of material will be sourced from Ardglen quarry, west of the site beyond Murrurundi. These trucks will require a right turn into Allandale Road and a left turn out which can occur in a safe and appropriate manner, due to the sheltered right turn lane at this intersection. The remaining material would generally be sourced from the Maitland and Newcastle area with other material also sourced from Allandale quarry to the south of the locality. The trucks associated with the Allandale quarry will not need to access the New England Highway to gain access to the site.

The number of truck movements required for the delivery of material to the site gives an average daily value in the order of 31 per day. There will be a peak demand of 57 trucks per day but only for a single week and less than 50 trucks per day either side of this peak demand. If the contract expands out to 18 months, the delivery numbers would reduce accordingly, with a peak of 38 trucks per day for the one week and 21 trucks per day as an average.

It has been assumed that the deliveries could be evenly spread out over the working day. This would give some 7 vehicles per hour inbound (and outbound) for the peak of 57 trucks daily for the one week and 4 trucks per hour for the average value of 31 per day trucks per week. Again, if the contract extends out to 18 months these values would decrease to 5 and 3 trucks per hour in and out respectively.

The majority of the deliveries will occur outside the peaks, with some material be delivered in the peak hours. Allowing for unloading of material, it can be seen that the vast majority of delivery vehicles will exit the site after the peak periods on the New England Highway. A Sidra analysis has been completed to assess the impact of the construction delivery vehicles during the shoulder periods (9.30 to 10.30 AM and 1.00-2.00 PM). Between these hours, the traffic flows on the New England Highway are lower and hence the impact will be less. The results of this Sidra analysis (based on a condensed construction timeframe of 12 months) are presented below:

- **Table 5-6 Sidra Analysis for Existing Situation plus Delivery Vehicles– New England Highway / Allandale Road,**
  9.30-10.30AM / 1.00-2.00 PM

Approach	LoS	Delay (seconds)	95th percentile queue (metres)
Allandale Road	C / D	39.4 / 51.0	18.0 / 16.6
New England Highway east	B / B	1.3 / 1.5	0.0 / 0.0
New England Highway west	B / A	0.1 / 0.1	0.5 / 0.2
Overall	A / A	2.8 / 2.9	18.0 / 16.6

The above results confirm that the additional traffic movements associated with the delivery vehicles will have a minimal impact upon the overall operation of this intersection and that this intersection can continue to operate in a safe and acceptable manner during the construction phase of the project.

The heavy vehicle access route via Mansfield Road / Camp Road / Lovedale Road / Allandale Road will form part of the Construction Management Plan for the development. This CMP will require no access for B-doubles (RAVs) until (or if) a route is approved by Council and the RTA.

Once the proposed upgrade to Nelson Street has been implemented by ARTC, the Construction Management Plan can be reviewed and altered in consultation with Council and the RTA to allow for access via Nelson Street if required.

All works on site will be governed by the relevant EP&A rules and as stipulated within any development consent granted by the NSW Department of Planning.

The construction works associated with the Hunter Expressway have been discussed with the project manager from the RTA. It is understood that the eastern section of the road length (F3 to Kurri Kurri) will commence construction in July 2010, whilst the contract for the western section between Kurri Kurri and Branxton has been awarded and is due to commence construction in January 2011. The full construction works will be completed towards the end of 2013. As part of the construction process for this project, a detailed Construction Management Plan will need to be developed and implemented by the successful tender. This CMP will need to be developed and approved by the RTA and will have to take into account the traffic (including construction traffic) associated with the development under consideration here.

There are no details available on the construction timetable, access routes or volumes of vehicles etc. However, once the alignment of the road has been established it is expected that the majority of traffic would use the Hunter Expressway road alignment and would therefore have little if any impact upon the New England Highway and the local road network.

The timing of the construction of Stages 2 and 3 of this development will occur in 2014 or beyond, when the Hunter Expressway is complete. Thus there will be no clash in construction traffic between the subject site (Stage 2 and 3) and the Hunter Expressway work. It can also be seen that the construction of Stages 2 and 3 will occur whilst Stage 1 is operational. However, the traffic associated with Stage 1 is relatively low. There will be between 4 and 6 trucks per day accessing the site for the Stage 1 operations and staff numbers will be in the order of 45 over the day, giving 45 inbound trips and 45 outbound trips per day. With the staggered shift times that will be operational on site, this gives a peak demand per hour of 10 vehicles (refer **Figure 5-1** above). This volume of traffic, as well as the additional traffic associated with the construction work, will have a minimal impact and when compared with the background traffic flows on the New England Highway represents less than 0.6%.

A summary of the construction work impact is provided below:

Scenario	**Future Traffic flows**	**Operation of Intersection of Nelson Street and New England Highway.**	**Reason for level of service**	**Construction traffic assumptions**	**Comment**
Existing traffic flows with no development traffic		**A** overall for intersection. **D** for right turn out of Nelson Street south of New England Highway.	High traffic flows along New England Highway restrict access for traffic turning right out of side roads.		Existing high traffic flows on the New England Highway create delays, especially in the PM peak period
Existing traffic flows plus construction traffic workers flows	Average of 80 vehicles per day and 125 maximum. If contract elongates to 18 months, then 53 and 83 respectively	Level of service of **A** overall BUT **F** for the right turn out of Nelson Street.	High traffic flows along New England Highway restrict access for traffic turning right out of side roads. Minimal capacity for any additional right turns during the afternoon peak period.	49% of construction traffic if unmanaged is expected to turn right out of Nelson Street during peak period	Need to avoid right hand turn out of Nelson Street by construction traffic during peak period 3.30 pm and 6.00 pm
Notes	Management of afternoon construction traffic includes	• Staggered release of traffic that will use Nelson Street from site ï 5 cars every 5 minutes • Immediate release of vehicles from the site that will use Camp Road and avoid intersection of Nelson Street and New England Highway. • Monitoring of Intersection to ensure cars that have been identified as being on the Pacific National site do not turn right out of Nelson Street during the peak period • All heavy vehicles to access the site via Camp Road			
Mitigation	Avoid right turn from Nelson Street in afternoon Peaks	• SIDRA analysis showed that the high through traffic flows along the New England Highway in the peak periods is the main cause for delays for side road at the intersection • Remaining options of turning left into New England has minimal impact on traffic flows during critical afternoon peak period • Overall contribution of traffic to the New England Highway is negligible • Avoiding right hand turn from Nelson Street in afternoon peaks will maintain current level of service of intersection			
Management of right hand turn from Nelson Street	Identification of cars and traffic marshals	• All cars on the Pacific National site will be clearly identified through semi permanent marking such as a sticker • Car makes and models and registration will be recorded • Traffic Marshals will be at the gate of the construction site and also at the intersection of Nelson Street and New England Highway. • Any cars found to be turning right out of Nelson Street during peak periods that come from the Pacific National site will be identified and reported under OH&S requirements as undertaking an unsafe action. • All employees on site will be educated of this matter through normal OH & S management such as tool box meetings, signs and inductions			

5.3.4 Other Developments

There are currently no other major developments occurring in the locality. There are some residential development proposed within the wider Greta locality but these are on the opposite side of the New England Highway or located some distance away from the subject development. The Anvil Creek Development and Masterplan has been approved by Council for subdivision into 11 lots only at this stage with no approval for construction.

It is noted that Stage 1 of the Anvil Creek development only has consent which allows for subdivision of the land into eleven (11) lots only. It can be seen that prior to the approval and subsequent construction of the development a detailed traffic assessment will be required prior to any consent to review the impact of this development upon the local road network. It can be seen that this site will generate a high volume of traffic, especially the permanent residential development i.e. 1364 dwellings, at standard RTA rate of 0.85 trips per lot in the peak hour this indicates some 1,159 vehicle movements during the critical morning and afternoon peak periods.

It is noted that the RTA model for the Lower Hunter developed as part of the approval process for the Hunter Expressway allowed for the urban release areas identified in the Lower Hunter. This included developments such as Huntlee as well as other centres up and down the New England Highway as well as developments within Greta. As Anvil Creek is a significant development, it is considered that this will have been taken into account by the RTA as part of the development of the model and therefore allowed for in the future flows along the New England Highway etc.

5.3.5 Assessment of Traffic Noise

An assessment of traffic noise is beyond the scope of work and expertise of Better Transport Futures and has been completed by Advitech.

5.4 Public Transport

5.4.1 Options for improving services

Given the type of development and the low employee numbers, it is considered that access demands via public transport are limited. The existing train station at Greta is located adjacent to the subject site but due to the very low frequency of trains it is considered that no one will use a train to access the site. The design of the facility allows for pedestrian access to / from the buildings and structures within the site footprint.

5.4.2 Pedestrian Access to Bus Stops

No bus stops are located within the general locality of the subject site, with the nearest bus stop located on the New England Highway. This bus stop is 1 km away from the subject site which will reduce the attractiveness of bus use, together with the infrequent services and routes provided. It is therefore considered that no additional pedestrian access provision is required to the bus stop as part of this development.

5.5 Recommended Works

5.5.1 Improvements to Access and Circulation

It is considered that the proposed site access and circulation can provide a safe and appropriate access arrangement for the development. The driveway and car park will all be designed and constructed in accordance with Council and Australian Standards requirements together with the specialist requirements of the development.

5.5.2 Improvements to External Road Network

It is considered that there are no external road works required as a consequence of the subject development. The planned realignment of Nelson Street over the railway line is being undertaken by ARTC. With the opening of the Hunter Expressway in January 2014 (or earlier) the traffic flows along the New England Highway in Greta will reduce significantly and the existing road network will operate to a much higher standard and will be able to accommodate the traffic flows associated with the future operations on site.

During the construction phase of the development, there will be a large number of heavy vehicles requiring access to the site via Allandale Road / Lovedale Road / Camp Road and Mansfield Street. The impact of this traffic upon the road surface of these roads will need to be monitored and repair work may be required. This monitoring and upgrade work will form part of the consent conditions through Council.

5.5.3 Improvements to Pedestrian Facilities

Given the low employee numbers on the site and the lack of public transport in the general locality in combination with the shift work, it is considered that there is no requirement for improvements to external pedestrian facilities in the locality. As part of the development, internal pedestrian paths will be provided to provide a connection between the buildings and structures within the site.

5.5.4 Effect of Recommended Works on Adjacent Developments

The proposed construction work within the site will have minimal impact upon the adjacent developments. Access to the existing adjacent properties will be maintained as a result of this development.

5.5.5 Effect of Recommended Works on Public Transport Services

There will be no effect upon the public transport services in the vicinity of the subject site. It can be seen that existing public transport use adjacent to the subject site is extremely low due to the very infrequent service together with the time of train and bus services during the working day. The availability of services at the weekend is even lower.

5.5.6 Provision of LATM Measures

There are no other Local Area Traffic Management measures required as part of this development.

5.5.7 Funding

All works associated with the development will be funded by the applicant.

5.5.8 Noise Attenuation

Any noise attenuation measures will be assessed by Advitech.

6. Conclusions

The following conclusions are drawn from the investigations into the proposed Train Support Facility off Mansfield Street, Greta, NSW:

1. The proposed Train Support Facility will be located off Mansfield Street to the immediate west of Greta. Once operational, it will provide employment for some 30 permanent workers and 15 contract workers, spread out over a 24 hour work day. Parking for the employees and delivery trucks associated with the development will be provided within the site.
2. A large portion of the traffic associated with the future operations on the development site is considered to access the greater road network via Nelson Street. It is expected that the traffic to/from the development will have a bias towards the New England Highway. For the purposes of this assessment, it has been assumed that 68% of the future operational traffic will access the site via the intersection of the New England Highway and Nelson Street.
3. The heavy vehicles associated with the operations on site will access the site via Allandale Road / Lovedale Road / Camp Road and Mansfield Street due to the poor road alignment of Nelson Street over the Main Northern Railway line.
4. The performance of the key intersection of Nelson Street and the New England Highway has been assessed using the computer program Sidra as well as site observations. Whilst the Sidra analysis indicates considerable delays for the side road traffic (mainly the right turn movements) observations on site indicate that the delays are much smaller. This is due to a combination of platooning of traffic on the New England Highway and drivers accepting smaller gaps in traffic flows.
5. The Sidra analysis indicates that the traffic flows associated with the development will have a minimal impact upon the overall operation of the intersection of the New England Highway and Nelson Street. Similarly, the overall operation of the New England Highway in this location will remain as per existing conditions. For Stage One of the development (and prior to the opening of the Hunter Expressway) there could be increase delays / queues for traffic turning right out of Nelson Street during the afternoon peak period. The observations on site indicate that due to platooning of traffic movements etc the actual delays / queues at this location are in fact lower than those predicted by the Sidra modelling.
6. Traffic data from the RTA shows that the future traffic flows on this section of the New England Highway will be significantly lower once the Hunter Expressway is opened in 2014. Thus the future impact of the development will also be negligible. The development will expand beyond the initial Stage One (after 5 years i.e. post 2014) but the actual peak demands associated with the future operations on the site do not increase significantly, due to varied shift times.
7. All of the parking requirements for the development can be accommodated on site. There will be an area of staff parking as well as hard stand areas that can be used for parking as well as delivery vehicles as required.

8. The primary impact to surrounding transport infrastructure as a result of the Project would be during the construction phase as the employee numbers would be much higher than during operation. A number of mitigation measures have been put forward to reduce the temporary impacts during construction. It is also recommended that further discussions be held with the RTA during the preparation of the sitesô Construction Management Plan to assist in the overall management of construction traffic. This is especially relevant to the potential cumulative impact that may arise in the event that this Project was under construction at the same time as the Hunter Expressway project. It is important to note that these construction impacts are short term only.
9. The heavy vehicles associated with the delivery of materials to the site during construction will access the site via Mansfield Street / Camp Road / Lovedale Road and Allandale Road, due to the poor alignment of Nelson Street over the Main Northern Railway line. The impact of this traffic has been assessed on the critical intersection of the New England Highway and Allandale Road and it can be seen that this additional traffic will have an acceptable impact upon the operation of this intersection.
10. Whilst Mansfield Street and Camp Road have adequate capacity to cater with the traffic flows associated with the construction traffic, the road surface condition may need to be monitored and repair work completed on the surface once the construction work is completed. The extent of this work will need to be discussed and agreed with Council.
11. The report has assessed the option for semi trailer access during the operational phase of the project via Mansfield Street / Camp Road /Lovedale Road and Allandale Road and it can be seen that access is available along this road as the current weight limit on this road is 42.5 tonnes.
12. There will be minimal demand for pedestrian, cyclist or public transport improvements generated by the subject development, in the main due to the shift times of operation and the lack of regular services at the railway station at Greta. There is public transport available via the railway station adjacent to the site or buses which service the New England Highway only. Pedestrian and cyclist facilities are provided within the site for internal pedestrian and cyclist movements.

The overall conclusion from the investigations is that traffic and access arrangements for the development proposal are satisfactory, subject to detailed design and approval by NSW Department of Planning.

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

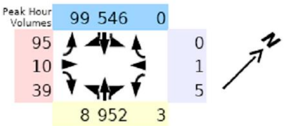
Better Transport Futures

Appendix A Traffic Survey results

Curtis Traffic Surveys

Turning movement count

Job: 090901bt p0643
Day, date: Tuesday, 1 September 2009
Location: New England H'y, & Nelson St Greta
Weather: Fine
Client: Better Transport Futures

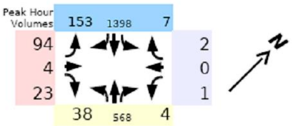


Time Period	From New England H'way north						From Nelson St west						From New England H'way south						From Nelson St east						Total vehicle movements	
	Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles		
06:00 to 06:15	0	0	38	6	3	0	22	1	0	0	4	0	0	0	230	16	0	0	0	0	0	0	0	0	320	
06:15 to 06:30	0	0	61	7	18	0	23	3	1	0	2	1	2	0	222	32	1	0	0	0	0	0	0	0	373	
06:30 to 06:45	0	0	67	16	6	0	21	1	0	0	6	2	1	0	149	25	0	0	2	1	1	0	0	0	298	
06:45 to 07:00	0	0	73	9	13	1	24	1	0	0	2	1	0	0	174	16	0	0	2	0	0	0	0	0	316	
07:00 to 07:15	1	0	150	15	31	0	30	4	0	0	6	0	2	0	266	32	0	0	0	0	0	0	0	0	537	Peak
07:15 to 07:30	0	0	90	12	23	0	20	1	0	1	1	0	0	1	168	10	2	0	0	0	2	0	0	0	331	
07:30 to 07:45	0	0	122	16	37	1	21	4	3	0	10	1	1	1	204	16	0	0	1	0	0	0	0	0	438	
07:45 to 08:00	0	0	130	19	19	2	23	4	2	0	7	0	0	0	204	16	2	0	0	0	1	0	0	0	429	
08:00 to 08:15	0	0	113	18	13	0	19	3	3	0	9	0	1	0	210	19	1	0	2	0	0	0	0	0	411	
08:15 to 08:30	0	0	111	17	27	0	21	0	2	0	12	0	5	0	264	19	0	0	2	0	0	0	0	0	480	
08:30 to 08:45	1	0	131	7	24	2	17	0	0	0	10	0	4	0	155	19	3	0	1	0	0	0	1	0	375	
08:45 to 09:00	0	0	118	11	27	1	29	1	1	0	11	0	4	0	171	25	1	0	3	0	2	0	0	0	405	
09:00 to 09:15	2	0	77	13	12	1	16	0	0	0	7	1	0	0	105	19	1	0	1	0	0	0	0	0	255	
09:15 to 09:30	0	0	111	25	14	0	14	1	1	0	7	0	6	0	122	33	0	0	1	0	0	0	0	0	335	
Hourly Summary	4	0	1392	191	267	8	300	24	13	1	94	6	26	2	2644	297	11	0	15	1	6	0	1	0		
06:00 to 07:00	0	0	239	38	40	1	90	6	1	0	14	4	3	0	775	89	1	0	4	1	1	0	0	0	1307	
06:15 to 07:15	1	0	351	47	68	1	98	9	1	0	16	4	5	0	811	105	1	0	4	1	1	0	0	0	1524	
06:30 to 07:30	1	0	380	52	73	1	95	7	0	1	15	3	3	1	757	83	2	0	4	1	3	0	0	0	1482	
06:45 to 07:45	1	0	435	52	104	2	95	10	3	1	19	2	3	2	812	74	2	0	3	0	2	0	0	0	1622	
07:00 to 08:00	1	0	492	62	110	3	94	13	5	1	24	1	3	2	842	74	4	0	1	0	3	0	0	0	1735	
07:15 to 08:15	0	0	455	65	92	3	83	12	8	1	27	1	2	2	786	61	5	0	3	0	3	0	0	0	1609	
07:30 to 08:30	0	0	476	70	96	3	84	11	10	0	38	1	7	1	882	70	3	0	5	0	1	0	0	0	1758	Peak Hour
07:45 to 08:45	1	0	485	61	83	4	80	7	7	0	38	0	10	0	833	73	6	0	5	0	1	0	1	0	1695	
08:00 to 09:00	1	0	473	53	91	3	86	4	6	0	42	0	14	0	800	82	5	0	8	0	2	0	1	0	1671	
08:15 to 09:15	3	0	437	48	90	4	83	1	3	0	40	1	13	0	695	82	5	0	7	0	2	0	1	0	1515	
08:30 to 09:30	3	0	437	56	77	4	76	2	2	0	35	1	14	0	553	96	5	0	6	0	2	0	1	0	1370	

Curtis Traffic Surveys

Turning movement count

Job: 090901bt p0643
Day, date: Tuesday, 1 September 2009
Location: New England H'y, & Nelson St Greta
Weather: Fine
Client: Better Transport Futures



Time Period	From New England H'way north						From Nelson St west						From New England H'way south						From Nelson St east						Total vehicle movements	
	Left		Through		Right		Left		Through		Right		Left		Through		Right		Left		Through		Right			
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles		
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14:15 to 14:30	1	0	160	22	20	0	18	1	3	0	7	0	4	0	110	18	0	0	0	0	2	0	0	0	366	
14:30 to 14:45	0	0	219	25	18	1	20	0	0	0	3	0	4	0	77	14	0	0	0	0	0	0	0	0	381	
14:45 to 15:00	0	0	190	28	11	0	18	2	1	0	2	2	5	0	104	15	0	0	0	0	1	0	0	0	379	
15:00 to 15:15	3	0	254	30	29	1	23	1	3	0	11	0	6	0	119	18	0	0	1	0	1	0	0	0	500	
15:15 to 15:30	2	0	285	15	22	0	20	0	2	0	7	0	6	0	105	15	0	0	1	0	0	0	0	0	480	
15:30 to 15:45	1	0	330	18	27	0	19	0	1	0	9	0	7	0	104	13	1	0	0	0	0	0	0	0	530	
15:45 to 16:00	2	0	301	22	23	2	21	1	1	0	6	0	5	0	67	16	0	0	0	0	0	0	1	0	468	
16:00 to 16:15	3	0	319	22	31	4	20	1	1	0	1	0	7	0	112	11	2	0	1	0	0	0	0	0	535	
16:15 to 16:30	1	0	356	26	45	2	24	1	0	0	7	0	14	0	134	19	1	0	0	0	0	0	1	0	631	Peak
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17:15 to 17:30	1	0	304	16	36	0	31	2	1	0	6	0	8	0	122	10	3	0	1	0	1	0	0	0	542	
17:30 to 17:45	1	0	245	11	10	0	10	0	2	0	4	0	0	0	90	7	4	0	1	0	2	0	0	0	387	
17:45 to 18:00	1	0	389	20	24	0	29	0	0	0	11	0	7	0	125	14	0	0	2	0	0	0	0	0	622	
18:00 to 18:15	0	0	335	16	15	0	14	0	5	0	8	0	7	1	125	8	0	0	0	0	0	0	0	0	534	
18:15 to 18:30	0	0	240	8	20	0	20	0	0	0	11	0	4	0	84	3	1	0	0	0	0	0	1	0	392	
Hourly Summary	23	0	5061	342	450	17	369	12	24	0	111	3	112	1	1955	238	14	1	9	0	7	0	4	0		
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14:15 to 15:15	4	0	823	105	78	2	79	4	7	0	23	2	19	0	410	65	0	0	1	0	4	0	0	0	1626	
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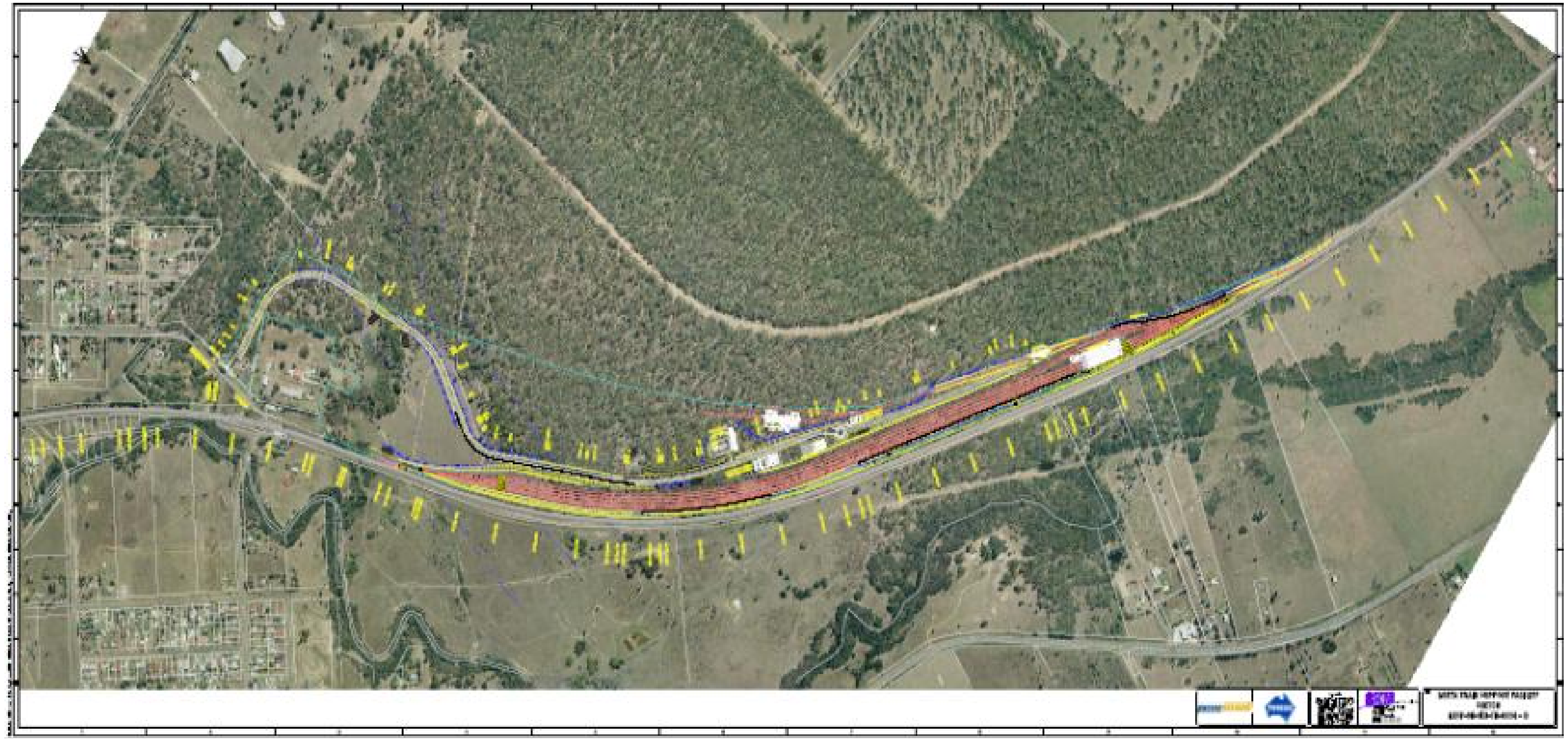
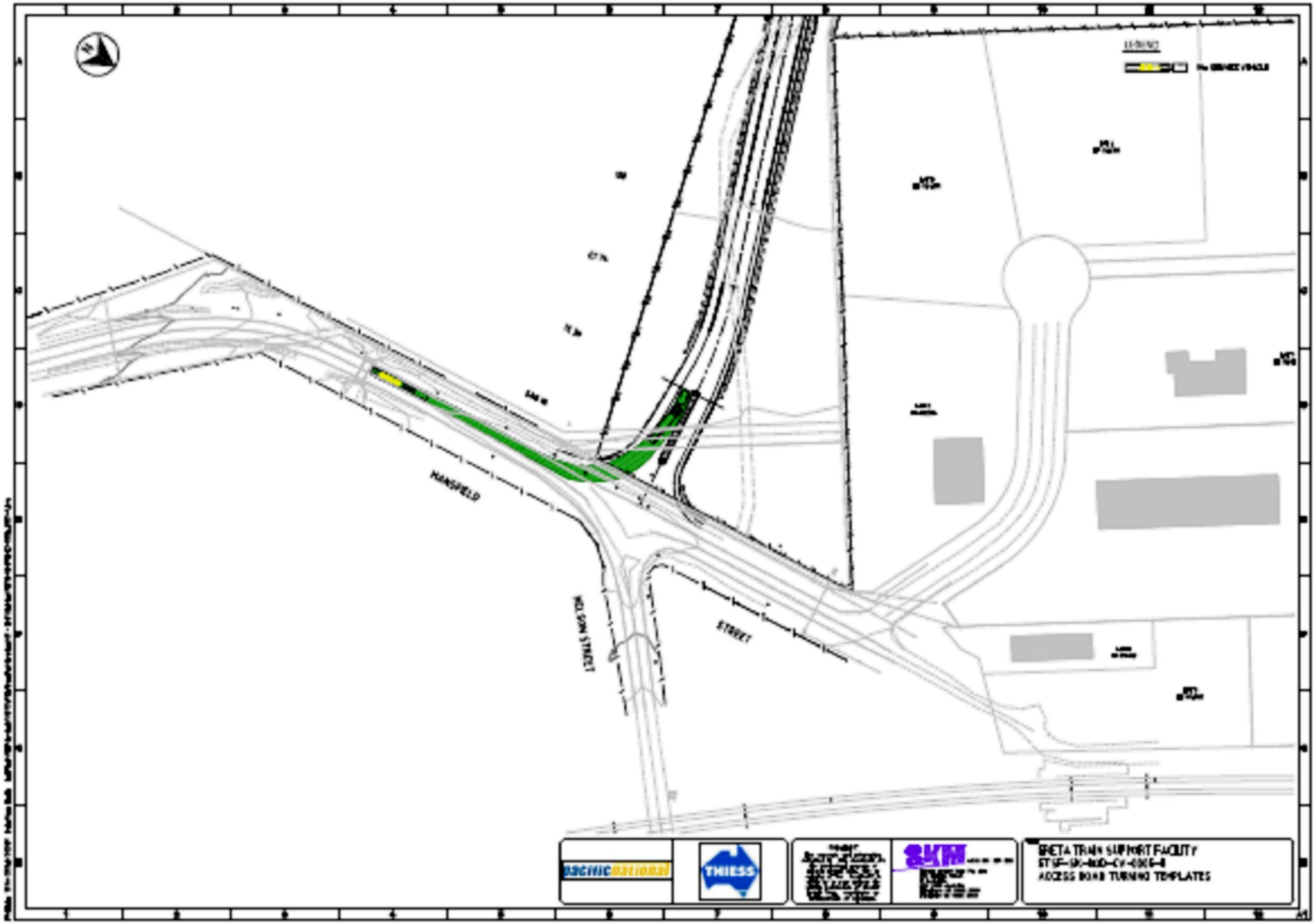
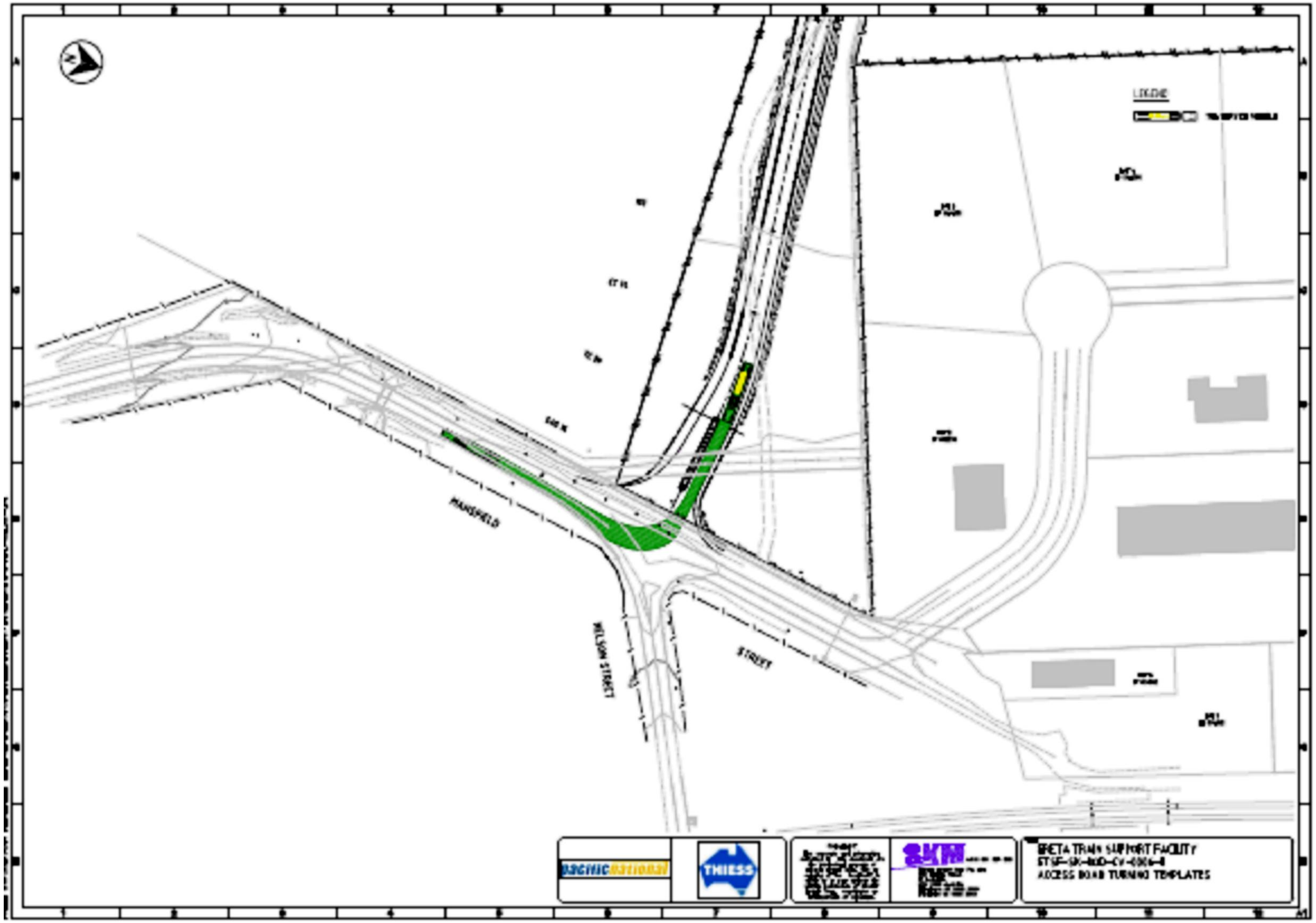
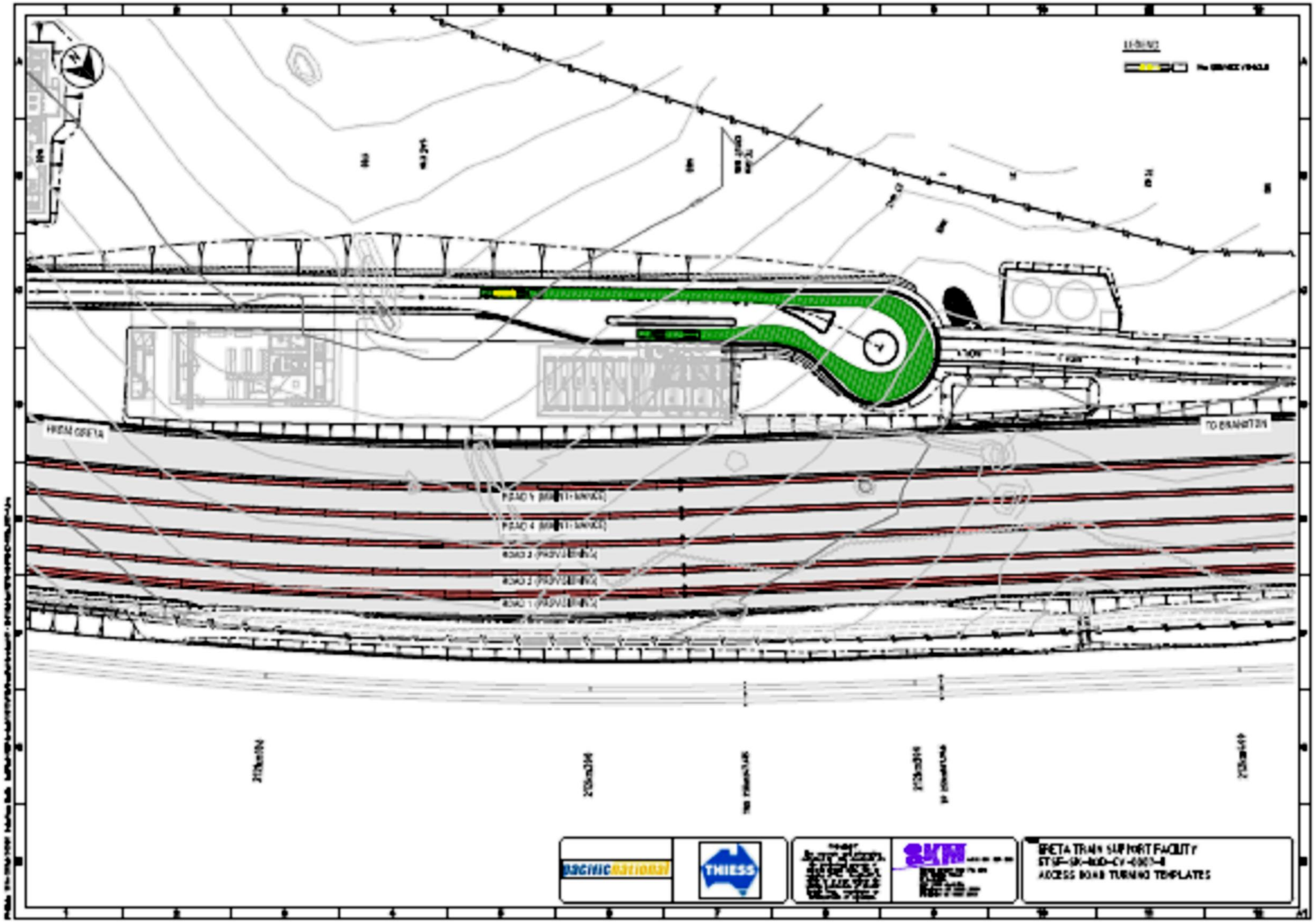
15:30 to 16:30	7	0	1306	88	126	8	84	3	3	0	23	0	33	0	417	59	4	0	1	0	0	0	2	0	2164	
15:45 to 16:45	8	0	1307	87	127	13	77	4	4	0	20	0	33	0	451	54	4	0	1	0	0	0	3	0	2193	
16:00 to 17:00	9	0	1294	80	137	11	81	3	3	0	18	1	37	0	509	56	5	0	2	0	0	0	2	0	2248	
16:15 to 17:15	7	0	1325	73	144	9	91	3	4	0	22	1	38	0	512	56	3	1	1	0	0	0	2	0	2292	Peak Hour
16:30 to 17:30	7	0	1273	63	135	7	98	4	5	0	21	1	32	0	500	47	5	1	2	0	1	0	1	0	2203	
16:45 to 17:45	6	0	1187	57	117	2	96	3	5	0	19	1	25	0	452	46	8	1	3	0	3	0	0	0	2031	
17:00 to 18:00	4	0	1288	62	108	2	100	3	5	0	26	0	23	0	452	42	7	1	4	0	3	0	0	0	2130	
17:15 to 18:15	3	0	1273	63	85	0	84	2	8	0	29	0	22	1	462	39	7	0	4	0	3	0	0	0	2085	
17:30 to 18:30	2	0	1209	55	69	0	73	0	7	0	34	0	18	1	424	32	5	0	3	0	2	0	1	0	1935	

Appendix B Site Plan and Autoturn Simulation




MANSFIELD
STREET
WILSON STREET
THIESS
GRETA TRAIN SUPPORT FACILITY
ACCESS ROAD TURNING TEMPLATES


MANSFIELD
STREET
WILSON STREET
THIESS
GRETA TRAIN SUPPORT FACILITY
ACCESS ROAD TURNING TEMPLATES


TO BRANXTON
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pacificnational
GRETA TRAIN SUPPORT FACILITY
ACCESS ROAD TURNING TEMPLATES

Appendix C Sidra Results

SIDRA INTERSECTION

Intersection Summary
NEH and Nelson Street Greta
AM base existing

Performance Measure	Vehicles	Persons
Demand Flows - Total	1829 veh/h	2744 pers/h
Percent Heavy Vehicles	8.5 %	
Degree of Saturation	0.688	
Effective Intersection Capacity	2660 veh/h	
95% Back of Queue (m)	27 m	
95% Back of Queue (veh)	3.5 veh	
Control Delay (Total)	2.44 veh-h/h	3.65 pers-h/h
Control Delay (Average)	4.8 s/veh	4.8 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS D	
Total Effective Stops	269 veh/h	403 pers/h
Effective Stop Rate	0.15 per veh	0.15 per pers
Proportion Queued	0.12	0.12
Travel Distance (Total)	1108.4 veh-km/h	1662.6 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	20.9 veh-h/h	31.3 pers-h/h
Travel Time (Average)	41.1 secs	41.1 secs
Travel Speed	53.1 km/h	53.1 km/h
Operating Cost (Total)	722 $/h	722 $/h
Fuel Consumption (Total)	105.4 L/h	
Carbon Dioxide (Total)	264.5 kg/h	
Hydrocarbons (Total)	0.340 kg/h	
Carbon Monoxide (Total)	9.83 kg/h	
NOX (Total)	0.449 kg/h	

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary

NEH and Nelson Street Greta

AM base existing

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	100	12.0	0.680	46.0	LOS D	27	0.95	1.15	26.6
2	T	11	0.0	0.688	44.3	LOS D	27	0.95	1.14	27.0
3	R	41	2.4	0.357	46.1	LOS D	10	0.94	1.02	26.4
Approach		**152**	**8.6**	**0.678**	**45.9**	**LOS D**	**27**	**0.94**	**1.11**	**26.6**
NEH eastern approach										
4	L	8	12.5	0.533	8.6	LOS A	0	0.00	0.67	49.0
5	T	1002	7.4	0.543	0.0	LOS A	0	0.00	0.00	60.0
6	R	3	0.0	0.003	10.7	LOS A	0	0.54	0.65	46.3
Approach		**1013**	**7.4**	**0.543**	**0.1**	**LOS A**	**0**	**0.00**	**0.01**	**59.8**
NelsoN St north										
7	L	5	0.0	0.018	16.5	LOS B	0	0.67	0.78	41.2
8	T	1	0.0	0.018	15.3	LOS B	0	0.67	0.86	42.2
9	R	1	0.0	0.011	42.9	LOS D	0	0.92	0.98	27.4
Approach		**7**	**0.0**	**0.018**	**20.1**	**LOS B**	**0**	**0.70**	**0.82**	**38.6**
NEH western approach										
10	L	1	0.0	0.333	8.2	LOS A	0	0.00	0.67	49.0
11	T	565	11.3	0.312	0.0	LOS A	0	0.00	0.00	60.0
12	R	92	4.4	0.208	17.0	LOS B	7	0.80	0.95	41.0
Approach		**657**	**10.4**	**0.312**	**2.4**	**LOS A**	**7**	**0.11**	**0.13**	**56.4**
All Vehicles		**1829**	**8.5**	**0.688**	**4.8**	**Not Applicable**	**27**	**0.12**	**0.15**	**53.1**

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Intersection Summary

NEH and Nelson Street Greta
PM base existing

Performance Measure	Vehicles	Persons
Demand Flows - Total	2413 veh/h	3619 pers/h
Percent Heavy Vehicles	6.2 %	
Degree of Saturation	0.784	
Effective Intersection Capacity	3077 veh/h	
95% Back of Queue (m)	17 m	
95% Back of Queue (veh)	2.4 veh	
Control Delay (Total)	2.51 veh-h/h	3.76 pers-h/h
Control Delay (Average)	3.7 s/veh	3.7 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS F	
Total Effective Stops	301 veh/h	451 pers/h
Effective Stop Rate	0.12 per veh	0.12 per pers
Proportion Queued	0.08	0.08
Travel Distance (Total)	1462.3 veh-km/h	2193.4 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	26.9 veh-h/h	40.3 pers-h/h
Travel Time (Average)	40.1 secs	40.1 secs
Travel Speed	54.4 km/h	54.4 km/h
Operating Cost (Total)	919 $/h	919 $/h
Fuel Consumption (Total)	131.4 L/h	
Carbon Dioxide (Total)	329.2 kg/h	
Hydrocarbons (Total)	0.435 kg/h	
Carbon Monoxide (Total)	12.29 kg/h	
NOX (Total)	0.574 kg/h	

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary
NEH and Nelson Street Greta
PM base existing
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	99	3.0	0.303	18.8	LOS B	10	0.72	0.95	39.6
2	T	4	0.0	0.308	17.5	LOS B	10	0.72	0.92	40.5
3	R	24	4.2	0.649	166.6	LOS F	17	0.99	1.06	10.7
Approach		**127**	**3.1**	**0.647**	**46.7**	**LOS D**	**17**	**0.77**	**0.97**	**26.3**
NEH eastern approach										
4	L	40	0.0	0.348	8.2	LOS A	0	0.00	0.67	49.0
5	T	598	9.9	0.348	0.0	LOS A	0	0.00	0.00	60.0
6	R	4	25.0	0.100	92.2	LOS F	3	0.98	0.99	17.0
Approach		**642**	**9.3**	**0.348**	**1.1**	**LOS A**	**3**	**0.01**	**0.05**	**58.3**
NelsoN St north										
7	L	1	0.0	0.062	102.9	LOS F	1	0.97	0.99	15.6
8	T	1	0.0	0.062	101.7	LOS F	1	0.97	0.99	15.8
9	R	2	0.0	0.065	111.1	LOS F	1	0.98	0.99	14.7
Approach		**4**	**0.0**	**0.065**	**106.7**	**LOS F**	**1**	**0.97**	**0.99**	**15.2**
NEH western approach										
10	L	7	0.0	0.778	8.2	LOS A	0	0.00	0.67	49.0
11	T	1472	5.2	0.784	0.0	LOS A	0	0.00	0.00	60.0
12	R	161	5.6	0.189	11.9	LOS A	7	0.61	0.86	45.3
Approach		**1640**	**5.2**	**0.784**	**1.2**	**LOS A**	**7**	**0.06**	**0.09**	**58.1**
All Vehicles		**2413**	**6.2**	**0.784**	**3.7**	**Not Applicable**	**17**	**0.08**	**0.12**	**54.4**

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Intersection Summary
NEH and Nelson Street Greta
AM base existing plus development

Performance Measure	Vehicles	Persons
Demand Flows - Total	1836 veh/h	2754 pers/h
Percent Heavy Vehicles	8.5 %	
Degree of Saturation	0.688	
Effective Intersection Capacity	2671 veh/h	
95% Back of Queue (m)	27 m	
95% Back of Queue (veh)	3.6 veh	
Control Delay (Total)	2.49 veh-h/h	3.74 pers-h/h
Control Delay (Average)	4.9 s/veh	4.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS D	
Total Effective Stops	275 veh/h	412 pers/h
Effective Stop Rate	0.15 per veh	0.15 per pers
Proportion Queued	0.12	0.12
Travel Distance (Total)	1112.6 veh-km/h	1668.9 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	21.0 veh-h/h	31.5 pers-h/h
Travel Time (Average)	41.2 secs	41.2 secs
Travel Speed	52.9 km/h	52.9 km/h
Operating Cost (Total)	727 $/h	727 $/h
Fuel Consumption (Total)	106.0 L/h	
Carbon Dioxide (Total)	265.9 kg/h	
Hydrocarbons (Total)	0.343 kg/h	
Carbon Monoxide (Total)	9.94 kg/h	
NOX (Total)	0.452 kg/h	

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary
NEH and Nelson Street Greta
AM base existing plus development
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	100	12.0	0.680	46.5	LOS D	27	0.95	1.15	26.4
2	T	11	0.0	0.688	44.8	LOS D	27	0.95	1.14	26.8
3	R	42	2.4	0.368	46.7	LOS D	11	0.94	1.02	26.2
Approach		**153**	**8.5**	**0.682**	**46.4**	**LOS D**	**27**	**0.95**	**1.11**	**26.4**
NEH eastern approach										
4	L	12	8.3	0.545	8.5	LOS A	0	0.00	0.67	49.0
5	T	1002	7.4	0.545	0.0	LOS A	0	0.00	0.00	60.0
6	R	3	0.0	0.003	10.7	LOS A	0	0.54	0.65	46.3
Approach		**1017**	**7.4**	**0.545**	**0.1**	**LOS A**	**0**	**0.00**	**0.01**	**59.8**
NelsoN St north										
7	L	5	0.0	0.018	16.6	LOS B	0	0.67	0.78	41.2
8	T	1	0.0	0.018	15.3	LOS B	0	0.67	0.86	42.1
9	R	1	0.0	0.011	43.1	LOS D	0	0.92	0.98	27.4
Approach		**7**	**0.0**	**0.018**	**20.2**	**LOS B**	**0**	**0.70**	**0.82**	**38.5**
NEH western approach										
10	L	1	0.0	0.333	8.2	LOS A	0	0.00	0.67	49.0
11	T	565	11.3	0.312	0.0	LOS A	0	0.00	0.00	60.0
12	R	94	4.3	0.214	17.1	LOS B	7	0.80	0.95	40.8
Approach		**659**	**10.3**	**0.312**	**2.4**	**LOS A**	**7**	**0.11**	**0.14**	**56.3**
All Vehicles		**1836**	**8.5**	**0.688**	**4.9**	**Not Applicable**	**27**	**0.12**	**0.15**	**52.9**

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Intersection Summary
NEH and Nelson Street Greta
PM base existing+dev

Performance Measure	Vehicles	Persons
Demand Flows - Total	2418 veh/h	3627 pers/h
Percent Heavy Vehicles	6.2 %	
Degree of Saturation	0.784	
Effective Intersection Capacity	3083 veh/h	
95% Back of Queue (m)	21 m	
95% Back of Queue (veh)	3.0 veh	
Control Delay (Total)	2.90 veh-h/h	4.35 pers-h/h
Control Delay (Average)	4.3 s/veh	4.3 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS F	
Total Effective Stops	307 veh/h	460 pers/h
Effective Stop Rate	0.13 per veh	0.13 per pers
Proportion Queued	0.09	0.09
Travel Distance (Total)	1465.3 veh-km/h	2197.9 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	27.3 veh-h/h	41.0 pers-h/h
Travel Time (Average)	40.7 secs	40.7 secs
Travel Speed	53.7 km/h	53.7 km/h
Operating Cost (Total)	932 $/h	932 $/h
Fuel Consumption (Total)	132.2 L/h	
Carbon Dioxide (Total)	331.4 kg/h	
Hydrocarbons (Total)	0.440 kg/h	
Carbon Monoxide (Total)	12.39 kg/h	
NOX (Total)	0.577 kg/h	

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Movement Summary
NEH and Nelson Street Greta
PM base existing+dev
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	100	3.0	0.305	18.8	LOS B	10	0.72	0.95	39.6
2	T	4	0.0	0.308	17.4	LOS B	10	0.72	0.92	40.5
3	R	28	3.6	0.757	192.3	LOS F	21	0.99	1.09	9.5
Approach		**132**	**3.0**	**0.753**	**55.6**	**LOS D**	**21**	**0.78**	**0.98**	**23.7**
NEH eastern approach										
4	L	40	0.0	0.348	8.2	LOS A	0	0.00	0.67	49.0
5	T	598	9.9	0.348	0.0	LOS A	0	0.00	0.00	60.0
6	R	4	25.0	0.100	92.2	LOS F	3	0.98	0.99	17.0
Approach		**642**	**9.3**	**0.348**	**1.1**	**LOS A**	**3**	**0.01**	**0.05**	**58.3**
NelsoN St north										
7	L	1	0.0	0.062	102.9	LOS F	1	0.97	0.99	15.6
8	T	1	0.0	0.062	101.7	LOS F	1	0.97	0.99	15.8
9	R	2	0.0	0.065	111.3	LOS F	1	0.98	0.99	14.7
Approach		**4**	**0.0**	**0.065**	**106.8**	**LOS F**	**1**	**0.98**	**0.99**	**15.2**
NEH western approach										
10	L	7	0.0	0.778	8.2	LOS A	0	0.00	0.67	49.0
11	T	1472	5.2	0.784	0.0	LOS A	0	0.00	0.00	60.0
12	R	161	5.6	0.189	11.9	LOS A	7	0.61	0.86	45.3
Approach		**1640**	**5.2**	**0.784**	**1.2**	**LOS A**	**7**	**0.06**	**0.09**	**58.1**
All Vehicles		**2418**	**6.2**	**0.784**	**4.3**	**Not Applicable**	**21**	**0.09**	**0.13**	**53.7**

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Intersection Summary
NEH and Nelson Street Greta
2020 AM base +dev

Performance Measure	Vehicles	Persons
Demand Flows - Total	1151 veh/h	1727 pers/h
Percent Heavy Vehicles	8.3 %	
Degree of Saturation	0.311	
Effective Intersection Capacity	3695 veh/h	
95% Back of Queue (m)	8 m	
95% Back of Queue (veh)	1.1 veh	
Control Delay (Total)	1.00 veh-h/h	1.51 pers-h/h
Control Delay (Average)	3.1 s/veh	3.1 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	227 veh/h	340 pers/h
Effective Stop Rate	0.20 per veh	0.20 per pers
Proportion Queued	0.13	0.13
Travel Distance (Total)	697.2 veh-km/h	1045.8 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	12.6 veh-h/h	18.9 pers-h/h
Travel Time (Average)	39.4 secs	39.4 secs
Travel Speed	55.3 km/h	55.3 km/h
Operating Cost (Total)	444 $/h	444 $/h
Fuel Consumption (Total)	68.1 L/h	
Carbon Dioxide (Total)	170.8 kg/h	
Hydrocarbons (Total)	0.225 kg/h	
Carbon Monoxide (Total)	7.58 kg/h	
NOX (Total)	0.313 kg/h	

SIDRA SOLUTIONS

Site: AM 2020 Base+dev
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SIDRA INTERSECTION

Movement Summary
NEH and Nelson Street Greta
2020 AM base +dev
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	100	12.0	0.230	14.8	LOS B	8	0.63	0.89	43.0
2	T	11	0.0	0.229	13.1	LOS A	8	0.63	0.86	44.1
3	R	41	2.4	0.115	17.2	LOS B	3	0.73	0.91	40.8
Approach		**152**	**8.6**	**0.230**	**15.3**	**LOS B**	**8**	**0.66**	**0.89**	**42.4**
NEH eastern approach										
4	L	18	5.6	0.310	8.4	LOS A	0	0.00	0.67	49.0
5	T	561	7.3	0.311	0.0	LOS A	0	0.00	0.00	60.0
6	R	3	0.0	0.003	9.3	LOS A	0	0.40	0.60	47.2
Approach		**582**	**7.2**	**0.311**	**0.3**	**LOS A**	**0**	**0.00**	**0.02**	**59.5**
NelsoN St north										
7	L	5	0.0	0.009	11.0	LOS A	0	0.44	0.65	46.0
8	T	1	0.0	0.009	9.7	LOS A	0	0.44	0.71	47.3
9	R	1	0.0	0.003	17.8	LOS B	0	0.74	0.77	40.2
Approach		**7**	**0.0**	**0.009**	**11.8**	**LOS A**	**0**	**0.48**	**0.67**	**45.3**
NEH western approach										
10	L	1	0.0	0.167	8.2	LOS A	0	0.00	0.67	49.0
11	T	317	11.4	0.175	0.0	LOS A	0	0.00	0.00	60.0
12	R	93	4.3	0.106	11.1	LOS A	4	0.55	0.78	46.1
Approach		**410**	**9.8**	**0.175**	**2.5**	**LOS A**	**4**	**0.12**	**0.18**	**56.2**
All Vehicles		**1151**	**8.3**	**0.311**	**3.1**	**Not Applicable**	**8**	**0.13**	**0.20**	**55.3**

SIDRA SOLUTIONS

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SIDRA INTERSECTION

Intersection Summary
NEH and Nelson Street Greta
2020 PM base+dev

Performance Measure	Vehicles	Persons
Demand Flows - Total	1512 veh/h	2268 pers/h
Percent Heavy Vehicles	6.0 %	
Degree of Saturation	0.441	
Effective Intersection Capacity	3431 veh/h	
95% Back of Queue (m)	6 m	
95% Back of Queue (veh)	0.8 veh	
Control Delay (Total)	1.15 veh-h/h	1.73 pers-h/h
Control Delay (Average)	2.7 s/veh	2.7 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	263 veh/h	394 pers/h
Effective Stop Rate	0.17 per veh	0.17 per pers
Proportion Queued	0.10	0.10
Travel Distance (Total)	915.8 veh-km/h	1373.8 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	16.4 veh-h/h	24.6 pers-h/h
Travel Time (Average)	39.1 secs	39.1 secs
Travel Speed	55.8 km/h	55.8 km/h
Operating Cost (Total)	570 $/h	570 $/h
Fuel Consumption (Total)	84.8 L/h	
Carbon Dioxide (Total)	212.5 kg/h	
Hydrocarbons (Total)	0.289 kg/h	
Carbon Monoxide (Total)	9.41 kg/h	
NOX (Total)	0.395 kg/h	

SIDRA SOLUTIONS

Site: PM 2020 Base+dev
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SIDRA INTERSECTION

Movement Summary
NEH and Nelson Street Greta
2020 PM base+dev
Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nelson St south										
1	L	99	3.0	0.155	11.2	LOS A	5	0.47	0.75	45.9
2	T	4	0.0	0.154	9.8	LOS A	5	0.47	0.78	47.2
3	R	34	2.9	0.160	24.7	LOS B	5	0.85	0.95	35.7
Approach		**137**	**2.9**	**0.160**	**14.5**	**LOS B**	**5**	**0.57**	**0.80**	**42.9**
NEH eastern approach										
4	L	40	0.0	0.204	8.2	LOS A	0	0.00	0.67	49.0
5	T	335	9.9	0.204	0.0	LOS A	0	0.00	0.00	60.0
6	R	4	25.0	0.009	16.5	LOS B	0	0.71	0.79	42.0
Approach		**379**	**9.0**	**0.204**	**1.0**	**LOS A**	**0**	**0.01**	**0.08**	**58.4**
NelsoN St north										
7	L	1	0.0	0.008	19.9	LOS B	0	0.78	0.83	38.8
8	T	1	0.0	0.008	18.6	LOS B	0	0.78	0.86	39.6
9	R	2	0.0	0.011	25.6	LOS B	0	0.85	0.93	35.1
Approach		**4**	**0.0**	**0.011**	**22.4**	**LOS B**	**0**	**0.81**	**0.89**	**37.1**
NEH western approach										
10	L	7	0.0	0.438	8.2	LOS A	0	0.00	0.67	49.0
11	T	824	5.2	0.441	0.0	LOS A	0	0.00	0.00	60.0
12	R	161	5.6	0.169	10.0	LOS A	6	0.46	0.71	46.9
Approach		**992**	**5.2**	**0.441**	**1.7**	**LOS A**	**6**	**0.08**	**0.12**	**57.3**
All Vehicles		**1512**	**6.0**	**0.441**	**2.7**	**Not Applicable**	**6**	**0.10**	**0.17**	**55.8**

SIDRA SOLUTIONS

Site: PM 2020 Base+dev
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INTERSECTION SUMMARY

Site: AM peak existing 2010

NEH and Allandale Road 2010 existing AM9.30 to 10.30
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	1496	veh/h	1795	pers/h
Percent Heavy Vehicles	15.7	%		
Degree of Saturation	0.385			
Practical Spare Capacity	107.7	%		
Effective Intersection Capacity	3883	veh/h		
Control Delay (Total)	0.99	veh-h/h	1.19	pers-h/h
Control Delay (Average)	2.4	sec	2.4	sec
Control Delay (Worst Lane)	38.2	sec		
Control Delay (Worst Movement)	38.2	sec	38.2	sec
Level of Service (Aver. Int. Delay)	NA			
Level of Service (Worst Movement)	LOS C			
Level of Service (Worst Lane)	LOS C			
95% Back of Queue - Vehicles (Worst Lane)	1.7	veh		
95% Back of Queue - Distance (Worst Lane)	14.9	m		
Total Effective Stops	156	veh/h	187	pers/h
Effective Stop Rate	0.10	per veh	0.10	per pers
Proportion Queued	0.05		0.05	
Performance Index	14.8		14.8	
Travel Distance (Total)	1113.0	veh-km/h	1335.5	pers-km/h
Travel Distance (Average)	744	m	744	m
Travel Time (Total)	13.3	veh-h/h	15.9	pers-h/h
Travel Time (Average)	31.9	sec	31.9	sec
Travel Speed	84.0	km/h	84.0	km/h
Cost (Total)	623.00	$/h	623.00	$/h
Fuel Consumption (Total)	162.1	L/h		
Carbon Dioxide (Total)	408.3	kg/h		
Hydrocarbons (Total)	0.398	kg/h		
Carbon Monoxide (Total)	11.58	kg/h		
NOx (Total)	0.859	kg/h		

LOS (Aver. Int. Delay) for Vehicles is not applicable since the average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: AM peak existing 2010

NEH and Allandale Road 2010 existing AM9.30 to 10.30
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Allandale Road											
1	L	6	50.0	0.060	30.4	LOS C	0.1	1.2	0.75	0.89	47.9
3	R	66	33.0	0.232	38.2	LOS C	1.7	14.9	0.92	0.99	40.9
Approach		73	34.5	0.232	37.5	LOS C	1.7	14.9	0.91	0.98	41.4
East: New England Highway											
4	L	52	33.0	0.207	14.8	LOS B	0.0	0.0	0.00	1.58	64.0
5	T	675	15.0	0.207	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
Approach		726	16.3	0.207	1.1	LOS B	0.0	0.0	0.00	0.11	87.5
West: New England Highway											
11	T	693	13.0	0.385	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	4	50.0	0.011	18.4	LOS B	0.1	0.5	0.68	0.77	41.6
Approach		697	13.2	0.385	0.1	LOS B	0.1	0.5	0.00	0.00	89.5
All Vehicles		1496	15.7	0.385	2.4	NA	1.7	14.9	0.05	0.10	84.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Project: M:\MW Pty Ltd\Active Projects\P0643 M&P PN TSF\Allandale Sidra Oct10.sip
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INTERSECTION SUMMARY

Site: PM peak existing 2010

NEH and Allandale Road 2010 existing PM
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	1273	veh/h	1527	pers/h
Percent Heavy Vehicles	15.8	%		
Degree of Saturation	0.357			
Practical Spare Capacity	124.1	%		
Effective Intersection Capacity	3564	veh/h		
Control Delay (Total)	0.82	veh-h/h	0.99	pers-h/h
Control Delay (Average)	2.3	sec	2.3	sec
Control Delay (Worst Lane)	49.1	sec		
Control Delay (Worst Movement)	49.1	sec	49.1	sec
Level of Service (Aver. Int. Delay)	NA			
Level of Service (Worst Movement)	LOS D			
Level of Service (Worst Lane)	LOS D			
95% Back of Queue - Vehicles (Worst Lane)	1.5	veh		
95% Back of Queue - Distance (Worst Lane)	12.8	m		
Total Effective Stops	124	veh/h	149	pers/h
Effective Stop Rate	0.10	per veh	0.10	per pers
Proportion Queued	0.03		0.03	
Performance Index	12.5		12.5	
Travel Distance (Total)	947.2	veh-km/h	1136.6	pers-km/h
Travel Distance (Average)	744	m	744	m
Travel Time (Total)	11.3	veh-h/h	13.5	pers-h/h
Travel Time (Average)	31.9	sec	31.9	sec
Travel Speed	84.0	km/h	84.0	km/h
Cost (Total)	521.97	$/h	521.97	$/h
Fuel Consumption (Total)	133.7	L/h		
Carbon Dioxide (Total)	336.6	kg/h		
Hydrocarbons (Total)	0.331	kg/h		
Carbon Monoxide (Total)	8.76	kg/h		
NOx (Total)	0.687	kg/h		

LOS (Aver. Int. Delay) for Vehicles is not applicable since the average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

Project: M:\MW Pty Ltd\Active Projects\P0643 M&P PN TSF\Allandale Sidra Oct10.sip
8000290, MARK WAUGH PTY LTD, SINGLE

MOVEMENT SUMMARY

Site: PM peak existing 2010

NEH and Allandale Road 2010 existing PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Allandale Road											
1	L	2	30.0	0.011	20.6	LOS B	0.0	0.2	0.61	0.72	55.9
3	R	43	30.0	0.348	49.1	LOS D	1.5	12.8	0.91	1.01	34.8
Approach		45	30.0	0.347	47.8	LOS D	1.5	12.8	0.90	1.00	35.4
East: New England Highway											
4	L	52	30.0	0.167	14.6	LOS B	0.0	0.0	0.00	1.48	64.0
5	T	542	13.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
Approach		594	14.5	0.168	1.3	LOS B	0.0	0.0	0.00	0.13	87.0
West: New England Highway											
11	T	631	16.0	0.357	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	3	30.0	0.005	13.3	LOS A	0.0	0.2	0.58	0.67	45.1
Approach		634	16.1	0.357	0.1	LOS A	0.0	0.2	0.00	0.00	89.6
All Vehicles		1273	15.8	0.357	2.3	NA	1.5	12.8	0.03	0.10	84.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

INTERSECTION SUMMARY

Site: AM peak existing 2010+delivery

NEH and Allandale Road 2010 existing AM9.30 to 10.30 plus delivery
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	1517	veh/h	1820	pers/h
Percent Heavy Vehicles	16.0	%		
Degree of Saturation	0.385			
Practical Spare Capacity	107.7	%		
Effective Intersection Capacity	3938	veh/h		
Control Delay (Total)	1.19	veh-h/h	1.43	pers-h/h
Control Delay (Average)	2.8	sec	2.8	sec
Control Delay (Worst Lane)	40.1	sec		
Control Delay (Worst Movement)	40.1	sec	40.1	sec
Level of Service (Aver. Int. Delay)	NA			
Level of Service (Worst Movement)	LOS C			
Level of Service (Worst Lane)	LOS C			
95% Back of Queue - Vehicles (Worst Lane)	2.0	veh		
95% Back of Queue - Distance (Worst Lane)	18.0	m		
Total Effective Stops	181	veh/h	217	pers/h
Effective Stop Rate	0.12	per veh	0.12	per pers
Proportion Queued	0.05		0.05	
Performance Index	15.4		15.4	
Travel Distance (Total)	1128.2	veh-km/h	1353.9	pers-km/h
Travel Distance (Average)	744	m	744	m
Travel Time (Total)	13.6	veh-h/h	16.3	pers-h/h
Travel Time (Average)	32.3	sec	32.3	sec
Travel Speed	82.9	km/h	82.9	km/h
Cost (Total)	642.55	$/h	642.55	$/h
Fuel Consumption (Total)	167.8	L/h		
Carbon Dioxide (Total)	422.7	kg/h		
Hydrocarbons (Total)	0.416	kg/h		
Carbon Monoxide (Total)	12.86	kg/h		
NOx (Total)	0.902	kg/h		

LOS (Aver. Int. Delay) for Vehicles is not applicable since the average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: AM peak existing 2010+delivery

NEH and Allandale Road 2010 existing AM9.30 to 10.30 plus delivery
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Allandale Road											
1	L	6	50.0	0.060	30.4	LOS C	0.1	1.2	0.75	0.89	47.9
3	R	77	33.0	0.269	40.1	LOS C	2.0	18.0	0.92	1.00	39.7
Approach		83	34.3	0.269	39.4	LOS C	2.0	18.0	0.91	1.00	40.2
East: New England Highway											
4	L	62	33.0	0.211	14.8	LOS B	0.0	0.0	0.00	1.52	64.0
5	T	675	15.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
Approach		737	16.5	0.211	1.3	LOS B	0.0	0.0	0.00	0.13	87.1
West: New England Highway											
11	T	693	13.0	0.385	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	4	50.0	0.011	18.6	LOS B	0.1	0.5	0.69	0.77	41.4
Approach		697	13.2	0.385	0.1	LOS B	0.1	0.5	0.00	0.00	89.5
All Vehicles		1517	16.0	0.385	2.8	NA	2.0	18.0	0.05	0.12	82.9

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

INTERSECTION SUMMARY

Site: PM peak existing 2010_delivery

NEH and Allandale Road 2010 existing PM plus delivery vehicles
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	1294	veh/h	1552	pers/h
Percent Heavy Vehicles	16.1	%		
Degree of Saturation	0.433			
Practical Spare Capacity	84.8	%		
Effective Intersection Capacity	2988	veh/h		
Control Delay (Total)	1.05	veh-h/h	1.26	pers-h/h
Control Delay (Average)	2.9	sec	2.9	sec
Control Delay (Worst Lane)	52.2	sec		
Control Delay (Worst Movement)	52.2	sec	52.2	sec
Level of Service (Aver. Int. Delay)	NA			
Level of Service (Worst Movement)	LOS D			
Level of Service (Worst Lane)	LOS D			
95% Back of Queue - Vehicles (Worst Lane)	1.9	veh		
95% Back of Queue - Distance (Worst Lane)	16.6	m		
Total Effective Stops	147	veh/h	177	pers/h
Effective Stop Rate	0.11	per veh	0.11	per pers
Proportion Queued	0.04		0.04	
Performance Index	13.2		13.2	
Travel Distance (Total)	962.4	veh-km/h	1154.9	pers-km/h
Travel Distance (Average)	744	m	744	m
Travel Time (Total)	11.7	veh-h/h	14.0	pers-h/h
Travel Time (Average)	32.5	sec	32.5	sec
Travel Speed	82.5	km/h	82.5	km/h
Cost (Total)	541.80	$/h	541.80	$/h
Fuel Consumption (Total)	139.2	L/h		
Carbon Dioxide (Total)	350.4	kg/h		
Hydrocarbons (Total)	0.349	kg/h		
Carbon Monoxide (Total)	9.99	kg/h		
NOx (Total)	0.728	kg/h		

LOS (Aver. Int. Delay) for Vehicles is not applicable since the average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: PM peak existing 2010_delivery

NEH and Allandale Road 2010 existing PM plus delivery vehicles
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

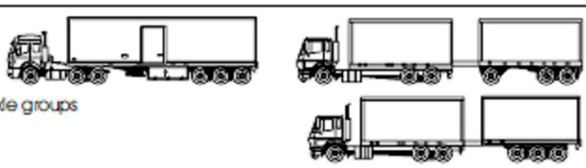
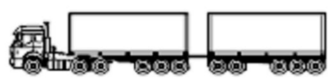
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Allandale Road											
1	L	2	30.0	0.011	20.6	LOS B	0.0	0.2	0.61	0.72	55.9
3	R	54	30.0	0.433	52.2	LOS D	1.9	16.6	0.92	1.03	33.4
Approach		56	30.0	0.431	51.0	LOS D	1.9	16.6	0.91	1.02	33.9
East: New England Highway											
4	L	62	30.0	0.171	14.6	LOS B	0.0	0.0	0.00	1.42	64.0
5	T	542	13.0	0.171	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
Approach		604	14.7	0.171	1.5	LOS B	0.0	0.0	0.00	0.15	86.5
West: New England Highway											
11	T	631	16.0	0.357	0.0	LOS A	0.0	0.0	0.00	0.00	90.0
12	R	3	30.0	0.005	13.5	LOS A	0.0	0.2	0.58	0.67	45.0
Approach		634	16.1	0.357	0.1	LOS A	0.0	0.2	0.00	0.00	89.6
All Vehicles		1294	16.1	0.433	2.9	NA	1.9	16.6	0.04	0.11	82.5

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Appendix D Vehicle Classification

VEHICLE CLASSIFICATION SYSTEM

AUSTROADS

CLASS	LIGHT VEHICLES	
1	SHORT Car, Van, Wagon, 4WD, Utility, Bicycle, Motorcycle	
2	SHORT - TOWING Trailer, Caravan, Boat	
	HEAVY VEHICLES	
3	TWO AXLE TRUCK OR BUS *2 axles	
4	THREE AXLE TRUCK OR BUS *3 axles, 2 axle groups	
5	FOUR (or FIVE) AXLE TRUCK *4 (5) axles, 2 axle groups	
6	THREE AXLE ARTICULATED *3 axles, 3 axle groups	
7	FOUR AXLE ARTICULATED *4 axles, 3 or 4 axle groups	
8	FIVE AXLE ARTICULATED *5 axles, 3+ axle groups	
9	SIX AXLE ARTICULATED *6 axles, 3+ axle groups or 7+ axles, 3 axle groups	
	LONG VEHICLES AND ROAD TRAINS	
10	B DOUBLE or HEAVY TRUCK and TRAILER *7+ axles, 4 axle groups	
11	DOUBLE ROAD TRAIN *7+ axles, 5 or 6 axle groups	
12	TRIPLE ROAD TRAIN *7+ axles, 7+ axle groups