Appendix A

NOISE AND VIBRATION ASSESSMENT

TRANSPORT FOR NSW

New Intercity Fleet Eveleigh Facility Project

NOISE AND VIBRATION ASSESSMENT

MARCH 2017

WSP | PARSONS BRINCKERHOFF

New Intercity Fleet Eveleigh Facility Project

NOISE AND VIBRATION ASSESSMENT

Transport for NSW

Report ref: 2202522PA-170223-CXM-REPORT Noise Impact Assessment Eveleigh NIF edited for accessibility
Date: March 2017

REV	DATE	DETAILS
00	9/12/16	Internal draft
01	9/12/16	Draft issue
02	24/01/2017	Updated Draft Issue
03	8/03/2017	Final

AUTHOR, REVIEWER AND APPROVER DETAILS

Prepared by:	C. Marsh	Date: 8/03/2017	Signature:
Reviewed by:	A Boladz	Date: 8/03/2017	Signature:
Approved by:	A. White	Date: 8/03/2017	Signature:

WSP | Parsons Brinckerhoff
Level 1, 41 McLaren Street
North Sydney NSW 2060
GPO Box 6245
Sydney NSW 2060

Tel: +61 2 8907 0900
Fax: +61 2 8907 0999

www.wsp-pb.com

TABLE OF CONTENTS

CONTENTS (Continued)

List of tables

List of figures

List of appendices

EXECUTIVE SUMMARY

WSP | Parsons Brinckerhoff Acoustics have been engaged to provide an operational and construction noise and vibration assessment for activities and modifications at the Eveleigh Maintenance Facility associated with the New Intercity Fleet (NIF) being commissioned and maintained at the facility.

The facility has a number of different users on the facility which provide maintenance and stabling services for Millennium, Oscar, Endeavour and XPLORER fleets in addition to heritage trains. The Millennium and Oscar fleet maintenance is done in sheds in the west of the facility. The Endeavour and XPLORER fleet are maintained in the Eveleigh Maintenance Centre (EMC) and heritage trains are operated and maintained by 3801 Limited within the Large Erecting Workshop.

The modifications to the existing infrastructure to accommodate the NIF trains includes:

- extending the existing decanting facility
- extending the Eastern Siding and Engineering Roads 1 and 2
- extending the overhead wiring (OHW) in the Millennium shed and
- modifying the supporting infrastructure (e.g. signals, lighting, driver's walkways) associated with the above extensions.

In addition to these modifications, the NIF will be delivered to the facility by diesel locomotive and then undergo static and dynamic commissioning activities at the facility. Once the commissioning has been completed, the facility will be used for routine maintenance of the NIF when it enters service. The Millennium fleet maintenance will be moved to another site on the network.

The facility is surrounded by a mix of residential, commercial and rail corridor land uses. The closest residential receivers are located on the southern boundary of the facility on Rowley Lane, Explorer Street and Railway Parade. The next closest residential receivers are located across the rail corridor on Wilson Street and also to the north east on Cornwallis Street. The facility is also adjacent to the Australian Technology Park, which is located on its eastern boundary. The surrounding receivers were grouped into noise catchment areas (NCA), labelled A to H, based on the land use and distance from the facility.

The existing noise environment was characterised by a series of short term and long term noise measurements. An unattended noise monitor was established at the southern boundary close to the potentially most affected residential receivers. The noise environment at other receivers was characterised by attended noise measurements. The background noise environment at all of the receivers was dominated by urban hum during the day, evening and night. Noise from the existing facility was audible at the closest receivers to the south.

Assessment criteria for the facility was established using the *Industrial Noise Policy (EPA, 2000)* and the noise measurements for operational changes. Construction noise criteria were established using the *Interim Construction Noise Guideline (EPA, 2009*) and the *Construction Noise Strategy* (Transport for NSW, 2013. Criteria for off-site road traffic noise impacts was established using the *Road Noise Policy (EPA, 2011)*. Criteria for vibration impacts were established using Assessing Vibration: A Technical Guideline (Vibration Guideline) (DEC, 2006) and DIN Standard 4150-2 Part 3: Structural Vibration in Buildings: Effects on Structures (DIN Deutsches Institut für Normung, 1999).

The operational noise assessment was concerned with the impacts associated with operational changes which occur as a result of the infrastructure extensions, the commissioning and maintenance of NIF trains.

Existing operations, aside from those associated with maintenance of the Millennium fleet are not expected to change as a result of the introduction of the NIF and are therefore were not assessed.

Commissioning activities are expected to include static testing in the Millennium shed and dynamic testing on the rail network. The delivery and shunting of the NIF will require diesel locomotives to be used within the facility. Up to five NIF trains could be being commissioned at any one time.

The static commissioning is expected to include full testing of all on board services, the most noise intensive being air conditioning, compressors, static inverters, digital voice announcements, brakes and horns.

The assessment predicted noise levels at the nearest sensitive receiver from the commissioning activities in addition to the use of the diesel locomotives in the facility using conservative assumptions as detailed in the report.

The predictions indicated that use of diesel locomotives and the simultaneous commissioning of all five NIF trains would exceed the operational noise criteria at the nearest receivers in NCA D. Receivers in the other NCAs are not predicted to be impacted by the commissioning. As a result of the predicted exceedance, a number of mitigation measures were recommended:

- scheduling the commissioning activities to occur during the day period, where possible
- scheduling specific commissioning activities to not occur simultaneously on all five trains
- limiting the use of the diesel locomotives in the facility
- utilising screening from static trains, the train wash or other buildings within the facility where locomotives are required to stand on idle.

After the trains have been commissioned, the facility will be used for routine maintenance of the NIF trains. The maintenance required for the NIF trains will be similar to that already carried out on the Millennium fleet at the facility. In addition the NIF will be subject to the same noise emission standards as existing rolling stock and therefore would not generate more noise than existing trains. As a result, noise impacts from regular maintenance activities are not expected to change with the introduction of the NIF.

The modifications to the existing infrastructure are predicted to result in an increase in the operational noise level by less than 3 dBA. A change in noise level of 3 dB or more is typically considered the smallest noticeable change by the average person. As a result, these modifications are not considered to significantly change the noise impact of the facility.

Impacts associated with the commissioning activities are expected to be carried out over a period of four years. The predicted noise levels indicated that the first two rows of houses adjacent to the facility on Rowley Lane would be impacted during the worst case commissioning activities when all activities are occurring at the same time. Mitigation and management measures were investigated to reduce noise levels which indicated that noise levels could be reduced towards the PSNLs by utilising a number of measures where reasonable and feasible.

Furthermore the residential buildings on Rowley Lane were built after the facility was operating in its current state. As the dwellings were built adjacent to an industrial facility it is assumed that they have sufficient ventilation systems to allow for windows to be closed. Noise levels estimated inside the dwellings with windows closed are expected to meet the internal design noise levels in *AS 2107 Acoustics – Recommended design sound levels and reverberation times for building interiors for sleeping areas*.

The use of horns within the facility was predicted to exceed the sleep disturbance screening criterion. As a result, it is recommended that the horns be managed in a similar manner as they are now which includes testing horns on the network instead of at the facility.

The construction of the modifications are expected to generally occur during standard hours (Monday to Friday 7am to 6pm and Saturdays 8am to 1pm). Work outside of these hours may occur for the overhead wiring connections when a possession is required.

The construction noise assessment indicated that only the closest receivers to the construction works were expected to be impacted above the construction noise guidelines. No residential receivers were predicted to experience noise levels above the highly noise affected level. The assessment indicated impacts as follows:

- NCA A and B would be impacted above the noise management levels (NML) during demolition works at the Eastern Siding
- NCA C commercial receivers would be impacted above the NMLs for all assessed activities carried out at the Eastern Siding
- NCA D would be impacted above the NMLs for demolition and installation of overhead wiring
- NCA F, G and H would be impacted above the NMLs for demolition and track extension works.

As a result of the predicted exceedances, a number of noise management measures have been recommended.

No off site road traffic impacts above the guideline levels are expected as a result of the operational or construction phases of the project.

Vibration impacts are not expected from construction or operation of the project, as long as the safe working distances for equipment are complied with and operational activities are consistent with that currently undertaken. The condition of any heritage item should be assessed prior to assigning a vibration limit.

1 INTRODUCTION

WSP | Parsons Brinckerhoff has been commissioned on behalf of Transport for NSW to prepare the noise and vibration impact assessment (NVIA) for the proposed changes to the Eveleigh Maintenance Facility for the New Intercity Fleet (hereafter, referred to as 'the project'). The purpose of the NVIA is to support the Review of Environmental Factors (REF) for the project.

This NVIA is one of a number of technical reports supporting the REF for the project.

The facility currently operates as a rail maintenance and stabling facility for Sydney Trains Millennium and Oscar fleets, NSW Trainlink Endeavour and XPLORER fleets and 3801 Limited's heritage rail fleet.

The project proposes to modify existing track and supporting infrastructure within the facility to accommodate the commissioning, maintenance and stabling of the New Intercity Fleet.

1.1 Scope of this report

The scope of this report is to assess the potential construction and operational noise and vibration impacts associated with the modifying the facility.

2

2 PROJECT DESCRIPTION

2.1 Project overview

To support the introduction of the New Intercity Fleet (NIF), a suitable facility is required to serve as a commissioning and maintenance site for the new trains. The existing Eveleigh Maintenance Facility (referred to hereafter as "the facility") is located approximately two kilometres south west of the Sydney Central Business District (CBD) and has been identified as the preferred location to support the commissioning and maintenance operations for the NIF.

To accommodate the NIF, Transport for NSW are proposing to undertake track, civil and overhead wiring (OHW) modifications at the facility which are longer than the current intercity fleet. The key activities would include:

- extension of Engineering Roads 1 and 2 and the associated OHW by approximately 49 metres
- extending the suction and non-potable water supply and the installation of additional decant point associated with the existing decant facility, to accommodate Long NIF decanting on both tracks
- relocation of the existing Welder's facility (located within the Welder's Training Annex building) to another building / location within the facility or at an offsite location
- demolition of the Welder's Training Annex building
- extension of the OHW for the full length of Roads 6 and 7 in the Millennium Shed
- extension of the Eastern Siding by approximately 26 metres
- static commissioning of the NIF within the Millennium shed
- dynamic commissioning of the NIF on the Sydney Trains network
- routine maintenance and stabling of the NIF.

2.2 Location

The facility is located immediately south of the existing rail corridor, approximately 300 metres east of Erskineville station and approximately 250 metres west of Redfern station. The rail corridor encompasses the T1 (North Shore, Northern & Western Line), T2 (Airport, Inner West & South Line), T3 (Bankstown Line) and T4 (Eastern Suburbs & Illawarra Line) lines.

The facility is bordered by mixed land uses including the residential area of Eveleigh, the Australian Technology Park (ATP) to the immediate south and east and the existing rail corridor to the immediate north. The ATP is a commercial district, occupied by numerous Government and privately owned firms.

The facility has been highly modified as part of its historical and current use as a train stabling and maintenance facility. Direct vehicle access to the site is provided by an existing access road off Railway Parade, Eveleigh.

The location of facility is shown in Figure 2.1.

2.3 History of operations

The facility has been operating as a train commissioning, stabling and maintenance facility since 1888 when the Eveleigh Railway Workshops was established. Since 1888, the facility has undergone a number of modifications and additions to support the increase in passenger train movements and the introduction of new train fleets over time. The facility is of exceptional historical and social significance, with its location wholly within the curtilage of the *Eveleigh Railway Workshops,* listed as item 01140 on the NSW State Heritage Register (SHR).

Currently, Sydney Train's suburban fleet and the intercity fleet operated by NSW Trainlink utilise the facility for stabling and maintenance purposes. The facility also supports the stabling and maintenance of steam and diesel engine heritage trains which are operated by 3801 Limited.

2.4 Assessment terminology

For the purposes of this assessment, the following definitions are used:

- the 'project' refers to:
  - all physical modification works to be undertaken to accommodate the commissioning, stabling and maintenance of the New Intercity Fleet at Eveleigh
  - commissioning, stabling and ongoing maintenance operations associated with the New Intercity Fleet at Eveleigh
- the 'Eveleigh Maintenance Facility' (the facility) refers to the boundary of the train stabling and maintenance yard, which incorporates all existing internal tracks and buildings as shown in Figure 2.1
- the construction works footprint has been divided in to three distinct study areas based on their location within the facility and are referred to as:
  - subject site 1 – Engineering Roads 1 and 2
  - subject site 2 – Millennium Shed
  - subject site 3 – Eastern Siding.

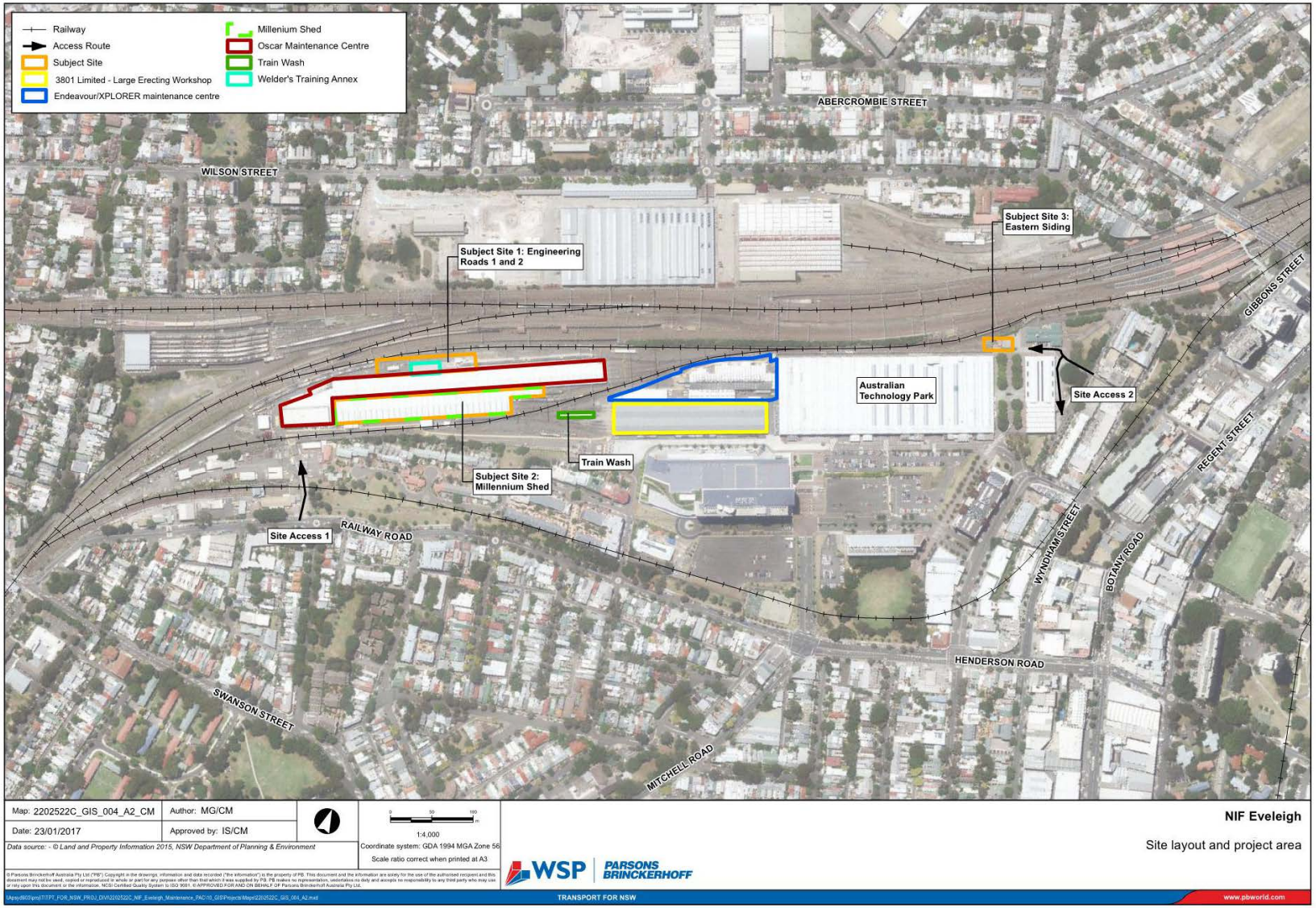


Figure 2.1 Facility layout

6

3 SENSITIVE RECEIVERS

The facility is located in an area of mixed land use. The facility is bounded to the north by the main suburban rail corridor with medium and high density residential properties along Wilson Street, Holdsworth Street and Leamington Avenue and the Carriageworks commercial premises located along the northern side of the rail corridor.

To the east of the facility is the Australian Technology Park (ATP) which is made up of various commercial land uses. At the eastern end of the ATP there are residential apartment buildings located on Cornwallis Street.

The south of the facility is bounded by multi-storey residential apartment buildings. The west of the facility is bounded by the Illawarra line rail corridor and beyond that there are medium and high density residential buildings on Burren Street.

The Macdonaldtown stabling yard is located to the northwest of the facility and includes a number of large concrete noise barriers along the length of Leamington Lane and along the western side of the Illawarra rail corridor on Burren Street.

The location of the sensitive land uses and existing noise barriers are presented in Figure 3.1.

Sensitive land uses have been grouped into noise catchment areas (NCAs). In each of these NCAs, representative receivers have been selected to assess the noise levels at that receiver and those in its vicinity with similar acoustic conditions. The location of the NCAs and representative receivers are shown in Figure 3.1. The details of the representative receivers are presented in Table 3.1.

Table 3.1 Noise catchment areas

NCA	DESCRIPTION	LAND USAGE	CLOSEST SUBJECT SITE	DISTANCE TO CLOSEST SUBJECT SITE (m)
A	Terraced housing with some limited low rise apartment buildings and commercial properties. NCA borders old suburban car workshops and is located over the rail corridor from subject site 3.	Primarily residential with some commercial	3	90
B	Residential apartment blocks (3 to 4 storeys) located along Cornwallis Street.	Residential	3	125
C	Australian Technology Park, containing offices and other similar commercial uses. Adjacent to Subject site 3.	Commercial	1,2 and 3	50, 60, 5
D	Residential development on southern border of Eveleigh facility consists of townhouses and apartment blocks up to 5 storeys tall.	Residential	2	18
E	Commercial properties on Eveleigh facility southern border	Commercial	2	45
F	Terraced residential properties on Burren Street. Existing noise barrier located at rear of properties along rail corridor.	Residential	2	150
G	Medium density terraced and free standing houses in addition to apartment block located adjacent to Carriageworks, located over the rail corridor from Eveleigh facility.	Residential	1	70
H	Commercial precinct containing Carriageworks and disused railway workshops and maintenance yard.	Commercial and industrial	1 and 3	55 and 55

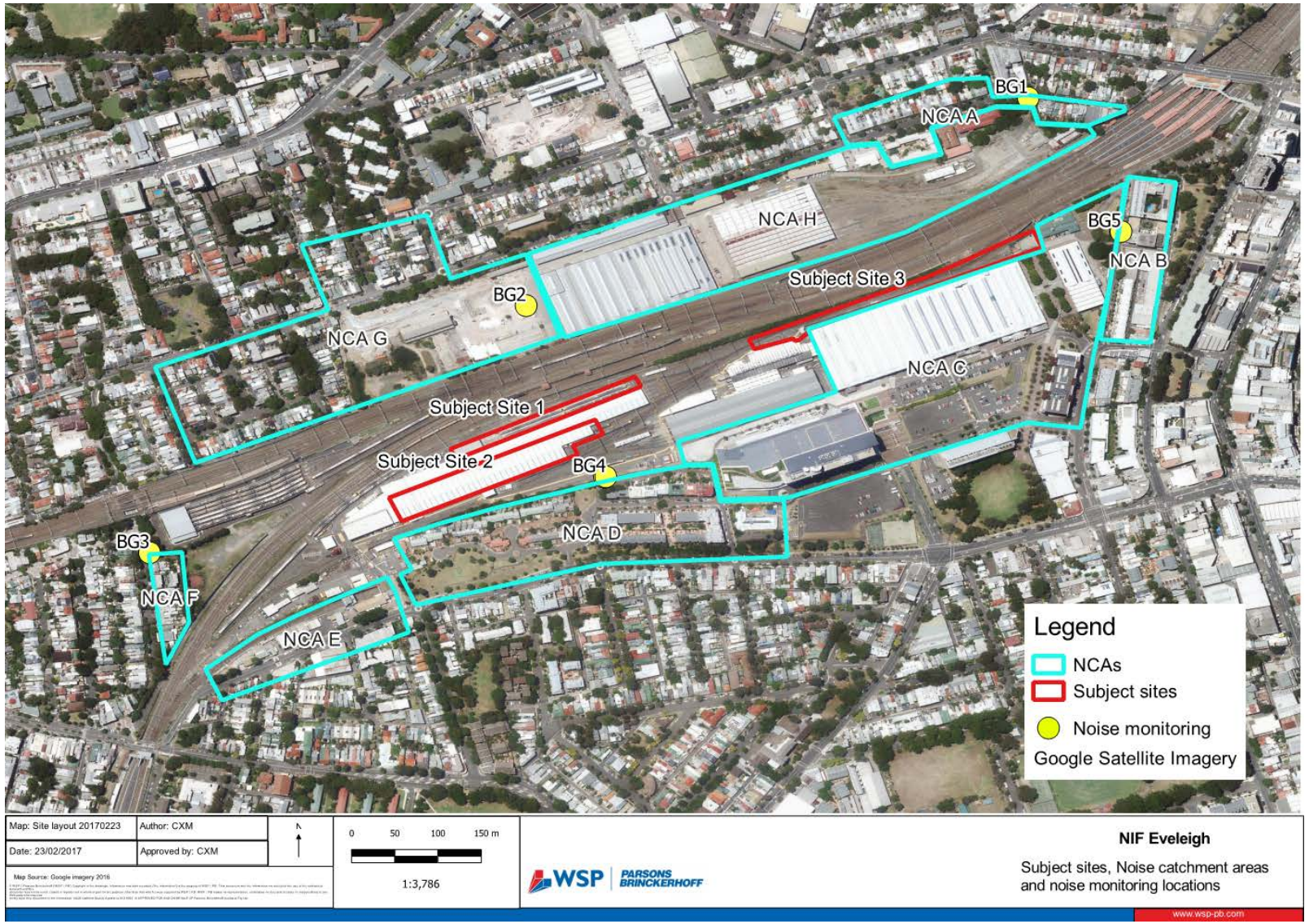


Figure 3.1 Subject Site locations, NCAs and noise monitoring locations

4 EXISTING ENVIRONMENT

4.1 Noise monitoring methodology

Short term attended and long term unattended noise measurements were taken between 17 and 29 February 2016, and 21 November and 2 December 2016. The noise monitoring was conducted with reference to Australian Standard AS 1055 *Acoustics, Description and Measurement of Environmental Noise*.

Table 4.1 describes the noise monitoring equipment used onsite, with the monitoring locations shown in Figure 3.1.

Table 4.1 Noise measurement equipment

ID	EQUIPMENT DESCRIPTION	ADDRESS	SURVEY DATE	MANUFACTURER & TYPE NO.	SERIAL NO.
BG1	Sound Level Meter	157 Little Eveleigh Street, Redfern	21 November 2016, 24 November 2016 and 2 December 2016	Norsonic – Nor140	1406502
BG2		7 Carriageworks Way, Eveleigh			
BG3		43 Burren Street, Erskineville			
BG4		1-5 Rowley Street, Eveleigh			
BG5		32 Rosehill Street, Redfern			
Logger	Environmental Noise Logger	1-5 Rowley Street, Eveleigh	21 November – 2 December 2016	SVAN Sound and Vibration Analyser – SVAN 958	36993
-	Calibrator	All	All	Rion NC-73	11248294

The data were gathered over a period of typical traffic movement and activity in the area (i.e. outside of school holiday periods). The monitoring equipment was fitted with windshields and were field calibrated before and after monitoring. No significant drifts in calibration (± 1.0dB) were noted.

The weather conditions at the time of monitoring were recorded at Observatory Hill Weather Station (Bureau of Meteorology station number 066062), which is located approximately four kilometres north of the project.

Periods of inclement weather (wind speeds greater than five metres per second and significant rainfall) and extraneous noise that were identified to adversely affect the noise monitoring were excluded from the analysis of monitoring data.

Operator attended noise surveys and observations were conducted at the noise monitoring locations on 21 November 2016, 24 November 2016, and 2 December 2016. The primary purpose of the attended monitoring was to measure background noise levels and characterise the existing ambient environment based on a short term noise measurement sample.

4.2 Noise monitoring results

Table 4.2 summaries the long term unattended noise monitoring results. The data are reported as the average equivalent continuous average sound levels ($L_{eq(15min)}$) and rating background levels (RBL) as defined in the NSW *Industrial Noise Policy* (INP) (EPA, 2000). Graphs of the long term measurement results are presented in Appendix A.

Table 4.3 presents the results of the short term attended noise monitoring.

Table 4.2 Unattended noise measurement results (dBA)

ID	DAY $L_{EQ(15MIN)}$	DAY RBL	EVENING $L_{EQ(15MIN)}$	EVENING RBL	NIGHT $L_{EQ(15MIN)}$	NIGHT RBL
BG4	61	45	56	42	51	39

Note: Day is defined as Monday to Saturday 7.00am to 6.00pm; 8.00am to 6.00pm Sundays and Public Holidays, Evening is 6.00pm to 10.00pm and Night is the remaining periods.

Table 4.3 Short term attended noise monitoring results

LOCATION	DATE	START TIME	$L_{EQ\ (15MIN)}$ dBA	$L_{90(15MIN)}$ dBA	MEASURED EVENT NOISE LEVELS L_{MAX}, dBA	COMMENTS
BG1 (NCA A)	21/11/16	12.00 pm	57	54	Construction activity nearby: 55-57 Aeroplane: 62-66 Road traffic: 66-71 Pedestrian traffic: 65-69	Facility related noise not discernible
	24/11/16	9.33 pm	55	43	Pedestrian: 45-77 Train: 46-54 Road traffic: 51-56 Aeroplanes: 52-53 Entry gate: 60-76 Generator: 43-45 Hand tools up to 47	Facility related noise not discernible
	24/11/16	11.54 pm	52	42	Pedestrian: 46-52 Train: 50-55 Road traffic: 44-56 Residential noise (e.g. dog and voice): 56-60 Entry gate: 73-85 Generator: 42-43 Light vehicle: 53-55	Facility related noise not discernible
BG2 (NCA G)	2/12/2016	10.23 am	60	47	Aeroplane: 60-71 Forklift activity: 55-70 Emergency vehicle siren audible Train: 53-70 Carpark activity: 50-53 Reverse alarm: 43-50 *Facility related events* Train horn: 53-75	
	24/11/16	9.51 pm	55	42	Train: 50-67 Mechanical plant: 41-42 Carpark activity: 50-59 Residential noise (e.g. voice): 48-50 *Facility related events* Horn: 55-58	

LOCATION	DATE	START TIME	$L_{EQ\ (15MIN)}$ dBA	$L_{90(15MIN)}$ dBA	MEASURED EVENT NOISE LEVELS L_{MAX}, dBA	COMMENTS
	24/11/16	10.08 pm	55	42	Train: 47-70 Mechanical plant: 42-44 Carpark activity: 50-59 Residential noise (e.g. voice): 48-50 Horn audible *Facility related events* Activity within shed (impact) up to 45	
BG3 (NCA F)	2/12/2016	9.57 am	51	43	Pedestrian (walking and voice): 52-60 Insects: 42-45 Train (inner west line): 50-59 Train (Bankstown line) 49-52 Train horn audible Road traffic: 50-70 Aeroplanes: 50-57 Construction 47-65	Facility related noise not discernible
	24/11/16	8.14 pm	52	41	Pedestrian: 55-73 Train (inner west line): 45-59 Train (Bankstown line): 48-59 Road traffic: 49-62 Aeroplanes: 58-62 Mechanical hum slightly audible in lulls of road and rail traffic.	Facility related noise not discernible
	24/11/16	10.31 pm	46	38	Train (inner west line): 48-59 Train (Bankstown line): 46-53 Road traffic: 45-48 Pedestrian: 44-68 Dog: 45-49 Mechanical hum: 37-38	Facility related noise not discernible
BG4 (NCA D)	21/11/16	10.40 am	54	47	Road traffic: up to 47 Aeroplane: 52-64 General residential noise (e.g. dog, pedestrian, door closing): 50-54 *Facility related events* Activity within shed (impact) up to 65 Diesel engine testing: 47 Horn: 76-80	

LOCATION	DATE	START TIME	$L_{EQ\ (15MIN)}$ dBA	$L_{90(15MIN)}$ dBA	MEASURED EVENT NOISE LEVELS L_{MAX}, dBA	COMMENTS
	24/11/16	8.42 pm	50	43	Road traffic: 50-55 Aeroplane: 50-60 General residential noise (e.g. dog, pedestrian, door closing): 51-72 Mechanical plant up to 43 *Facility related events* Rolling stock: 54-56 Activity within shed (impact): 45-48 Diesel engine testing: 53-55 Door alarm and announcement tests audible	
	24/11/16	10.54 pm	50	41	Road traffic: 55-60 Pedestrian: 41-43 Aeroplane: 47-56 Train: 47-50 Mechanical plant: 40-42 *Facility related events* Rolling stock: 49-62 Diesel engine testing: 54-55 Horn up to 58 High pressure air: 44-57	
BG5 (NCA B)	21/11/16	11.25 am	55	48	Train: 50-60 Aeroplane: 63-69 Tractor: 58-65 Mechanical plant up to 48	Facility related noise not discernible
	24/11/16	9.10 pm	50	46	Road traffic: 52-68 Car entering garage up to 65 Aeroplane: 55-57 Pedestrian: 48-55 Mechanical plant: 45-47	Facility related noise not discernible
	24/11/16	11.20 pm	49	47	Train: 50-58 Road traffic: 58-66 Pedestrian noise: 59 Mechanical plant: 46-47	Facility related noise not discernible

The results of the long term monitoring are considered representative of the receivers closest to BG4. Noise monitoring was conducted on the boundary of the Eveleigh maintenance facility. As a result, noise from activities within the facility would affect the noise monitoring. However, noise from activities are intermittent and did not dominate noise levels measured at the logging location.

As the INP method for determining the RBL takes the lowest tenth percentile background noise levels, it is considered that due to the intermittent nature of works at Eveleigh, the calculated RBL is representative of receivers adjacent to the facility in the absence of noise from the facility.

Furthermore, the result of the monitoring are within 2 dBA of previously measured background noise levels used to assess the facility (Eveleigh Maintenance Centre Noise Impact Assessment, Wilkinson Murray Report 1431 Version A, May 2014).

At location BG1 (NCA A), the noise environment was dominated by urban hum comprising primarily of distant traffic noise. During the day, some nearby construction work also contributed to the measured levels. During the evening and night, a nearby generator contributed to the background noise environment with distant traffic noise also a significant contributor.

At location BG2 (NCA G) the background noise environment was dominated by urban hum with a significant contribution coming from train passbys within the rail corridor. Noise sources from the facility were observed to be impulsive noises from horns and impacts within the maintenance sheds.

At BG3 (NCA F) the activities within the facility were generally not discernible and the noise environment was comprised urban hum with significant contributions from train passbys on the existing network.

At BG4 (NCA D) the noise environment was made up of intermittent noise from the facility in addition to a background of urban hum during the day, evening and night periods.

At BG5 (NCA B), the noise environment was dominated by general urban hum, nearby mechanical plant and the facility was not discernible at this location.

5 ASSESSMENT CRITERIA

The assessment has been prepared with reference to the following guidelines, policies and standards:

- noise
  - Industrial Noise Policy (INP) (EPA, 2000)
  - Interim Construction Noise Guideline (ICNG) (DECC, 2009)
  - *Construction Noise Strategy* (CNS) (Transport for NSW, 2013)
  - Road Noise Policy (RNP) (EPA, 2011)
- vibration
  - Assessing Vibration: A Technical Guideline (Vibration Guideline) (DEC, 2006)
  - DIN Standard 4150-2 Part 3: Structural Vibration in Buildings: Effects on Structures (DIN Deutsches Institut für Normung, 1999).

5.1 Operational

Operational noise is assessed according to the *Industrial Noise Policy* (INP) (EPA, 2000). The INP is the appropriate assessment method for the proposal as the *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013) assessment method specifically excludes noise from maintenance and stabling yards.

The INP defines two criteria for the assessment of noise; the intrusive and amenity criteria. The more onerous criterion is then adopted as the project specific noise level (PSNL) which the proposal is assessed against.

The intrusive criterion is intended to protect residential receivers against intrusive noise in the short term. It is defined as $L_{eq(15min)}$ dBA less than or equal to the rating background level (RBL) plus 5 dBA. The RBL is the background noise level determined in accordance with Appendix B of the INP.

The amenity criterion is intended to maintain noise amenity and limit cumulative noise increases for sensitive land uses. In Table 2.1 of the INP, recommended amenity noise levels are defined for each day, evening and night period for each sensitive land use. The recommended amenity noise levels apply to noise from industrial noise only and where existing industrial noise exceeds or approaches the recommended amenity levels, a modifying factor (INP Table 2.2) is applied to limit the cumulative increase in total industrial noise at a receiver.

The closest and potentially most affected residential receivers to the operational activities are located in NCA D. It is expected that where compliance is achieved at NCA D, compliance would also be achieved at the other NCAs, located further away.

The receivers in all NCAs are considered to be an urban amenity area as the background noise environment is dominated by urban hum during all times of the day, evening and night.

Table 5.1 presents the criteria and PSNL for receivers in NCA D. Table 5.2 presents the project specific noise level for non-residential receivers as presented in the INP.

Table 5.1 Operational criteria for closest residential receivers

NOISE MONITORING LOCATION	TIME PERIOD[1]	RBL dBA	INTRUSIVE CRITERIA $L_{EQ(15MIN)}$ dBA	EXISTING INDUSTRIAL NOISE LEVEL $L_{EQ(15MIN)}$ dBA	ACCEPTABLE NOISE LEVEL $L_{EQ(PERIOD)}$ dBA	AMENITY CRITERIA[2] $L_{EQ(PERIOD)}$ dBA	PSNL $L_{EQ(15MIN)}$ dBA[5]
NCA A	Day	54	59	<47	60	60	59
	Evening	43	48	45	50	48	48
	Night	42	47	43	45	41	41
NCA B	Day	48	53	48	60	60	53
	Evening[3]	46	51	47	50	47	47
	Night	46	51	47	45	37	37
NCA D[2]	Day	45	50	<61	60	60	50
	Evening	42	47	<56	50	50	47
	Night	39	44	<51	45	45	44
NCA F	Day	43	48	<41	60	60	48
	Evening	41	46	<42	50	50	46
	Night	38	43	38	45	45	43
NCA G	Day	47	52	<50	60	60	52
	Evening	42	47	42	50	50	47
	Night	42	47	44	45	39	39

Note 1: Day is defined as Monday to Saturday 7.00am to 6.00pm; 8.00am to 6.00pm Sundays and Public Holidays, Evening is 6.00pm to 10.00pm and Night is the remaining periods.

Note 2: It is considered that the existing industrial noise measured at the logging location is from the existing Eveleigh maintenance yard. Since the existing industrial noise level used to determine the amenity criteria should exclude that of the premises being assessed (Section 2.1, INP) the amenity criteria do not require modification.

Note 3: The measured evening RBL was higher than the night. In accordance with the *INP Application Notes*, in this situation the evening RBL should be set no higher than the night RBL.

Table 5.2 Operational criteria for non-residential receivers

RECEIVER	TIME PERIOD	AMENITY CRITERIA[1] $L_{EQ(PERIOD)}$ dBA
Industrial (NCA H)	When in use	70
Commercial (NCA C, NCA E and NCA H)	When in use	65

Note 1: The PSNL has been set as a $L_{eq(15min)}$ in order to provide a conservative assessment. Where compliance is achieved over a 15 minute period is therefore implied it will occur over the day, evening or night period.

Note 2: For NCA H, the most stringent assessment criteria have been applied.

5.2 Construction

Noise impacts from construction activities are assessed using the *Interim Construction Noise Guideline* (ICNG) (DECCW 2009) and the Transport for NSW *Construction Noise Strategy* (CNS) (Transport for NSW, 2013). The ICNG defines a noise management level for residential and other sensitive land uses. Above this level, feasible and reasonable mitigation should be considered to reduce noise levels.

Table 5.3 defines noise management levels (NML) as specified in the ICNG and how they are applied for residential receivers. NMLs are the level of noise above which receivers are considered to be 'noise affected'. They are based on the measured RBL as defined in the INP plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours.

Where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered 'highly noise affected' and require additional considerations to mitigate potential impacts.

Table 5.3 Interim Construction Noise Guideline construction noise management levels for residential receivers and working hours

TIME OF DAY	NML $L_{EQ(15MIN)}$[1,2] dBA	HOW TO APPLY
Recommended standard hours: Monday–Friday 7 am–6 pm Saturday 8 am– 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. → Where the predicted or measured $L_{eq(15min)}$ dBA is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. → The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: → times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) → if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (INP) (EPA 2000).

Table 5.4 provides a summary of the applicable NMLs based on the background noise monitoring conducted. In addition, Table 5.5 lists the NMLs that have been adopted for non-residential sensitive receivers as required by the ICNG.

Table 5.4 Construction noise management levels for residential receivers

NCA	NML $L_{eq(15min)}$ dBA			
	Day (SH)	Day (OOHW)	Evening (OOHW)	Night (OOHW)
A	64	59	48	47
B	58	53	51	51
D	55	50	47	44
F	53	48	46	43
G	57	52	47	47

Note: SH = Recommended standard working hours. OOHW = outside of recommended standard hours work as defined in Table 5.3.

Table 5.5 Noise management levels at sensitive land uses (other than residences)

LAND USE	NML $L_{EQ(15\ MIN)}$ dBA (APPLIES WHEN PROPERTIES ARE BEING USED)
Commercial (NCA C, NCA E, NCA H)	70 (external)
Industrial (NCA H)	75 (external)

5.3 Sleep disturbance

Operational and construction noise during the night have the potential to disturb people's sleep patterns.

Guidance in the ICNG and INP Application Notes references further information in the *Road Noise Policy* (RNP) (EPA, 2011) that discusses criteria for the assessment of sleep disturbance.

The RNP and the INP application notes suggest a screening level of $L_{1(1min)}$ dBA, equivalent to the RBL + 15 dB. Where this level is exceeded, further analysis should be carried out. Section 5.4 of the RNP then goes on to state that:

- maximum internal noise levels below 50 to 55 dBA would be unlikely to result in people's sleep being disturbed
- if the noise exceeds 65 to 70 dBA once or twice each night the disturbance would be unlikely to have any notable health or wellbeing effects.

Based on the above, at levels above 55 dBA, sleep disturbance would be considered likely. Assuming that receivers may have windows partially open for ventilation, a 10 dB outside to inside correction has been adopted as indicated in the INP. Therefore sleep disturbance screening criterion of L_{max} 65 dBA has been adopted in this assessment.

5.4 Off-site road traffic

The project will generate construction and operational vehicle movements on the surrounding roads which have the potential to impact sensitive receivers along the access routes.

The RNP has been used to assess traffic noise from generated during the operational and construction phases of the project.

Table 5.6 presents the road traffic noise criteria from the RNP for land use developments with a potential to create additional traffic on an existing road. The external noise criteria are applied one metre from the external facades of the affected building and at a height of 1.5 metres from the most affected storey.

Table 5.6 Applicable Road Noise Policy assessment criteria

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	DAY (7.00am to 10.00pm)	NIGHT (10.00pm to 7.00am)
Collector/sub-arterial/arterial/freeway	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq(15hr)}$ 60 dBA	$L_{eq(9hr)}$ 55 dBA
Local road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq(1hr)}$ 55 dBA	$L_{eq(1hr)}$ 50 dBA

In addition, the RNP application notes state that where an existing receiver is affected by a land use development, the increase in road traffic noise above the existing road noise level should be limited to 2 dBA. This applies where the existing noise level is either above or within 2 dBA of the criteria presented in Table 5.6.

5.5 Vibration

Vibration from construction and operation can lead to:

- cosmetic and structural building damage
- loss of amenity due to perceptible vibration, termed human comfort.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. Damage of this nature is typically described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic damage then structural damage is not considered a significant risk and is not further assessed.

COSMETIC BUILDING DAMAGE

There is currently no guidance in NSW specifically addressing cosmetic damage to buildings from vibration. Two international standards are typically referenced for the assessment of cosmetic damage in buildings; British Standard BS 7385-2: *1993 Evaluation and measurement for vibration in buildings* and German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structure*

The guidance in the Transport for NSW *Construction Noise Strategy* (CNS) refers to BS 7385 for safe working distances to avoid cosmetic damage of buildings. The standard provides guidance on the 'evaluation and measurement of vibration in buildings' and defines guidance for categorising building damage in terms of 'cosmetic', 'minor' and 'major'; providing limits for each (refer to Table 5.7).

Table 5.7 BS7385 Cosmetic damage criteria, peak component particle velocity, (mm/s [1])

GROUP	TYPE OF STRUCTURE	4–15 Hz	15–40 Hz	40 Hz AND ABOVE
1	Reinforced or framed structures Industrial or heavy commercial buildings		50	
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 – 20[2]	20 – 50	50

Note 1: Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).

Note 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

These peak vibration limits are set so that the risk of 'cosmetic' damage in residential or commercial buildings is minimal. They have been set at the lowest level above which damage has been credibly demonstrated. The limits also assume that the equipment causing the vibration is only used intermittently, however if the equipment is used continuously, then the limits may need to be reduced by up to 50 per cent.

For 'minor' or 'major' vibrational damage to occur, the standard states that vibration need to be two times and four times (respectively for group 1 and group 2) the values shown in Table 5.7.

Guidance in BS 7385 also suggests that unless structurally unsound, heritage items should not be considered to be more sensitive than dwellings for the purposes of assessment.

Vibration limits given in DIN 4150 are more conservative than BS 7385 and specifically address heritage items as being more sensitive. Table 5.8 presents a summary of the vibration limits from DIN 4150.

Table 5.8 Guideline values for short term vibration on structures (DIN 4150-3), guideline values for velocity, (mm/s)

Type of structure	1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz
Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particularly sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10

In this assessment, the DIN 4150 limits have been adopted for heritage items as they represent the more conservative limits.

HUMAN COMFORT (AMENITY)

Table 5.9 presents the limits (vibration dose values) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by construction work. The limits are taken from *Assessing Vibration: A Technical Guideline* (DEC, 2006).

Table 5.9 Vibration limits (human comfort), Vibration dose value, ($m/s^{1.75}$)

LOCATION	ASSESSMENT PERIOD	PREFERRED VALUES	MAXIMUM VALUES
Critical areas	Day or night time	0.10	0.20
Residences	Daytime	0.20	0.40
Residences	Night time	0.13	0.26
Offices, schools, educational institutions, and places of worship	Day or night time	0.40	0.80
Workshops	Day or night time	0.80	1.60

6 OPERATIONAL ASSESSMENT

6.1 Introduction

The operational activities associated with the project are expected to consist of commissioning activities and once complete, maintenance and stabling activities. The following sections outline the expected activities and an assessment of the potential noise impacts associated with these operational activities.

6.2 Existing operations

The facility has operational activities associated with the Endeavour and XPLORER maintenance centre and 3801 Limited in addition to other stabling and ad-hoc maintenance activities as required by the Sydney Trains. These existing operations are not expected to change as a result of the NIF trains being commissioned and maintained at the facility and therefore no assessment of these activities is required.

6.3 Commissioning activities

The commissioning of the new trains is expected to occur at the Eveleigh facility on roads five to nine within the Millennium Shed. Up to five NIF sets can be commissioned at the same time within the facility.

Both static and dynamic commissioning activities are required to be carried out. The static commissioning involves comprehensive testing of all train systems and services, similar to preparation for service routine. The dynamic testing involves taking the NIF train out on the network to test systems concerned with the network and the train in motion.

The activities required to carry out the commissioning are as follows:

- all NIF trains will be delivered as ten car sets and hauled from the port to the facility by a diesel locomotive
- up to two diesel locomotives may be required to move NIF trains into the Millennium shed
  - either one locomotive would be used to haul NIF train into the facility then uncouple and then travel around the network to couple at the back of the train and propel it into the shed
  - or an additional locomotive would be coupled at the rear of the train. The lead locomotive would haul the train into the facility and then uncouple, leaving the rear locomotive to propel the train into the shed
- locomotives would not be required to operate at full power during shunting or at idle
- uncoupling would typically take 5 to 15 minutes, during which time the locomotive would be idling continuously
- dynamic testing such as signal interference testing is required to be undertaken on the network
  - there are 13 signal systems to be tested
  - NIF trains would be propelled by a diesel locomotive to testing locations
  - signal interference testing is only required on the first two NIF trains
- trains can self-propel within the facility and on the network once the signal interference and type testing is completed on the first two NIF trains
  - the trains self-propelling within the facility is not a significant noise source
- static commissioning is to take place on roads five to nine within the Millennium shed
- static commissioning and dynamic testing may take place at any time during the day, evening or night, seven days a week to meet operational requirements.

ASSESSMENT SCENARIOS

The activities with the most potential to cause noise impacts at the nearest noise sensitive receivers have been assessed. Table 6.1 provides a summary of the assessment scenarios.

Table 6.1 NIF train commissioning assessment scenarios

ID	DESCRIPTION	LOCATION	EQUIPMENT	TIME PERIOD
1	2 locomotives manoeuvre NIF train within the facility	On roads approaching Millennium Shed	2 diesel locomotives equivalent to 81 or 82 class diesel locomotives	Day, evening or night
2	2 locomotives idle outside	Outside of the Millennium Shed	2 diesel locomotives equivalent to 81 or 82 class diesel locomotives	Day, evening or night
3	1 loco idles outside	Outside of the Millennium Shed	1 diesel loco equivalent to 81 or 82 class diesel locomotives	Day, evening or night
4	5 NIF trains running all services	Inside Millennium Shed	Each NIF train running air compressors, static inverters and air conditioning	Day, evening or night
5	Brake testing (assumed 5 New Intercity Fleet trains tested at the same time)	Inside Millennium Shed	Brake testing including emergency and other brakes	Day, evening or night
6	Digital Voice Announcement (assumed 5 New Intercity Fleet trains tested at the same time)	Inside Millennium Shed	DVA on each NIF train	Day, evening or night
7	Horn testing	Inside Millennium Shed	Country horn test	Day, evening or night

METHOD

Predictions of noise levels at receivers have been made using the ISO 9613 method as implemented in the CadnaA 4.2 noise modelling software. The following conservative assumptions were used:

- flat topography between the source and the nearest receivers
- hard ground absorption
- all noise sources in each scenario operating simultaneously
- noise source levels and directionalities as stated in Table 6.2 and Table 6.3
- noise sources for those located on top of the trains have been assumed to be at 4 metres and those under the train at 0.5 metres
- all activities can occur during the day, evening or night.

Noise source levels for each of the activities and equipment has been sourced from information provided within *Sydney Trains Environmental Management System Document EMS-09-GD-0080 Noise and vibration from Rail Facilities Chapter 4 – Stabling Yards*, and other published sources where applicable.

The noise levels for the NIF have been based on the most recently produced train sets, the Waratah (A-set). Table 6.2 presents the noise levels used for the assessment.

Table 6.2 Noise source levels

TRAIN TYPE[1]	OPERATING CONDITION	SOUND POWER LEVEL	DETAILS
Waratah	Static inverter	$L_{eq(15min)}$ 83 dBA	Located at top of train, two units per car.
Waratah	Air compressor	$L_{eq(15min)}$ 86 dBA	Underfloor at end of train. One unit per four car set.
Waratah	Air conditioning (AC) unit	$L_{eq(15min)}$ 80 dBA	On full load. Located at top of train, two units per car.
Waratah	Brake test discharge	$L_{eq(15min)}$ 96 dBA L_{max} 120 dBA (emergency brakes) L_{max} 115 dBA (other brake release)	Underfloor at end of train. One unit per four car set.
Waratah	Horn testing	Town $L_{1(1min)}$ 136 dBA Country $L_{1(1min)}$ 145 dBA	Underfloor at end of train.
Waratah	DVA testing	$L_{eq(15min)}$ 91 dBA	Distributed along both sides of train, four locations per side per car.
Diesel locomotive	Moving at 8km/h	$L_{eq(15min)}$ 107 dBA	Primarily noise sources from engine bay and exhaust.
Diesel locomotive	Idle	$L_{eq(15min)}$ 103 dBA	Primarily noise sources from engine bay and exhaust.

Note 1: Waratah (A-set) noise emissions have been used to represent emissions from the NIF.

The directionality of the noise sources has also been included as presented in Table 6.3. The directionality is based on previously published stabling and maintenance facility assessments and Asset Standards Authority (ASA) requirements where applicable.

Table 6.3 Source directivities, adjustment by angle (dBA)

LOCATION OF SOURCE	0°	45°	90°	135°	180°	NOTES
Top of train	0	0	0	-9	-15	0 degrees is defined straight up from top of train
Bottom of train	-12	-5	0	-5	-12	0 degrees is defined as perpendicular to the track
Horn[1]	0	-4.5	-8	-10	-11	0 degrees is parallel with the track

Note 1: directionalities of the country and yard horn have been taken from Asset Standards Authority, T-HR-RS-00100-ST RSU 100 Series – Minimum Operating Standards for Rolling Stock – General Interface Standards

PREDICTED NOISE LEVELS

Noise levels were predicted for the assessment scenarios at the nearest NCAs to the commissioning activities. A summary of the predicted $L_{eq(15min)}$ noise levels is presented in Table 6.4.

Cells have been highlighted grey where they exceed the night PSNL, green where they exceed the evening PSNL and orange where they exceed the day PSNL.

Table 6.4 Predicted noise levels at nearest sensitive receivers

NCA	PSNL $L_{eq(15min)}$ dBA			Scenario noise level $L_{eq(15min)}$ dBA					
	Day	Evening	Night	1	2	3	4	5	6
A	59	48	41	41	32	<30	<30	<30	<30
B	53	47	37	35	<30	<30	<30	<30	<30
C	65	65	65	<30	33	34	<30	37	30
D	50	47	44	46	59	56	52	52	52
F	48	46	43	<30	<30	<30	<30	<30	<30
G	52	47	39	37	36	32	31	33	<30

ASSESSMENT AND DISCUSSION

The predicted noise levels in Table 6.4 indicate that the activities would exceed the PSNLs in NCA D. All other NCAs are not expected to receive noise levels above the PSNLs.

For NCA D Scenarios 2 to 6 all exceed the day, evening and night PSNLs and scenario 1 exceeds the night PSNLs.

The most substantial noise sources are the diesel locomotives that are used to haul and propel the NIF trains within the facility, train horns and simultaneous commissioning activities on five trains occurring within the sheds.

For activities that occur within the shed, the assumptions are based on activities taking place on five NIF trains at once, which is a worst case assumption. In reality, the commissioning activities in any 15 minute period are unlikely to include the same activity occurring simultaneously on all five trains.

The use of diesel locomotives is expected to occur only over the first few months prior to NIF being approved to operate on the network. Therefore the potential impact of diesel trains would be term and would be limited to a few months of locomotives operating in the precinct prior to the type approval and after this only when locomotives delivered trains.

The commissioning activities (scenarios 4 to 6) that occur within the sheds are operational activities that are expected to occur over the course of four years. Impacts associated with the commissioning activities are expected during the day, evening and night when they occur. Whilst they will not form part of the permanent operations of the facility as the operations will occur over a number of years, they are considered to have similar impacts as a permanent operation.

A detailed review of the predicted noise levels indicate that noise levels within NCA D vary between less than 30 dBA at the receivers on Henderson Road to the worst case predicted noise levels presented in Table 6.4 for the receivers at the boundary of the facility. The existing buildings within NCAD provide good acoustic shielding to those receivers located behind them. This indicates that the impact of the noise levels above the PSNLs is limited to the first two rows of residential properties adjacent to the facility.

The nearest residential receivers in NCA D were constructed after the current configuration of the Eveleigh facility was established. AS 2107 specifies noise levels in sleeping areas at night should be between $L_{eq(15min)}$ 35 and 40 dBA.

Due to the fact that the receivers were built adjacent to an industrial facility, receivers would have a ventilation system sufficient to allow windows to be closed at night. Assuming a correction of 20 dBA for a

closed façade, the internal $L_{eq(15min)}$ noise levels would all be less than 40 dBA, indicating that an acceptable level of noise can be achieved within the nearest residential buildings.

However, the predicted worst case noise levels indicate operational noise levels above the PSNLs would only occur at NCA D for both the temporary use of locomotives within the facility in addition to commissioning activities which are expected to occur over four years. As a result, mitigation measures should be considered to reduce external noise levels towards the PSNLs where reasonable and feasible.

SLEEP DISTURBANCE

For the horn testing, the sleep disturbance screening criteria as described in Section 5.3 are the most appropriate criteria. The predicted maximum noise levels at the nearest receivers in NCA D from testing the horns in the Millennium Shed are as follows:

- country horn: L_{max} 106 dBA
- town horn: L_{max} 97 dBA.

These predicted noise levels are in excess of the 65 dBA sleep disturbance screening criterion for the nearest receivers. Where receivers close their windows at night, this translates to an internal noise level of 86 and 77 dBA for country horns and town horns respectively. These noise levels are in excess of the maximum internal noise levels discussed in Section 5.3.

Horns are currently used at the facility with some testing occurring on the network in the vicinity of Redfern station. The proposed commissioning activities are likely to require similar usage of horns within the facility. Whilst the predicted noise levels are above the screening criteria, the use of horns for commissioning activities is not considered to increase the frequency or noise level above that of the existing horns used on the site.

However, in consideration of the predicted exceedances of the sleep disturbance screening criteria, mitigation and management measures should be considered for implementation as described in the Noise Mitigation and Management section.

NOISE MITIGATION AND MANAGEMENT

As there are predicted exceedances of the PSNLs, feasible and reasonable mitigation should be investigated to reduce the noise emission towards the PSNLs in NCA D. Noise management and mitigation measures should include consideration of the following:

- scheduling commissioning activities to reduce the number of trains that are conducting noise intensive activities at the same time
- scheduling noise intensive commissioning activities such as brake and Digital Voice Announcements testing during the day and evening time
- scheduling use of diesel locomotives for shunting in the facility to avoid night time period
- use locomotives in lowest permissible power/notch setting within facility
- shutting off diesel locomotives when not in use
- stand idling locomotive immediately behind train wash in front of 3801 Limited shed to shield the locomotive from the residential receivers
- allocate a place for diesel locomotives to stand and idle, if required in a location that is shielded from the nearest residential receivers
- adopt a similar horn testing regime as currently in place at Eveleigh, such as testing country and town horns on the network
- utilise existing building / structures (e.g. train wash, Australian Technology Park, other trains) to shield residential receivers from noise from standing locomotives, when it does not significantly impact the operation of the Precinct or as directed by the Eveleigh Precinct Manager.

In addition, where intensive night time commissioning activities are planned that may exceed the night PSNLs, it is recommended that the community in NCA D be informed at least 24 hours in advance.

Table 6.5 presents the potential reductions in noise level that could be achieved for the applicable mitigation measure.

The measures shown in the table indicated significant reductions in the noise levels and in some cases, compliance with the PSNLs can be achieved through applying the measures.

It is recommended that an operational management plan is developed to include these measures to reduce the potential noise emissions within practical operational centralists.

Table 6.5 Effectiveness of mitigation measures

SCENARIO	MANAGEMENT MEASURE	POTENTIAL REDUCTION dB	PREDICTED LEVEL IN NCA D WITH MITIGATION MEASURE $L_{EQ(15MIN)}$ dBA	PERIODS OF COMPLIANCE[1]
1	Use stabled train to shield nearest receivers	5-7	41	Day Evening Night
2	Use stabled train to shield nearest receivers	5-7	52	Day (marginal)
3	Use stabled train to shield nearest receivers	5-7	49	Day Evening (marginal)
	Stand idling locomotive in front of EMC	30	<30	Day Evening Night
	Stand idling locomotive behind train wash	13	43	Day Evening Night
4	Use stabled train to shield nearest receivers	5-7	45	Day Evening Night (marginal)
	3 trains powered up with all services running	3	49	Day Evening (marginal)
	2 trains powered up with all services running	5	47	Day Evening
	1 train powered up with all services running	6	46	Day Evening Night (marginal)
	3 trains powered up with all services running and stabled train to shield nearest receivers	7	42	Day Evening Night
5	1 train only undertaking brake testing	6	46	Day Evening Night (marginal)
	Use stabled train to shield nearest receivers	5-7	47	Day Evening

SCENARIO	MANAGEMENT MEASURE	POTENTIAL REDUCTION dB	PREDICTED LEVEL IN NCA D WITH MITIGATION MEASURE $L_{EQ(15MIN)}$ dBA	PERIODS OF COMPLIANCE[1]
6	1 train only undertaking DVA testing	6	46	Day Evening Night (marginal)
	Use stabled train to shield nearest receivers	5-7	45	Day Evening Night (marginal)

Note 1: A marginal compliance is where the predicted noise level is 2 dB or less above the PSNL. According to Chapter 11 of the INP, a noise level of more than 2 dB above the PSNL is considered an exceedance for compliance purposes.

6.4 Maintenance and stabling activities

After the NIF trains have been commissioned and enter regular service, the Eveleigh facility will be used as a maintenance and stabling facility where Level 1 and 2 maintenance will be carried out regularly. This is expected to include:

- internal and external cleaning
- minor works such as replacing seats, changing wiper blades and minor repairs to compressors
- preparation of trains for service
- pantograph maintenance
- repair and replacement of air conditioning units.

In addition, occasional Level 3 maintenance would be carried out. This includes more extensive repairs such as changing bogeys.

All of these activities are currently carried out within the Oscar and Millennium Sheds routinely. The location, operating times and activities are not expected to substantially change when the NIF are maintained at the facility.

The extension of the OHW in the Millennium Shed as part of the NIF changes to the facility are not expected to generate additional noise impacts as their purpose is to allow the trains to move further into the shed. Therefore no significant increase in noise impact is expected to result from the maintenance of the NIF compared with the existing situation with Millennium and Oscar sets.

The NIF trains will be subject to the same noise emission standards as the current rolling stock. Therefore there is not expected to be any additional noise impacts associated with stabling the NIF at the facility.

The maintenance and stabling operations should continue to be managed in line with current noise management practices at the facility.

6.5 Other operational changes

In addition to the maintenance and commissioning activities, occurring within the Millennium Shed (subject site 2) the changes associated with subject site 2 and 3 also have the potential to increase the impact of the development.

SUBJECT SITE 1 – ENGINEERING ROADS 1 AND 2

The changes at subject site 1 include a small extension of the existing Engineering Roads and extending the water pipeline and the installation of an additional decant point.

The extension of engineering roads 1 and 2 by 49 metres to the west is not expected to significantly change the noise levels experienced by the nearest sensitive receivers. The nearest receivers to the in NCA F are over 415 metres away. The end of the Engineering Roads being 49 metres closer would change the noise emission by less than 1 dB which is not considered acoustically significant. A change of 3 dB or more is typically considered to be the smallest change in noise that the average person can perceive.

Receivers in NCA G are located across the rail corridor from the engineering roads. The extension of the engineering road is expected to move 45 metres closer to the closest receiver. There is an existing noise wall along the northern boundary of the rail corridor that is more than 4 metres in height above the existing rail corridor. The noise wall blocks line of sight and provides significant shielding for these receivers and as a result, additional significant noise impacts are not expected to occur at these receivers.

Based on the above, no additional operational noise impacts are expected as a result of the proposed changes at subject site 1.

SUBJECT SITE 3 – EXTENSION OF EASTERN SIDING

The Eastern Siding is proposed to be extended by 26 metres to the east. This would bring standing trains closer to the residential receivers in NCA B. The residential receivers are currently approximately 150 metres from the end of the eastern siding. This is predicted to result in an increase to the existing noise level of less than 2 dBA. This change is not considered acoustically significant and no additional operational impacts would be expected as a result of the changes to the siding.

6.6 Operational vibration assessment

Significant operational vibration is not expected to be generated from the proposed activities and no further assessment is required.

7 CONSTRUCTION NOISE ASSESSMENT

7.1 Assessment scenarios

The proposed changes to the facility at the three subject sites are to be conducted in stages. The details of construction have been based on the staging and activities presented in the Constructability Feasibility and Staging Report (GHD June 2016 Draft version C ref: 2125210-215812).

The most significant noise generating stages have been identified for assessment. Table 7.1 presents the assessed scenarios for each subject site. According to the constructability report, the duration of the works is expected to take between 3 and 4 months for each subject site.

Where works on the OHW are required, a track possession is necessary. Track possessions typically take place during periods of less operational activity such as at weekends and during the night. At this the timing of the possessions cannot be confirmed and therefore it has been assumed that it may take place during the night period in order to minimise potential disruption to operations.

Table 7.1 Construction assessment scenarios

SUBJECT SITE	SCENARIO ID	ACTIVITY	TIME OF DAY[1]
1	1A	Site establishment	Standard hours
	1B	Demolition of existing buildings	Standard hours
	1C	Demolition of existing slabs and rail tracks	Standard hours
	1D	Install new slab footings and tracks	Standard hours and out of hours works
	1E	Extension of decant facility piping	Standard hours
	1F	Installation of new OHW for extended tracks	Standard hours and OOHW
	1G	Relocation of buffer stops and associated infrastructure.	Standard hours
2	2A	Site establishment	Standard hours
	2B	Installation of new OHW in the Millennium Shed	Standard hours and OOHW
	2C	Demolish old OHW footings and dispose	Standard hours
3	3A	Site establishment	Standard hours
	3B	Relocate heritage train	Standard hours
	3C	Demolish existing footings	Standard hours
	3D	Install new footings and tracks	Standard hours
	3E	Relocation of buffer stops and associated infrastructure	Standard hours
	3F	Install new OHW for extended tracks	Standard hours and OOHW

Note 1: Time periods are those defined by the ICNG in Section 5.2.

7.2 Assessment method

Noise levels from construction activities have been predicted at the nearest receiver types in each NCA as presented in Table 3.1. As a worst case scenario, each item of plant in the scenario has been assumed to be operating simultaneously and at the closest point to the receiver.

The prediction accounted for the attenuation due to distance and shielding from topography and intervening structures. The calculation also accounted for air absorption in accordance with *ISO 9613 Part 1 Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere* (ISO 9613-1).

In addition, certain activities are specified by the ICNG to require the addition of 5 dB to the predicted level to account for the “annoying” characteristics of the noise produced. These activities include jackhammering and steel cutting.

7.3 Noise source levels

The noise sources levels for each item of plant used in each scenario are presented in Table 7.2. Noise levels were sourced from *AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436), *UK Department of Environment, Food and Rural Affairs Construction Noise Database* and WSP | Parsons Brinckerhoff database.

Table 7.2 Construction equipment sound power levels

PLANT	PLANT SWL dBA	USAGE FACTOR	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	3A	3B	3C	3D	3E	3F
Trucks	107	10%	X	X	X	X				X			X		X			
Mobile crane	104	75%	X			X		X	X	X	X		X			X		X
Excavator mounted hammer[1]	113	25%		X														
Backhoe	100	75%		X			X								X			
Loader	107	75%		X	X													
Jackhammer[1]	112	25%		X	X							X						
Power tools	105	25%			X							X						
Hand tools	100	50%			X		X	X	X		X			X		X	X	
Rail cutting saw[1]	119	25%			X	X									X			
Concrete trucks	107	50%				X												
Tractor/truck rail installer	110	75%				X										X		
Hiab truck	105	75%					X							X			X	
Hi-rail cherry picker	105	75%						X			X	X						X
Overhead wire truck	104	75%						X			X							X
Compactor	110	75%				X										X		
Vibratory roller[1]	102	75%				X										X		
Compressor	94	75%			X	X										X		
Rail tamper[1]	114	50%				X										X		
Ballast tamper[1]	115	50%														X		
Light tower	85	100%				X		X		X								X
		Total SWL	104	116	120	120	106	108	104	104	108	114	104	105	118	122	105	108

Note 1: These items require a +5 dB correction to be added in accordance with the ICNG.
Note 2: The total sound power level is calculated as a logarithmic sum of all of the equipment and includes the usage percentage for each item.

7.4 Predicted noise levels

Table 7.3 and Table 7.4 presents the predicted worst case construction noise levels for Subject Sites 1 and 2 and 3 respectively. Cells have been shaded to indicate exceedance of the NMLs for the applicable time period as follows: orange for day (SH), yellow for day (OOHW), green for evening (OOHW) and grey for night (OOHW).

Table 7.3 Predicted noise levels for subject site 1 construction activities

NCA	Noise Management Level				Predicted noise level $L_{eq(15min)}$ dBA					
	Day	Day	Evening	Night	1A	1B	1C	1D	1E	1F
	SH	OOHW	OOHW	OOHW	SH	SH	SH	SH, OOHW	SH	SH, OOHW
A	64	59	48	47	42	54	58	58	44	46
B	58	53	51	51	38	50	54	54	40	42
C	70	70	70	70	53	65	69	69	55	57
D	55	50	47	44	30	42	46	46	32	34
E	70	70	70	70	25	37	41	41	<30	<30
F	53	48	46	43	35	47	51	51	37	39
G	57	52	47	47	52	64	68	68	54	56
H	70	70	70	70	58	70	74	74	60	62

Note 1: SH = Recommended standard working hours. OOHW = outside of recommended standard hours work as defined in Table 5.3.

Note 2: Cells have been shaded for exceedances of the applicable time periods as follows: orange for day (SH), yellow for day (OOHW), green for evening (OOHW) and grey for night (OOHW).

Table 7.4 Predicted noise levels for subject sites 2 and 3 construction activities

NCA	Noise Management Level				Predicted noise level $L_{eq(15min)}$ dBA								
	Day	Day	Evening	Night	2A	2B	2C	3A	3B	3C	3D	3E	3F
	SH	OOHW	OOHW	OOHW	SH	SH, OOHW	SH	SH	SH	SH	SH	SH	SH, OOHW
A	64	59	48	47	<30	<30	<30	51	52	65	69	52	55
B	58	53	51	51	<30	<30	33	54	55	68	72	55	58
C	70	70	70	70	53	57	63	82	83	96	100	83	86
D	55	50	47	44	55	59	65	<30	<30	36	40	<30	<30
E	70	70	70	70	43	47	53	<30	<30	<30	33	<30	<30
F	53	48	46	43	<30	31	37	<30	<30	<30	31	<30	<30
G	57	52	47	47	<30	<30	34	31	32	45	49	32	35
H	70	70	70	70	33	37	43	45	46	59	63	46	49

Note 1: SH = Recommended standard working hours. OOHW = outside of recommended standard hours work as defined in Table 5.3.

Note 2: Cells have been shaded for exceedances of the applicable time periods as follows: orange for day (SH), yellow for day (OOHW), green for evening (OOHW) and grey for night (OOHW).

7.5 Assessment of predicted noise levels

The worst case predicted noise levels indicate the following impacts at subject site 1:

- exceedance of the day NMLs in NCA G for scenarios 1B, 1C, 1D
- exceedance of the day (OOHW), evening and night NMLs in NCAs G for scenario 1F
- exceedance of the commercial NML in NCA H for scenario 1C and 1D
- in addition to the above, scenario 1D is also expected to exceed the day NML in NCA F, day OOHW in NCA B, evening NML in NCA A and F and the night NMLs in NCA A, D and F.
- all other scenarios are not expected to impact the NCAs.

As a result, noise levels are within acceptable levels during standard hours for residential NCAs except NCA G. Where work occurs outside of standard hours at subject site 1, additional impacts are predicted NCAs in A, B, D and F.

For subject site 2, the following impacts are expected:

- exceedance of the day, evening and night NMLs in NCA D for scenario 2B and 2C
- exceedance of the night NML in NCA E for scenario 2B
- all other NCAs are not expected to be impacted by the works.

Due to the proximity of the works at subject site 2 to NCA D, the predicted noise levels are higher than other NCAs and impacts are expected for NCA D when works are carried out at any time of the day, evening and night. NCA E is only potentially affected during the night. Exceedances of the noise management levels are not expected at other NCAs for works at subject site 2 carried out at any time of day, evening and night.

For subject site 3, the following impacts are expected:

- exceedance of the day NMLs in NCAs A and B for scenarios 3C and 3D
- exceedance of the evening and night NMLs in NCAs A and B in scenario 3F
- large exceedances of the commercial NML in NCA C
- compliance with the NMLs for all other NCAs.

The works at subject site 3 are on the border of NCA C and therefore the highest impacts are predicted in this NCA. The closest residential NCAs are NCA A and B where noise levels during the evening and night are predicted to exceed the noise management levels for scenario 3F. Predicted noise levels were all within acceptable levels for all other residential NCAs and scenarios.

Predicted noise levels at receivers were not predicted to be above the highly noise affected level at any subject site and scenario.

7.6 Sleep disturbance

For the assessment of the potential for sleep disturbance, a +5 dB was added to the predicted $L_{eq(15min)}$ levels predicted in Table 7.3 and Table 7.4 to approximate a maximum noise level emission from the activity.

The assessment of the potential of sleep disturbance consider residential properties affected by work carried out during the night period only.

Table 7.5 presents the predicted noise levels during scenarios that occur during the night for residential NCAs. Cells are highlighted grey where the screening criterion is exceeded.

Table 7.5 Sleep disturbance assessment for residential NCAs

NCA	Sleep disturbance screening criteria	Predicted noise level $L_{max(15min)}$ dBA			
	Night	1D	1F	2B	3F
	OOHW	OOHW	OOHW		
A	65	63	51	<35	60
B	65	59	47	<35	63
D	65	51	62	64	<35
F	65	56	<35	36	<35
G	65	73	44	<35	40

A review of the predicted noise levels indicates that the sleep disturbance screening criteria were exceeded in NCA G for scenario 1D. The predicted internal noise level, assuming a partially open window is 63 dBA. The latest available guidance on sleep disturbance (contained within the RNP) indicates that one or two events between 65 and 70 dBA would be unlikely to have any notable health or wellbeing effects.

With closed windows, an additional 10 dBA reduction of external noise can be expected. This would mean an internal noise level of 53 dBA could be achieved which is below the level at which sleep disturbance is typically considered likely.

Mitigation measures should be implemented to minimise the chance of maximum noise levels occurring as a result of the construction works. In addition, residents should be made aware of the potential for sleep disturbance so that they may be able to close their windows where possible.

8 CONSTRUCTION VIBRATION ASSESSMENT

The significant vibration generating equipment is expected to be as follows:

- excavator mounted hammer
- jackhammers
- vibratory rollers/compactors.

The Transport for NSW CNS includes safe working distances for human comfort and building damage as for the above equipment. Using these safe working distances, the potential for impacts to heritage items was extrapolated.

Table 8.1 presents the indicative safe working distances for cosmetic damage for standard and heritage structures in addition to human comfort.

Site specific safe working distances should be developed on site as the propagation of vibration is highly dependent on local ground conditions and specific equipment being used. Where work is proposed within the safe working distances, mitigation and management measures should be implemented to ensure that vibration can be controlled to appropriate levels.

The condition of the heritage items must be considered when setting vibration limits for construction works. Structures such as heritage industrial buildings which are structurally sound should not necessarily be considered more vibration sensitive than other structures.

Table 8.1 Indicative safe working distances for construction vibration

PLANT ITEM	RATING	SAFE WORKING	DISTANCES (m)	
		Cosmetic damage (BS 7385)	Cosmetic damage for heritage items[1] (DIN 4150)	Human comfort
Vibratory roller	<50kN (1-2 tonnes)	5	15	15-20
	<100kN (2-4 tonne)	6	20	20
Hydraulic hammer	(300kg 5-12t excavator)	2	6	7
Jackhammer	Hand held	1	5	Avoid contact with structure

Note 1: Heritage items should be assessed on a case by case basis and the condition of the items considered when setting vibration limits.

9 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

A construction noise and vibration management plan (CNVMP) should be developed for the project, prior to commencement of works. The management plan would utilise detailed construction methodologies of the contractor. The management plan would include (but is not limited to) the following:

- identified nearby residences and other sensitive land uses
- approved hours of work and what work would be undertaken
- dominant noise and vibration generating activities
- details of noise mitigation and management measures to be applied
- information for worker training to minimise noise impacts
- community consultation protocol(s)
- complaints handling protocol(s)
- construction works should be planned and carried out during standard construction hours wherever possible.

Table 9.1 presents the standard mitigation measured contained within the Transport for NSW *Construction Noise Strategy* (CNS) which should be considered as mitigation measures as part of the noise management plan.

Table 9.1 Transport for NSW *Construction Noise Strategy* standard mitigation measures

ACTION REQUIRED	DETAILS
Management measures	
Implement any project specific mitigation measures required	In addition to the measures set out in this table, any project specific mitigation measures identified in this report.
Implement community consultation measures	Periodic notification (monthly letterbox drop or equivalent), website, project Infoline, Construction Response Line, email distribution list.
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction.
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Noise Monitoring	A noise monitoring program is to be carried out for the duration of the works in accordance with the *Construction Noise and Vibration Management Plan* and any approval and licence conditions.
Source controls	
Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period	High noise and vibration generating activities may only be carried out in continuous blocks, not exceeding three hours each, with a minimum respite period of one hour between each block.
Equipment selection	Use quieter and less vibration emitting construction methods where feasible and reasonable.

ACTION REQUIRED	DETAILS
Maximum noise levels	The noise levels of plant and equipment must have operating sound power or sound pressure levels that would meet the predicted noise levels.
Rental plant and equipment	Noise emissions should be considered as part of the selection process.
Use and siting of plant	Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Plant and vehicles to be turned off when not in use. Noise-emitting plant to be directed away from sensitive receivers.
Plan works site and activities to minimise noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the facility.
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on the facility and for any out-of-hours work.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Path controls	
Shield stationary noise sources such as pumps, compressors, fans etc.	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

In addition to the standard mitigation measures identified in the Transport for NSW CNS, the following specific mitigation measures have been developed as a result of the predicted impacts associated with the proposal.

To minimise noise levels, the work practices in Table 9.1 practices should be implemented in addition to minimising the potential for construction vehicles to access the facility prior to 7am.

To minimise the risk of vibration impacts, the following is recommended:

- ensure that safe working distances are complied with
- where work is required within the distance, site-specific safe working distances are to be established on-site prior to the relevant vibration generating works commencing
- where possible, the use of less vibration intensive methods of construction or equipment should be considered where possible to reduce the potential for cosmetic damage
- all equipment should be maintained and operated in an efficient manner, in accordance with manufacturer's specifications, to reduce the potential for adverse vibration impacts
- if vibration intensive equipment is to be used within the safe working distances, vibration measurements are to be undertaken when work commences

- assess the condition of heritage items to assign the appropriate vibration limits and set safe working distances
- conduct building condition surveys of buildings before and after works where work inside the safe working distances is required.

To minimise the potential for sleep disturbance, where night works are proposed to be undertaken, the following controls should be implemented where feasible and reasonable:

- avoid conducting noise intensive night works for more than two consecutive nights
- schedule noise intensive activities to before 10pm
- schedule activities which are likely to cause maximum noise events such as deliveries, moving material or equipment and compacting works to avoid the night time period (10pm to 7am)
- avoid dropping tools or materials from height, striking materials, dragging materials or making metal on metal contact
- educate workers on the importance of minimising noise and avoid creating short duration high noise level events
- inform surrounding residents by mail of planned works prior to the works commencing.

Table 9.2 provides an indicative benefit of typical mitigation measures for construction activities, based on guidance in AS 2436 and experience on similar construction projects.

Table 9.2 Indicative noise reduction from construction controls

MANAGEMENT AND ENGINEERING CONTROLS	POSSIBLE NOISE BENEFIT, dBA
Noise Management Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers.	3-6
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.	2-5
Orienting equipment away from sensitive receivers.	3-5
Carrying out loading and unloading away from sensitive receivers.	3-5
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting Facility access points and roads as far as possible away from sensitive receivers	3-6
Using spotters, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms	N/A

9.1 Application of additional mitigation measures

According to the Transport for NSW CNS, where there is potential for a project's construction noise objectives to be exceeded, a number of additional measures to mitigate such exceedances should be explored. The additional mitigation measures matrix is primarily aimed at pro-active engagement with affected receivers.

Table 9.3, reproduced from the Transport for NSW CNS, outlines what measures may apply depending on the level by which the predicted noise levels exceed the measured RBLs, and the time of the day.

Additional mitigation measures that may be applicable to affected receivers include letterbox drops, noise monitoring, individual briefings, phone calls, specific notifications, proposal specific respite offers and alternate accommodation. Specific additional mitigation measures would be identified for affected receivers at the CNVMP stage of the project.

Table 9.3 Application of mitigation measures in addition to Transport for NSW *Construction Noise Strategy* standard mitigation measures

Period	Time and day	$L_{eq\ (15min)}$ noise level above background (RBL) noise levels Qualitative assessment			
		0 to 10 dBA Noticeable	10 to 20 dBA Clearly audible	20 to 30 dBA Moderately intrusive	> 30 dBA Highly intrusive
Standard	Mon-Fri (7.00am-6.00pm) Sat (8.00am-1.00pm) Sun/Pub (Nil)	-	-	Letterbox drops, monitoring	Letterbox drops, monitoring
OOHW Period 1	Mon-Fri (6.00pm-10.00pm) Sat (1.00pm-10.00pm) Sun/Pub (8.00am-6.00pm)	-	Letterbox drops	Monitoring, letterbox drops	Monitoring, individual briefings, letterbox drops, project specific respite offer, phone calls, specific notifications.
OOHW Period 2	Mon-Fri (10.00pm-7.00am) Sat (10.00pm-8.00am) Sun/Pub (6.00pm-7.00am)	Letterbox drops	Monitoring, letterbox drops	Monitoring, individual briefings, letterbox drops, phone calls, specific notifications.	Alternative accommodation, monitoring, individual briefings, letterbox drops, phone calls, specific notifications.

10 OFF SITE ROAD TRAFFIC NOISE

The potential for the proposal to generate additional traffic on the surrounding roads has been considered.

As the operations of the maintenance facility are not expected to significantly change, the road traffic generated by the facility is also not expected to significantly increase.

During construction, additional vehicles would need to access the facility for employees, equipment and material deliveries.

For works at subject site 1 and 2, access to the sites would be via the existing driveway on Railway Parade. For subject site 3, the access would be off Cornwallis Street. It is envisaged that construction employee would access the facility and utilise existing parking facilities at the main entrance off Railway Parade.

The potentially affected roads would be Railway Parade, Henderson Road, and Cornwallis Street. Other major roads in the vicinity which would provide access include Gibbon Street, Botany Road and Swanson Street.

The RNP criteria for traffic generating developments is limited to an increase of 2 dBA or less above the existing traffic noise levels. In order to generate an increase of more than 2 dBA, the traffic volume needs to increase by more than 60%. Given the small size and scale of the proposed construction works, an increase of more than 60% of the total traffic volumes on any of the project related roads is not considered likely. Therefore the risk of adverse impacts from construction traffic is considered low.

11 SUMMARY OF ENVIRONMENTAL NOISE AND VIBRATION IMPACTS

The predicted impacts with the mitigation recommended in Sections 6.3 and 9 as a result of the proposal have each been assigned a rating. The rating considers the likelihood of the impact occurring and the magnitude of the impact on the receiving environment. The ratings are defined where one or more of the following conditions are satisfied:

- *negligible*: where the predicted changes are not sufficient to affect ambient noise or vibration levels beyond natural variations
- *minor*: where there is predicted to be some level of generated noise and vibration or there is a perceptible change that would occur for less than a week during construction and is generally below the operational criteria
- *moderate*: where there is predicted to be a perceptible change in noise and vibration lasting more than a week, an exceedance of the 'noise affected' noise management levels, the potential for sleep disturbance to occur at some point or the potential for ground-borne vibration to cause cosmetic damage or to result in 'annoyance' at some point during construction
- *major*: where there is predicted to be a notable change in noise and vibration lasting more than three weeks, an exceedance of the 'highly noise affected' construction noise management levels, the risk of long-term sleep disturbance or an accepted certainty that ground-borne vibration would have an impact on people or buildings.

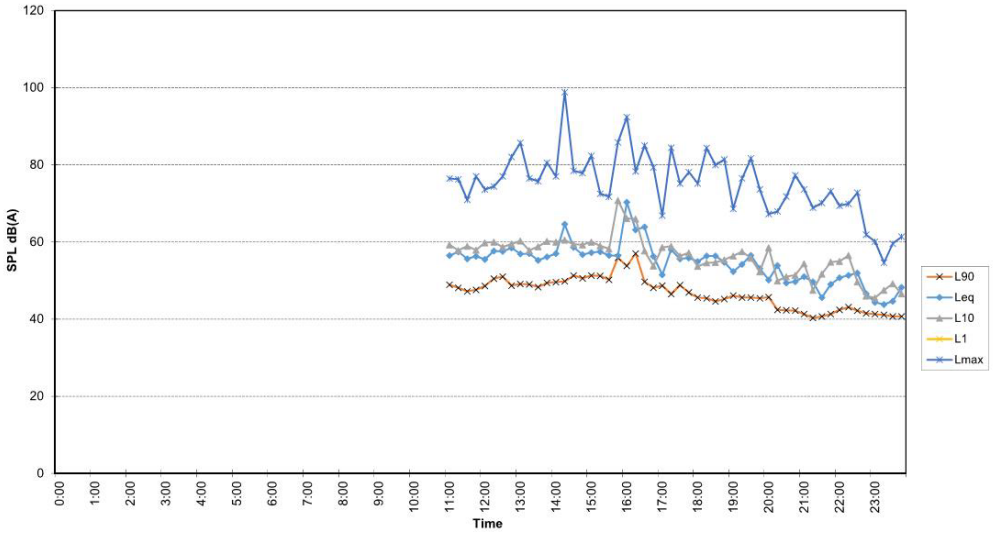
Table 11.1 Summary of noise and vibration impacts using recommended mitigation

SOURCE	ASSESSED IMPACT	RECOMMENDED MITIGATION
Operational noise daytime	Minor	See section 6.3
Operational noise: evening	Minor to moderate	See section 6.3
Operational noise: night	Moderate	See section 6.3
Operational noise: sleep disturbance	Moderate to major	See section 6.3
Operational vibration	Negligible	Not applicable
Operational road traffic	Negligible	Not applicable
Construction noise: standard hours	Minor to major	See Section 9
Construction noise: outside of standard hours	Minor to major	See Section 9
Construction vibration: building damage	Minor	See Section 9
Construction vibration: human perception	Minor	See Section 9
Construction road traffic	Minor	See Section 9

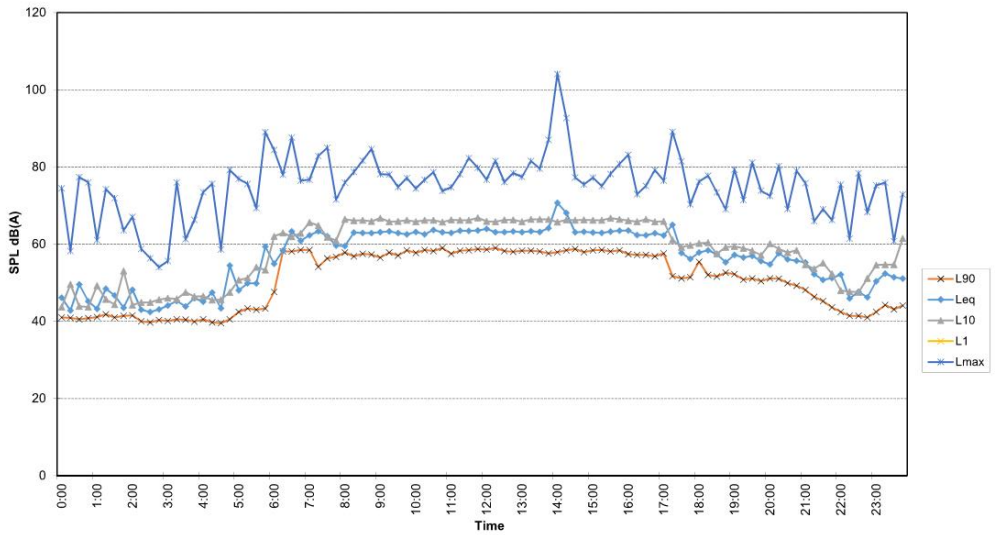
APPENDIX A

NOISE MONITORING DATA

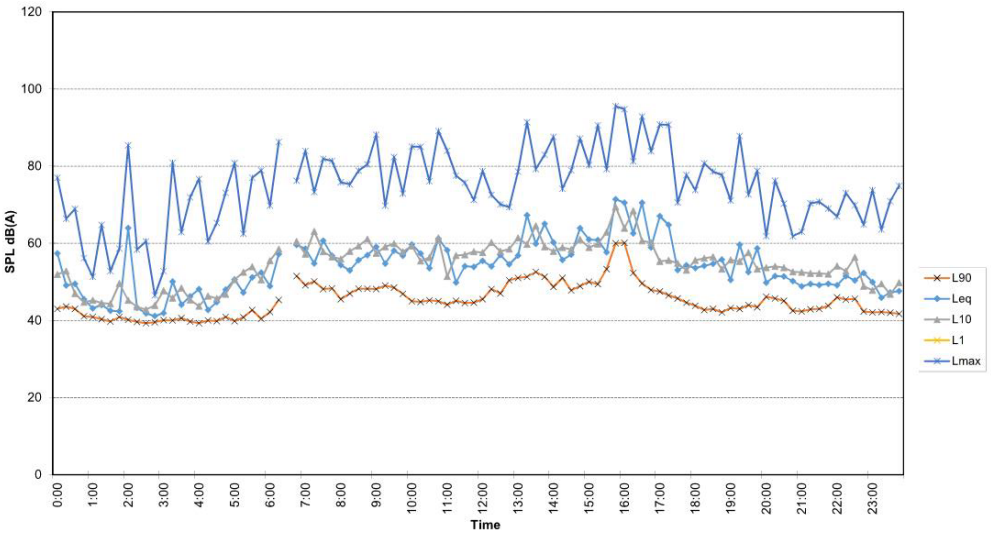
Location - BG4 NCA D
Measured Noise Levels - Monday 21/11/2016



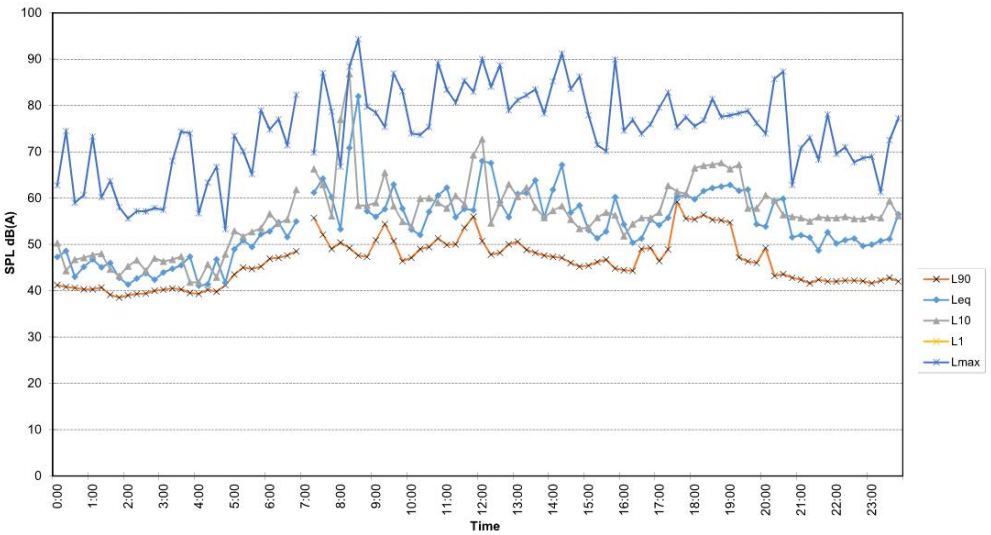
Location - BG4 NCA D
Measured Noise Levels - Tuesday 22/11/2016



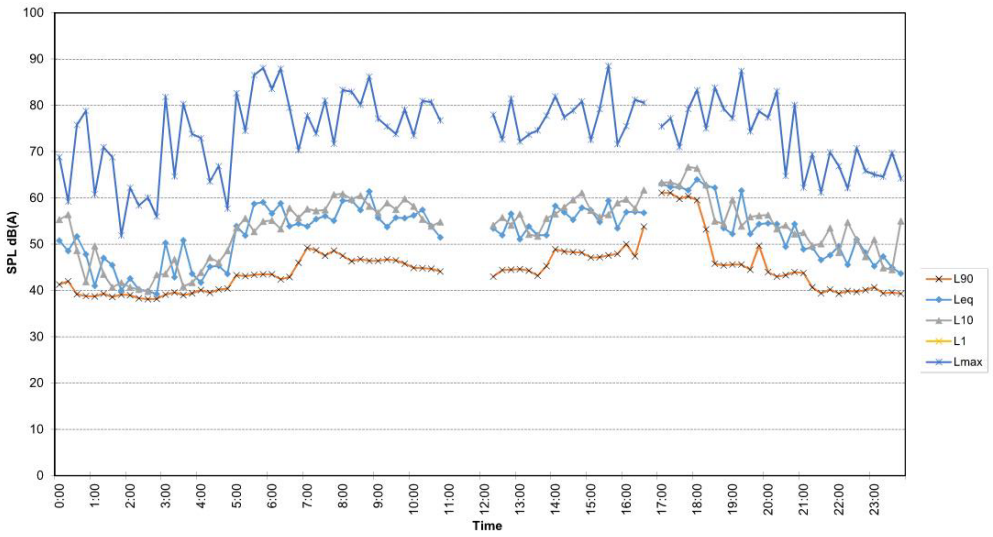
Location - BG4 NCA D
Measured Noise Levels - Wednesday 23/11/2016



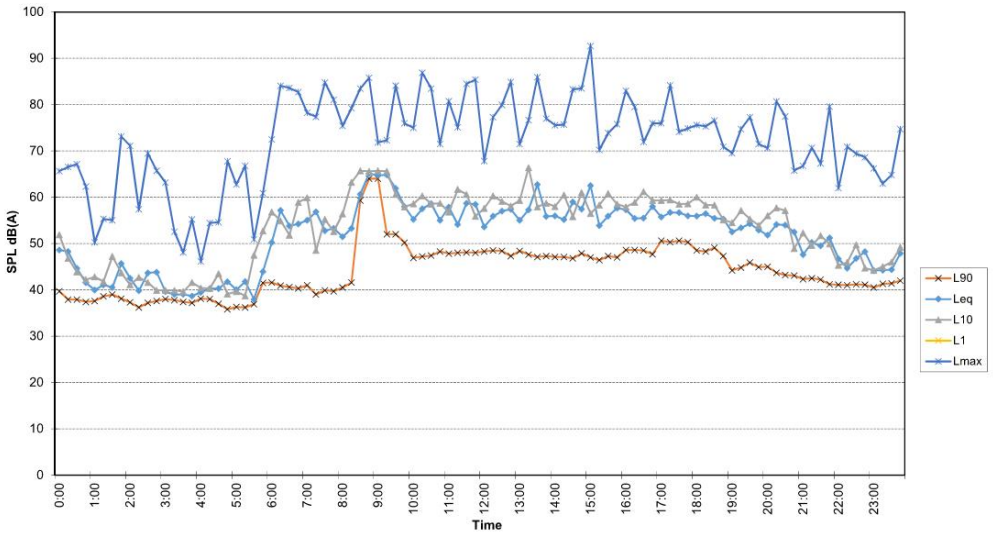
Location - BG4 NCA D
Measured Noise Levels - Thursday 24/11/2016



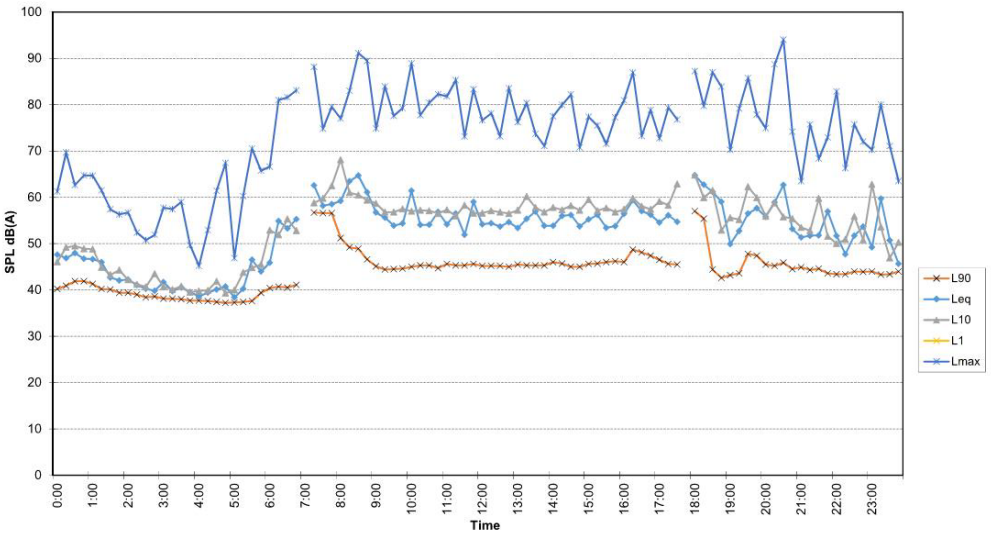
Location - BG4 NCA D
Measured Noise Levels - Friday 25/11/2016



Location - BG4 NCA D
Measured Noise Levels - Saturday 26/11/2016



Location - BG4 NCA D
Measured Noise Levels - Sunday 27/11/2016



Location - BG4 NCA D
Measured Noise Levels - Monday 28/11/2016