

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

Moorebank Precinct West Stage 1

01 DECEMBER 2020

SYDNEY INTERMODAL TERMINAL ALLIANCE

Moorebank Precinct West Stage 1

Construction Noise and Vibration Management Plan

Current Revision Author Madeleine Watson-Reeves

Checker Anthony Lusher

Approver Anthony Lusher

Report No MIC1-QPMS-EN-PLN-00008

Date 1/12/2020

Revision Text SIMTA.005

Author Details

Author Details	Qualifications and Experience
Alexander Mendoza Acoustic Consultant (Day Design Pty Ltd)	MDesSc (Audio and Acoustics)

REVISIONS

Revision	Date	Description	Prepared by	Approved by
Draft	23.07.2016	By email, for client review (Day Design Documents)	AM	WW
Draft 2	10.08.2016	By email, for client review (Day Design Documents)	AM	WW
Draft 3	31.08.2016	By email, for client review (Day Design Documents)	AM	SG
Draft 4	01.09.2016	By email, for client review (Day Design Documents)	AM	SG
Final	15.09.2016	By email, for client review (Day Design Documents)	AM	SG
Rev A	28.09.2016	(Day Design Documents)	AM	SG
Rev B	15.11.2016	(Day Design Documents)	AM	WW

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN



Revision	Date	Description	Prepared by	Approved by
Rev C	18.11.2016	(Day Design Documents)	AM	WW
Rev D	15.12.2016	(Day Design Documents)	AM	SG
Rev E	10.01.2017	Response to comments	AM	SG
Rev F	24.01.2017	(Day Design Documents)	AM	SG
Rev G	06.03.2017	(Day Design Documents)	AM	SG
Rev H	28.07.2017	(Day Design Documents)	AM	SG
		Rebranded CNVMP to SIMTA Version		
SIMTA.001	19.06.2019	- Updated against RfMA 002 - Updated against RfMA 007 - Updated against RfMA 008 - Updated against RfMA 012	JH/MWR	JC
SIMTA.002	25.09.2019	Updated to address ER comments on SIMTA.001	ZQ	KP
SIMTA.003	31.10.2019	Updated to address ER comments on SIMTA.002	RM	AL
SIMTA.004	5.11.2019	Updated to address additional ER comments on Figure 2	MWR	AL
SIMTA.005	01.12.2020	Figure 2 updated to show revised stockpile locations following DPIE approval.	AW	MW

KEY TERMS AND ACRONYMS

Acronym/Term	Meaning
ACM	Asbestos Containing Material
CEMP	Construction Environmental Management Plan
CoC	Conditions of Consent
DA	Development Application
DEWHA	Department of Environment, Water, Heritage and Arts
DGRs	Director General's Requirements
DPE	NSW Department of Planning and Environment
DotEE	Department of the Environment and Energy (formerly Department of Sustainability, Environment, Water, Population and Community)
EA	Environmental Assessment
EEC	Ecologically Endangered Communities
EIS	Environmental Impact Statement titled <i>Environmental Impact Statement titled Moorebank Intermodal Terminal Project Environmental Impact Statement</i> , prepared by Parsons Brinckerhoff Australia Pty Limited, dated October 2014.
Environmental Aspect	means the interaction, relationship or impact of an operation or activity with the Environment including
Environmental Law	relating to the storage, handling or transportation of waste, dangerous goods or hazardous material relating to Workplace health and safety; or which has as one of its purposes or effects the protection of the Environment
Environmental Notice	means any direction, order, demand, license or other requirement from a Government Agency to take action or refrain from taking any action in respect of the Site or the Works in connection with any Environmental Law
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Planning and Assessment
EPBC Act	Environment Protection Biodiversity Conservation Act 1999
EWMS	Environmental Work Method Statements
NPW Act	National Parks and Wildlife Act 1974
OEH	Office of Environment and Heritage
NSWHC	NSW Heritage Council
MPW Main Compound	MPW Early Works (Stage 1) compound relocated in accordance with RfMA 002 to meet future MPW Stage 2 requirements
MPW Stage 1	Moorebank Precinct West Stage 1 – Early Earthworks as approved under SSD 5066
Non-compliance	An occurrence, set of circumstances, or development that results in a non-compliance or is non-compliant with Development Consent SSD 5066 Conditions of

Acronym/Term	Meaning
	Consent or EPBC Act Approval or EPBC Act Approval (EPBC 2011/6086) Conditions of Approval but is not an incident
Non-conformance	Observations or actions that are not in strict accordance with the CEMP and the aspect specific subplan
REMM	Review of Environmental Mitigating Measures
SIMTA	Sydney Intermodal Terminal Alliance
Site	Means the project site or work area where the Contractor is undertaking activities on behalf of SIMTA
SoHI	Statement of Heritage Impact
SSD 5066	Means State Significant Development number 5066 – Concept Approval and Early Earthworks Approval for MPW Stage 1
Standards	Standards are published documents setting out specifications and procedure
The Contractor	The company, companies or other legal entity appointed by SIMTA to undertake works under the Project Approval

CONTENTS

REVISIONS	I
KEY TERMS AND ACRONYMS	III
EXECUTIVE SUMMARY	VII
1 SITE & DEVELOPMENT DESCRIPTION	1
1.1 Scope of Work	1
2 DOCUMENT STRUCTURE	6
3 CONDITIONS OF CONSENT & NOISE CRITERIA	7
3.1 Planning Assessment Commission of NSW	7
3.2 EPA Interim Construction Noise Guideline	10
3.3 German Standard DIN 4150-3 – Effects of Vibration on Structures	10
3.3.1 Buried Pipework	10
3.3.2 Structural Damage	10
3.4 EPA Vibration Guideline – Human Exposure	11
3.5 Commercial and Industrial Premises	12
3.6 Sleep Disturbance Criteria	12
3.7 Project Specific Criteria	12
4 NOISE AND VIBRATION IMPACTS	15
4.1 Phase 1 – Pre-Commencement Works	15
4.2 Phase 2 – Early Works	16
4.3 Vibration Impacts	17
5 NOISE AND VIBRATION MITIGATION	19
5.1 Noise Measurement Equipment	19
5.2 Attended Residential Noise Monitoring Procedure	19
5.3 Noise Monitoring of Equipment	19
5.4 Attended Monitoring Schedule	20
5.5 Reporting on Attended Noise Monitoring	20
5.6 Periods of Respite	20
5.7 Work Practices	21
5.8 Heavy Vehicles and Staff Vehicles	21
5.9 Consultation for Preparation of the CNVMP	22
5.10 Community Relations	22
5.11 Managing a Noise Complaint	23
5.12 Out-of-Hours Work Protocol	23
5.13 Amendments to this Noise and Vibration Plan	24
5.14 Noise Monitoring	24
5.15 Non-compliance, Non-conformance and Actions	24
5.16 Vibration Monitoring	24

APPENDIX A PROPOSED SITE LAYOUT AND DEMOLITION PLANS	26
APPENDIX B SAMPLE OUT-OF-HOURS WORK REQUEST	33
APPENDIX C SOUNDPLAN NOISE PROPAGATION CONTOURS.....	35
APPENDIX D ASSESSED RECEIVER LEVELS	38
APPENDIX E HIGH ENERGY IMPACT COMPACTION TRIAL, INTIAL ASSESSMENT	42

LIST OF TABLES

Table 1: Noise Sensitive Receptors.....	2
Table 2 Conditions of Consent.....	7
Table 3 Guideline Value for Vibration on Buried Pipework	10
Table 4 Vibration Guide Values for Structural Damage	11
Table 5 Vibration Dose Values (VDV) from Construction Activities	11
Table 6 Commercial and Industrial Premises	12
Table 7 Leq Noise Management Levels from Construction Activities	13
Table 8 Other Sensitive Land Uses	14
Table 9 Typical Demolition Equipment Phase 1 - Sound Power Levels	15
Table 10 Calculated Receptor Sound Pressure Levels from Pre-Commencement Works Activities	15
Table 11 Typical Demolition Equipment Phase 2 - Sound Power Levels	16
Table 12 Calculated Receptor Sound Pressure Levels from Early Works Activities	16
Table 13 Recommended safe working distances for vibration generating plant.....	17
Table 14 Noise Monitoring Schedule	20
Table 15 Consultation Summary.....	22

LIST OF FIGURES

Figure 1 Residential Location Plan, Moorebank Intermodal Terminal, Moorebank	3
Figure 2 Site Layout	5

EXECUTIVE SUMMARY

Day Design Pty Ltd were engaged to prepare a Construction Noise and Vibration Management Plan for the demolition and remediation of the Moorebank Precinct West (MPW) parcel of land at Moorebank Avenue, Moorebank.

Phase 1 of the Early Works will include, establishment of the site, mobilization of equipment and plant, hazardous materials removal, strip out of existing buildings and structures, isolation of services and heritage works.

Phase 2 will include the relocation and construction works of the MPW Early Works Compound, demolition of buildings and structures, remediation works and bulk filling of excavated areas.

The major noise sources associated with the project are mobile plant and machinery to be used during the demolition and remediation, and the transport of materials to and from the site.

The highest predicted noise level is 49 dBA during Phase 2 of demolition works at the nearest sensitive receptor area, which is within the noise management level of 49 dBA in the Casula area.

Attended noise compliance monitoring will be conducted at the three representative residential locations, in Casula, Wattle Grove and Glenfield, during the first week of each Phase of the project to determine the extent of noise impacts and to monitor any exceedance. Continued and/or unattended noise monitoring at residential receptors will be carried out in response to complaints or if work is scheduled out of standard construction hours.

Given the distances to the nearest sensitive receptors, exceedance of the vibration criteria is unlikely. However, vibration monitoring at the commencement of any high impact activities will be carried out to ascertain baseline vibration levels at the nearest receptors. Further vibration monitoring will be carried out in response to complaints reported during the works.

This Construction Noise and Vibration Management Plan has been prepared in accordance with the Australian Standard AS2436 – 2010 *“Guide to noise and vibration control on construction, demolition and maintenance sites”*. Construction noise management levels have been derived from the Environment Protection Authority’s *Interim Construction Noise Guideline* and are used for a quantitative assessment at the nearest affected residential receiver locations.

All feasible and reasonable methods to limit the noise emissions and minimise the noise impact on neighbouring properties have been provided in Section 6 of this report. These include; selecting quiet equipment, incorporating periods of respite, maintaining community consultation relations, managing noise complaints and conducting noise and vibration monitoring.

1 SITE & DEVELOPMENT DESCRIPTION

The establishment of the Sydney International Terminal Alliance (SIMTA) facility involves the construction of an intermodal terminal, warehouses and other facilities, and all related infrastructure. The parcel of land is approximately 220 hectares, owned by the Commonwealth, and houses the Australian Defence Force Military Engineering School and other Department of Defence facilities. This Noise and Vibration Management Plan addresses the activities in the first two phases of the project, designated as Moorebank Precinct West Stage 1 (MPW Stage 1) – Early Works.

1.1 Scope of Work

This scope of work is to undertake demolition and remediation works on MPW Stage 1, in order to provide unencumbered access for the subsequent works package/s. It includes the following:

- Establishment of construction site facilities and management of site security;
- Utility services and stormwater identification, termination and removal
- Heritage salvage and relocation works;
- Demolition of existing infrastructure and buildings;
- Remediation of identified contaminated areas;
- PFAS affected catchment capping and lining

The site works will include two phases. A brief description of the activities to be conducted and anticipated time frame for completion during each phase is outlined below. The layout of the Site, including work areas, site compounds and access points are shown in Appendix A.

Early Works, Phase 1 – Pre-commencement works

- Site establishment – 1 month
- Mobilisation – 1 month
- Hazardous materials removal – 2 months
- Soft strip (removal of furniture etc.) – 2 months
- Service isolation – 1 month
- Heritage works – 7 months

Early Works, Phase 2 – Demolition and Remediation

- Compound relocation – 2 months
- Demolition – 7 months
- Remediation works – 7 months
- Reinstatement (bulk filling of excavated areas for remediation) – 7 months

The Minister for Planning has authorised early works to be undertaken during the following standard construction hours:

- 7:00am to 6:00pm, Monday to Friday inclusive; and
- 8:00am to 1:00pm Saturdays;
- At no time on Sundays or public holidays.

Works that result in impulsive or tonal noise emissions shall only be undertaken:

- 8:00am and 5:00pm Monday to Friday inclusive;

- 8:00am and 1:00pm Saturday; and
- In continuous blocks, not exceeding 3 hours with a minimum 1-hour respite between each block.

The nearest sensitive receptors to the works are shown in Figure 1 and in Table 1 below. Each receptor location is considered representative of all receptors in each direction from the site.

Receptor locations within each suburb have been taken from Figure 1, 2.1, Chapter 12 of the Parson Brinckerhoff, Noise and Vibration report dated October 2014.

Table 1: Noise Sensitive Receptors

Residential Receptors	Representative Location	Direction from Site
Casula – Representative of locations R1-6	Location 1 – Dunmore Court, Casula	West
Wattle Grove – Representative of location R14	Location 2 – Anzac Road, Wattle Grove	East
Glenfield – Representative of locations R8-R10	Location 3 - Goodenough Street, Glenfield	South

The MPW Stage 1 Early Works footprint and site layout is shown in Figure 2.

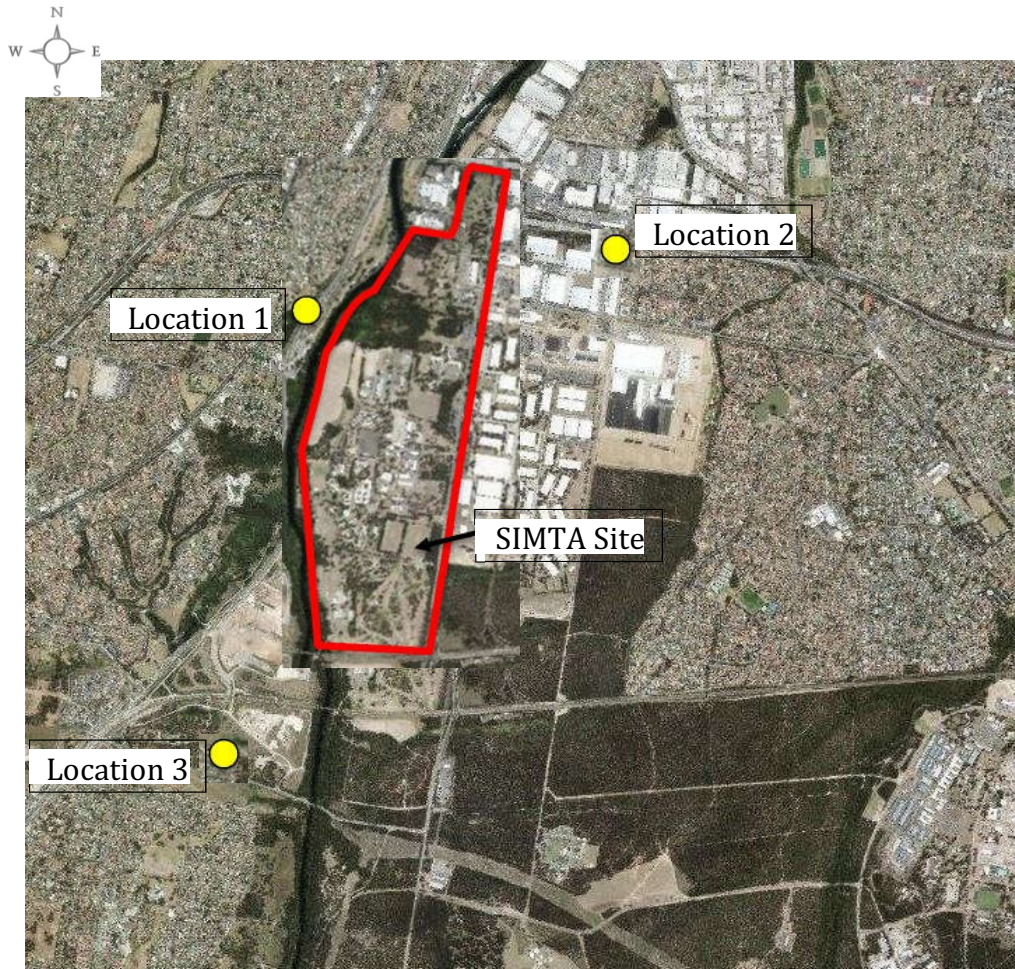


Figure 1 Residential Location Plan, Moorebank Intermodal Terminal, Moorebank

Construction Noise and Vibration Management Plan



Figure 2 Site Layout

2 DOCUMENT STRUCTURE

The Construction Noise and Vibration Management Plan (CNVMP) for the Early Works forms a sub-plan of the overarching Construction Environmental Management Plan (CEMP) for the Early Works project.

This sub-plan shall be reviewed and updated as necessary throughout the project.

3 CONDITIONS OF CONSENT & NOISE CRITERIA

The NSW Minister for Planning granted approval for Application No SSD 5066 which consists of the Early Works (MPW Stage 1) on the Intermodal site and Rail Corridor, as defined in the Consent. The Consent contains several conditions relating to noise impact as detailed below.

3.1 Planning Assessment Commission of NSW

The following table lists the Conditions of Consent required to be satisfied, as issued by the Planning Assessment Commission (PAC) of NSW.

Table 2 Conditions of Consent

Condition No.	Consent Condition	Sub- Plan Ref.
C2	Prior to the commencement of Early Works, or otherwise as agreed by the Secretary, the Applicant shall ensure that the following are available for community enquiries and complaints for the duration of Early Works: a) A 24 hour telephone number(s) on which complaints and enquiries about the SSD may be registered; b) A postal address to which written complaints and enquiries may be sent; c) An email address to which electronic complaints and enquiries may be transmitted, and; d) A mediation system for complaints unable to be resolved The telephone number, the postal address and the email address shall be published in newspaper(s) circulating in the local area prior to the commencement of construction and prior to the commencement of operation. This information shall also be provided on the website (or dedicated pages) required by this approval.	Section 6.10 & 6.11
C3	Prior to the commencement of Early works, or as otherwise agreed by the Secretary, the Applicant shall prepare and implement a Construction Complaints Management System consistent with AS ISO 10002-2006 Customer satisfaction – Guidelines for complaints handling in organisations (ISO 10002:2004, MOD) and maintain the System for the duration of Early Works and up to 12 months following completion of this stage. Information on all complaints received, including the means by which they were addressed and whether resolution was reached, with or without mediation, shall be maintained in a complaint register and included in the construction compliance reports required by this approval. The information contained within the System shall be made available to the Secretary on request.	Section 6.11
D5	Early Works shall be undertaken during the following standard construction hours: a) 7:00 am to 6:00pm Mondays to Fridays, inclusive; and, b) 8:00am to 1:00pm Saturdays; c) At no time on Sundays or Public Holidays.	Section 4.7 & 6.6
D6	Activities resulting in impulsive or tonal noise emissions shall only be undertaken: a) Between the hours of 8:00am to 5:00pm Monday to Friday; b) Between the hours of 8:00am to 1:00pm Saturday; and, In continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. For the purposes of this condition, 'continuous' includes any period during which there is less than a one-hour respite between ceasing and recommencing any of the work the subject of this condition.	Section 6.6
D7	Notwithstanding conditions D5 and D6, works may be undertaken outside the hours specified under those conditions in the following circumstances:	Section 4.7

Condition No.	Consent Condition	Sub- Plan Ref.
	Construction works that cause LAeq(15 minute) noise levels that are: No more than 5dB above rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC 2009); and, No more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC 2009) at other sensitive land uses. for the delivery of materials required by the police or other authorities for safety reasons; or where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or construction works approved through an Out-Of-Hours Work Protocol prepared as part of the Construction Noise and Vibration Management Plan required by Condition D21(b) identified works approved by the Secretary.	
D8	The Applicant shall implement all feasible and reasonable noise mitigation measures with the aim of achieving the following noise management levels and vibration criteria: Construction noise management levels established using the Interim Construction Noise Guideline (DECC 2009); Vibration criteria established using the Assessing Vibration: A Technical Guide (DECC 2006) (for human exposure); and The vibration limits set out in the German Standard DIN4150-3: Structural Vibration – effects of vibration on structures (for structural damage). Any construction activities identified as exceeding the construction noise management levels and/or vibration criteria shall be managed in accordance with the Construction Noise and Vibration Management Plan required by condition D21(b)	Section 4.7 Section 4.3 Section 4.4 Section 6
D9	The Applicant is to ensure that construction vehicle contractors operate so as to minimise and construction noise impacts from the subject site. Measures that could be used include toolbox talks, contracts that include provisions to deal with unsatisfactory noise performance for vehicle and/or the operator, and specifying non- tonal movement alarms in place of reversing beepers or alternatives such as reversing cameras and proximity alarms, or a combination of these, where tonal alarms are not mandated by legislation.	Section 6.8
D10	No use of compression brakes shall be permitted for construction vehicles associated with the Early Works in the vicinity of the subject site.	Section 6.8
D11	Construction heavy vehicle access to and from the site via Moorebank Avenue (south)/Cambridge Avenue during Early Works is not permitted, with the exception of heavy vehicles travelling to and from the Glenfield Waste Facility.	Section 6.8
D12	The Early Works shall be carried out, where feasible and reasonable, to avoid the use of local roads (through residential streets) by heavy vehicles to gain access to the site and/or ancillary facilities.	Section 6.8
D13	Construction vehicles (including staff vehicles) associated with the Early Works shall be managed to: a) Minimise parking or queuing on public roads b) Minimise idling and queuing in local residential streets where practicable; c) Adhere to the nominated haulage routes identified in the Construction Traffic and Access Management Plan required under condition D20(a).	Section 6.8

Condition No.	Consent Condition	Sub- Plan Ref.
D21 (b)	A Construction Noise and Vibration Management Plan to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be consistent with the guidelines contained in the Interim Construction Noise Guideline (DECC 2009). The Plan shall be developed in consultation with the EPA and shall include, but not limited to:	
	a) Identification of the work areas, site compounds and access points;	Appendix A
	b) Identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSD and stipulated in the conditions above;	Section 2 & Appendix C, D & E
	c) Details of Early Works activities and an indicative schedule for works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Section 5
	d) An Out-Of-Hours Work Protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition D5 of this approval, for the Secretary's approval. The Out-Of-Hours Work Protocol must detail:	Section 6.12
	a. Assessment of out-of-hours works against the relevant noise and vibration criteria	Section 6
	b. Detailed mitigation measures for any residual impacts (that is, additional to general mitigation measures), including extent of at-receiver treatments; and	Section 6.16
	c. Proposed notification arrangements.	Section 6.12
	e) Identification of feasible and reasonable measures proposed to be implemented to minimise noise impacts (including construction traffic noise impacts), including, but not limited to, acoustic enclosures, erection of noise walls (hoardings) and respite periods;	Section 6
	f) Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibration criteria are achieved, including applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre and post construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria);	Section 6.10 & Appendix B
	g) A description of how the effectiveness of mitigation and management measures would be monitored during the Early Works, clearly indicating how often this monitoring would take place, how the results of this monitoring recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified; and,	Section 6
	h) Mechanisms for the monitoring, review and amendment of this plan	Section 6.5 & 6.11
		Section 6.9, 6.11 & 6.13

3.2 EPA Interim Construction Noise Guideline

The NSW Environment Protection Authority published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance, the quantitative method is the most appropriate and has been used in this assessment. Details of the quantitative method are given in Section 4 of the Guideline.

Standard construction hours are defined by the EPA as follows:

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

3.3 German Standard DIN 4150-3 – Effects of Vibration on Structures

3.3.1 Buried Pipework

Service pipelines exist on the eastern boundary of the MPW site, running parallel with Moorebank Avenue. German Standard DIN 4150-3:1999 provides guideline vibration values for vibration velocity on buried pipework, which is summarised as follows in Table 3.

Table 3 Guideline Value for Vibration on Buried Pipework

Line	Pipe Material	Guideline Values for Peak Particle Velocity Measured On the Pipe – mm/s
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, Plastic	50

3.3.2 Structural Damage

The German Standard DIN 4150-Part 3 provides guideline values for vibration relating to structural damage, summarised in Table 4 below.

Table 4 Vibration Guide Values for Structural Damage

Guideline Values For Velocity – mm/s				
Type of Building	Vibration at the Foundations			Horizontal plane on highest floor – All
	<10 Hz	0-50 Hz	50-100 Hz	
Commercial	20	20 - 40	40 - 50	40
Residential	5	5 - 15	15 - 20	15
Structures particularly	3	3 - 8	8 - 10	8

Consideration is also given to vibration impacts upon rail infrastructure located to the south of the site. If required, an assessment of vibration at the rail line (or as close as possible to the rail line), shall adopt values given for Commercial purposes, however, German Standard DIN 4150-3:1999 also states that;

‘For civil engineering structures...the values in Line 1 of Table 1¹...may be increased by as much as a factor of two...’

Therefore, values given for Commercial purposes above may be doubled when assessing vibration affecting the rail corridor.

3.4 EPA Vibration Guideline – Human Exposure

The NSW EPA published the *Assessing Vibration: a technical guideline in February 2006*. This guideline is based on the British Standard BS 6472:1992 “*Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*.”

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The guideline considers vibration from construction activities as Intermittent Vibration. Table 2.4 of the guideline sets out qualitative limits for Vibration Dose Values to assess intermittent vibration and is replicated in Table 5 below for residential receptor locations.

The EPA published the Interim Construction Noise Guidelines in July 2009. This recent document is designed to simplify the assessment of the impact of construction noise on neighbouring properties.

Table 5 Vibration Dose Values (VDV) from Construction Activities

Receptor Locations	Daytime	
	Preferred value (m/s ^{1.75})	Maximum value (m/s ^{1.75})
All Residences	0.20	0.40

¹ Table 4 of this report

3.5 Commercial and Industrial Premises

Given the broad range of operations within commercial and industrial land use types, the Interim Construction Noise Guideline recommends the following noise levels, as shown in Table 6 below. The external noise levels should be assessed at the most affected occupied point on the premises. A conservative estimate of 10 dB is generally applied as the difference between the external and internal level for noise sensitive businesses that require internal noise measurement.

Table 6 Commercial and Industrial Premises

Land Use	Noise Management Level, LAeq, (15 minute) Applies when properties are being used
Industrial Premises	75dBA – External Noise Level
Offices and retail outlets	70dBA – External Noise Level
Noise sensitive businesses	Refer to AS2107 for specific internal noise levels appropriate to individual business type

3.6 Sleep Disturbance Criteria

Section 4.3 of the Interim Construction Noise Guideline discusses the consideration of sleep disturbance at residences. The section refers to the EPA's NSW Environmental Criteria for Road Traffic Noise for guidance on the assessment of sleep disturbance.

Appendix B5 of the NSW EPA's Environmental Criteria for Road Traffic Noise (ECRTN) reviews the current level of knowledge and concludes that maximum internal noise levels below 50– 55 dBA are unlikely to cause awakening reactions, and that one or two noise events per night with maximum internal noise levels of 65–70 dBA are not likely to affect health and wellbeing significantly.

For the purposes of assessment at external locations, 10 dB is added to the internal noise level. Therefore, the sleep disturbance criteria is 60-65 dBA outside a residential window.

In addition, in an application note to the Industrial Noise Policy, the EPA states:-

“Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.”

3.7 Project Specific Criteria

The Environmental Impact Statement, prepared by Parsons-Brinckerhoff dated October 2014, provides a list of RBL's for various residential locations around Casula, Wattle Grove and North Glenfield. These values have been adopted for this assessment. It is noted that Evening RBL's in receptor locations 1 – 3 are at least the same level as the Daytime RBL.

Table 7 Leq Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
Standard Construction Hours - 7.00am to 6.00pm Monday to Friday; 8.00am to 1.00pm Saturday and Evening Period – 6:00pm to 10:00pm Monday to Friday.		
All Residential Receptors	Locations 2 & 3 45 dBA	The noise affected level represents the point above which there may be some community reaction to noise. i. Where the predicted or measured LAeq (15 min) noise level is greater than the noise affected level.
	Location 1 49 dBA (39 + 10)	ii. 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.
All Residential Receptors	Highly Noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. i. 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: ii. 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); iii. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Normal Construction Hours		
All Residential Receptors	Locations 1 & 3 38 dBA (33+5)	i. Activities where the NML cannot be achieved with noise controls, should not be conducted outside of hours.
	Location 2 37 dBA (32 + 5)	ii. 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.

* Section 6, 'work practices' of The Interim Construction Noise Guideline, states: *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise"*.

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

Further to the Construction Noise Management levels outlined above in Table 7, the Interim Construction Noise Guideline recommends noise levels for other sensitive land uses. These levels are to be assessed at either the most affected point within 50 metres of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of 10 dB is generally applied as the difference between the external and internal level for buildings other than residences. The recommended levels are shown below in Table 8.

Table 8 Other Sensitive Land Uses

Land Use	Management Level, LAeq,(15 minute) Applies when properties are being used.
Classrooms, other educational institutions, hospital wards, place of worship	45 dBA – Internal Noise Level
Active recreation areas, (areas which generate their own noise during use)	65 dBA – External Noise Level
Passive Recreation Areas, (areas that generate no or little noise during use)	60 dBA – External Noise Level
Community Centres	Refer to AS2107 for maximum internal noise levels for areas with specific uses.

In addition to Table 7 and Table 8, the noise management levels for this proposal are summarised as follows:-

- 60 to 65 dBA LA_{max} external noise management level, outside of standard construction hours as measured at the nearest residential façade, for sleep disturbance;
- Internal noise management level of 45 dBA (Leq, 15 minute) for classrooms and educational facilities, hospital wards and places of worship;
- External noise management level of 65 dBA (Leq, 15 minute) for active recreation areas;
- External noise management level of 60 dBA (Leq, 15 minute) for passive recreation areas;
- External noise management level of 70 dBA (Leq, 15 minute) for offices and retail outlets;
- External noise management level of 75 dBA (Leq, 15 minute) for industrial premises.

The vibration management levels for this proposal are summarised as follows: -

- Vibration dose values (VDV), for human exposure of 0.2 (m/s^{1.75}) during both demolition Phases and during standard construction hours, and;
- Peak Particle Velocity values for residential premises, as measured at the foundations of the structure for structural damage of: 5mm/s below 10Hz, 5 – 15mm/s between 10 – 50 Hz, 40 – 50mm/s between 50 – 100Hz. For multi-storey residential structures, 15mm/s measured on the horizontal plane of the highest floor.
- Peak Particle Velocity values for buried pipework, as measured on or within close proximity to the buried pipework for structural damage of: 50 mm/s for masonry or plastic pipes, 80 mm/s for concrete, clay or metal pipes and 100 mm/s for steel pipes.
- Peak Particle Velocity values for rail infrastructure or other civil engineering structures, as measured on or within close proximity to the structure for structural damage of: 40 mm/s below 10Hz, 40 – 80 mm/s between 10 – 50 Hz, 80 – 100 mm/s between 50 – 100Hz.

4 NOISE AND VIBRATION IMPACTS

The main sources of noise on the site during the Early Works will be from heavy machinery such as excavators, dump trucks and handheld pneumatic and electric power tools, etc. Activities that may cause particular annoyance, due to tonality, spectral content or impulsiveness include generator motors, hand tools such as grinders, jackhammering and other activities involving impacts. These activities will require particular attention with regard to mitigation.

4.1 Phase 1 – Pre-Commencement Works

It is anticipated that the majority of the pre-commencement works will be completed within two months, with activity associated with heritage works continuing throughout both Phases. Works will involve the use of excavators and regular truck movements transporting waste materials from the site. The equipment likely to be used and their corresponding sound power levels are presented in Table 9 below.

Table 9 Typical Demolition Equipment Phase 1 - Sound Power Levels

Description	Qty	Sound Power Level, dBA [^]
Excavators (up to 70 ton)	Up to 5	107 to 110
Trucks (up to 40 ton)	Up to 3	107 to 110
Bulldozer (21 ton)	1	108
Generator	2	Up to 89
Pneumatic and Electric Hand Tools	Up to 5 simultaneously	Up to 110

[^]All sound power levels are based on AS2436-2010 of various plant noise measurements.

As a conservative approach, it is assumed that all items of plant will be operating simultaneously.

Calculations have been performed using SoundPlan version 7.3. Levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective residential location, taking into account topography and objects. The calculated noise levels at nearby residential receptors are presented in Table 10 below.

Table 10 Calculated Receptor Sound Pressure Levels from Pre-Commencement Works Activities

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Casula	48	49	Yes
Wattle Grove	38	45	Yes
Glenfield	40	45	Yes

The SoundPlan noise level contour maps and a complete list of corresponding predicted levels at various receptors for the Pre-commencement works, as summarized in Table 9, is shown in Appendix C1 – *SoundPlan Noise Propagation Contours* and Appendix D1 – *Assessed Receiver Level* respectively.

4.2 Phase 2 – Early Works

The Phase 2 Early Works will be completed within 7 months. Demolition works will involve the use of excavators and regular truck movements transporting waste materials from the site. The equipment likely to be used and their corresponding sound power levels are presented in Table 11 below.

Table 11 Typical Demolition Equipment Phase 2 - Sound Power Levels

Description	Qty	Sound Power Level, dBA [^]
Excavators (up to 70 ton)	Up to 14	107 to 110
Trucks (up to 40 ton)	Up to 8	107 to 110
Compactor Rollers	Up to 2	110
Bulldozer (25 ton)	2	108
Front End Loader (25 ton)	1	110 to 115
Silenced Diesel Generator	Up to 2	Up to 89
Telehandler (3 ton)	1	Up to 99
Elevated Work Platforms	2	Up to 95
Pneumatic and Electric Hand Tools	Up to 5 simultaneous	Up to 110

[^]All sound power levels are based on AS2436-2010 and DEFRA database of various plant noise measurements.

As a conservative approach, it is assumed that all items of plant will be operating simultaneously. Calculations have been performed using SoundPlan version 7.3. Levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective residential location, taking into account topography and objects.

Phase 2 Early Works will also include the use of a Denyo DCA-150ESK (150 KVA unit) generator operating 24 hours a day seven days a week in the Main Compound. An assessment was undertaken using the Roads and Maritime Services (RMS) Noise Calculator to determine the noise impacts of the operation of the generator. Three locations were chosen to represent the closest residential receptor within each noise catchment area (Casula, Wattle Grove and Glenfield) the noise impacts were calculated taking into account existing conditions. The results of this assessment indicate that the noise impacts of the generator operating 24 hours a day, seven days a week upon residential receivers was negligible.

4.2.1.1 Sensitive Receptors

The calculated noise levels at nearby residential receptors are presented in Table 12 below.

Table 12 Calculated Receptor Sound Pressure Levels from Early Works Activities

Receptor Location	Calculated Sound Pressure Levels (dBA)	Noise Management Level (dBA)	Compliance
Casula	49	49	Yes
Wattle Grove	37	45	Yes
Glenfield	40	45	Yes

The SoundPlan noise level contour maps and a complete list of corresponding predicted levels at various receptors for the Early Works, as summarized in Table 12, is shown in Appendices C2 - *SoundPlan Noise Propagation Contours* and Appendix D2 - *Assessed Receiver Levels* respectively.

4.3 Vibration Impacts

Past measurements of ground borne vibration show that vibration levels can vary significantly at different distances and receptor locations. Recommended safe working distances for various items of vibration generating plant are given in Section 6.3 of Transport for NSW Construction Noise Strategy 2012. This information is shown below in Table 13.

Table 13 Recommended safe working distances for vibration generating plant

Plant Item	Rating/ Description	Safe Cosmetic Damage (BS 7385)	Human Response (OH&E Assessing Vibration – A Technical Guideline)
Vibratory Roller	<50kN (Typical 1 – 2 Tonnes)	5 m	15 – 20 m
	<100kN (Typical 2 – 4 Tonnes)	6 m	20 m
	<200kN (Typical 4 – 6 Tonnes)	12 m	40 m
	<300kN (Typical 7 – 13 Tonnes)	15 m	100 m
	>300kN (Typical 13 – 18 Tonnes)	20 m	100 m
	300kN (Typical > 18 Tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12T Excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18T Excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34T Excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Given the large intervening distances (>400 metres) between the site and neighbouring residences, it is unlikely levels of vibration will approach those specified in Section 4.3. However, we recommend that compliance monitoring of ground borne vibration is carried out at the nearest residence, when vibratory machinery such as pile drivers, jackhammers, High Energy Impact Compaction (HEIC) equipment and the like are used on site. Refer to Section 6.16 for the mitigation measures to be engaged to reduce the impact of adverse vibration.

It is anticipated that the use of High Energy Impact Compaction (HEIC) equipment will be deployed on site which has the potential to generate significant levels of noise and vibration.

To determine suitability for purpose, compliance and conformance with noise and vibration criteria established in Section 4.7 of this document, trial runs utilizing HEIC equipment is proposed on at least 3 sites within the MPW site. Two of the proposed trial HEIC locations are within close proximity to buried pipework and rail infrastructure.

An initial noise and vibration impact assessment has been conducted prior to HEIC equipment being deployed on site. This assessment concluded that noise and vibration management levels could be met at all locations, with no mitigation measures necessary to achieve compliance and conformance. This noise and vibration impact assessment is attached as Appendix E.

5 NOISE AND VIBRATION MITIGATION

The predicted level of noise (Section 5.1 and 5.2) and vibration (Section 5.3) emission from Phase 1 and Phase 2 show that noise levels will comply with Noise Management Levels established in Section 4.7 of this report. Distance and ground absorption provide sufficient noise attenuation and additional mitigation measures such as hoardings and enclosures, are not necessary to achieve noise goals.

- However, given the wide range of activities, the number of sensitive receivers and the large area over which the works will take place, the following work practices will be implemented where necessary and practicable, to ensure compliance and conformance throughout the project.
- Works will be staged to minimise noise impact,
- Methodology of demolition will be carried out so that noisy activities do not occur concurrently where possible,
- Impact noise will be limited (Section 6.6),
- Where practicable and safe the wall of the building nearest to the noise receptor will be left in place to act as a noise barrier,
- Substitution of equipment will be considered to minimise noise (Section 6.3)
- Impulsive and tonal noise is restricted to the hours of 8.00am to 5.00pm Mon-Fri, and continuous blocks will not exceed three hours each with a minimum respite from those activities and works of not less than one hour between each block (Section 6.6)
- Activities required to be conducted outside of the standard hours will be undertaken in accordance with the OOH protocol in Section 6.12.

5.1 Noise Measurement Equipment

All acoustic instrumentation employed throughout the monitoring programme will comply with the requirements of AS IEC 61672.1-2004 *Electroacoustics – Sound level Meters- Specifications*. All sound level meters must have a current calibration certificate from a NATA accredited laboratory in accordance with NATA guidelines. Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ± 0.5 dB.

5.2 Attended Residential Noise Monitoring Procedure

The measurements will be conducted in accordance with the procedures outlined in Australian Standard AS1055 *Acoustics – Description and measurement of environmental noise* and in accordance with methods outlined in the NSW Industrial Noise Policy (INP). The following points should be followed when conducting noise monitoring:

- A field calibration should be conducted before and after measurements;
- The sound level meters must be set to A-weighting and Fast response;
- The sound level meters sample period should be set to 15 minutes;
- The following descriptors should be measured as a minimum: LA1, LAeq and LA90; and
- Measurements should be conducted a minimum of 3 metres from the nearest façade and/or solid fence/wall. If it is not possible to do this, corrections for façade reflection should be applied to the measurement results.

5.3 Noise Monitoring of Equipment

In addition to the residential noise monitoring procedures described above, the following equipment measurements will be undertaken:

- Noise emission levels of all critical items of mobile plant and equipment will be checked by the site environmental officer for compliance and conformance with noise limits appropriate to those items prior to the equipment going into regular service;

- For equipment and mobile plant used for construction works, L_{Aeq} measurements will be taken at an appropriate distance, normally 7m and converted to a Sound Power Level;
- An *Equipment Noise Certificate*, presenting relevant sound levels of the equipment tested, will be issued by the Construction Contractor's site environmental officer within the first week of the equipment commencing at the construction site.

The equipment sound power levels will be compared to the levels contained in Table 8 & Table 10. If noise checks on any equipment result in a prediction of non-compliance or non-conformance, quieter equipment will be substituted.

5.4 Attended Monitoring Schedule

Table 14 below provides a preliminary schedule for noise monitoring.

Table 14 Noise Monitoring Schedule

Monitoring Schedule	Measurement Procedure	Reporting
During the first week of each Phase during Early Works	Complete one round of operator-attended 15 minute noise monitoring on separate days at site boundaries and closest residences	Reporting procedure as outlined in Section 6.5
	Carry out equipment noise level checks on all critical items of plant and issue Equipment Noise Certificates.	
During subsequent months	Carry out equipment noise level checks on any new (untested) critical items of plant and issue Equipment Noise Certificates	
	Carry out attended noise monitoring in the event of complaints and/or recorded exceedances. Continue noise monitoring after noise mitigation measures have been employed to confirm compliance and conformance	

5.5 Reporting on Attended Noise Monitoring

The following information must be included in the weekly reports when applicable:

- Field calibration results (before and after measurements);
- Measurement times and dates;
- Qualitative description of the noise environment during measurement;
- $LA1$, L_{Aeq} and $LA90$ levels;
- Meteorological conditions during the measurements;
- Estimation of recorded noise contribution from other major noise sources.

The Construction Contractor Project Manager shall establish and maintain a system of records which provides full documentation of all noise monitoring results, complaint handling and responses to non-compliances and non-conformances. The Construction Contractor Project Manager shall establish and maintain procedures for the collection, indexing, filing, storage and maintenance of the records.

5.6 Periods of Respite

All activities associated with the Early Works shall take place within the standard hours, as shown below:

- 7:00am to 6:00pm, Monday to Friday inclusive; and

- 8:00am to 1:00pm Saturdays;
- At no time on Sundays or public holidays.

Works that result in impulsive or tonal noise emissions shall only be undertaken;

- 8:00am and 5:00pm Monday to Friday inclusive;
- 8:00am and 1:00pm Saturday; and,
- In continuous blocks, not exceeding 3 hours each, with a minimum respite from those activities and works of not less than one hour between each block.

Activities required to be conducted outside of the standard hours will be undertaken in accordance with the OOH protocol in Section 6.12.

5.7 Work Practices

Workers and contractors shall be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out work only within the approved hours of operation.

Activities required to be conducted outside of the standard hours will be undertaken in accordance with the OOH protocol in Section 6.12.

5.8 Heavy Vehicles and Staff Vehicles

The following points shall be implemented in conjunction with the Construction Traffic and Access Management Plan, as required under Condition D20(a) of the Development Consent.

- Truck drivers shall be informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Site vehicle entrances shall be located away from residences where practicable.
- In accordance with Condition D11, no access shall be gained to the site along Cambridge Avenue or the southern side of Moorebank Avenue.
- The number of vehicle trips shall be configured to reduce the number of trips to and from the site – movements shall be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas shall be located as far from residential receiver locations as practicable, preferably within a dedicated area within the site.
- Parking and queuing of staff vehicles and other construction vehicles shall be avoided as far as is practicable on streets outside of the site.
- There shall be no access the site via, or park within residential areas prior to 7 am on any occasion, in order to avoid sleep disturbance.
- Vehicles shall be fitted with broadband reversing alarms or alternative, non-tonal proximity warning systems.
- For the duration of activity associated with the Early Works, use of compression braking shall not be permitted on the site or nearby the site, such as on access roads within close proximity to residential premises.

5.9 Consultation for Preparation of the CNVMP

This CNVMP has been developed in conjunction with the EPA, in accordance with CoC D21(b). A summary of consultation undertaken during the preparation of this CNVMP is provided in Table 15 below.

Table 15 Consultation Summary

Organisation	Date	Outcome
Environment Protection Authority (EPA)	26 Sept 2016	The CNVMP was dropped off to George Orel at the Environment Protection Authority.
Environment Protection Authority (EPA)	27 Sept 2016	Followed up with a phone call to George Orel of EPA and left a voice message asking for feedback in regard to the CNVMP. George Orel returned the phone call and advised that he would review the plan.
Environment Protection Authority (EPA)	6 Oct 2016	Followed up with a phone call to George Orel of EPA and left a voice message asking for feedback in regard to the CNVMP
Environment Protection Authority (EPA)	7 Oct 2016	George Orel sent email to Nethan Kana of Liberty Industrial stating, "EPA does not intend to review the details of the proposal".

5.10 Community Relations

- A Community Liaison Officer shall to be appointed by the contractor prior to the commencement of any works;
- The officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide their contact details;
- The officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical;
- A community information telephone number has been established to provide access and information about the project. The telephone number is 1800 986 465 and is the primary contact number for inquiries from the community. It is accessible 24 hours a day, 7 days a week.
- An email address has been established to manage correspondence and to provide access and information about the project. The email address for all enquiries is simta@elton.com.au
- A postal address has been established to manage correspondence and to provide access and information about the project. The postal address for all enquiries is PO Box 1488, Bondi Junction NSW 2022.
- A newspaper advertisement shall be prepared and placed in local media by SIMTA at least 7-days in advance, where there are significant out-of-hours work that have the potential to impact the community, and or at key project milestones that are of interest to the community.
- Information would typically include an overview of work, including specific construction information, expected duration, and the above contact details for complaints and correspondence.
- Community notifications and newsletters shall be prepared and distributed, at least 7 days prior to commencement of any works, to the community in areas that are potentially affected by the project. The contents of the notifications shall include information on the nature of the works, location of works being carried out, possible impacts to amenity, traffic flow or services, and the contact details as listed above.

- Community drop-in sessions shall be organised to engage with the community and to provide a conduit for direct consultation between those affected, or with an interest in the project, and the project team. To encourage the widest attendance and accessibility to the community, drop-in sessions shall be arranged outside of business hours such as weeknights or on Saturday.
- Information cards with the above contact details shall be prepared and distributed to the project management team and other staff on site. These cards shall be given to members of the community or other interested parties should they approach staff on site for information.

Once works commence, communication with the community shall be maintained by the Community Liaison Officer. Communication shall be maintained via the aforementioned methods.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

5.11 Managing a Noise Complaint

The Liaison Officer shall receive and manage noise complaints and implement a Construction Complaints Management System, as specified in Condition C3 of the Development Consent.

All complaints shall be treated promptly and with courtesy.

In the event that a noise complaint is received, noise monitoring will be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable. If the NML is found to be exceeded, works on the site will stop and site staff determine the best method of reducing the noise based on the mitigation measures described in this CNVMP. Noisy works will be restricted to outside the nominated respite periods.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop shall be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint, which may include standing equipment down.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

5.12 Out-of-Hours Work Protocol

Any work proposed to be conducted out of standard construction hours shall be subject to approval by the Environmental Representative. Details of proposed work shall be submitted for evaluation which will include; location of work to be conducted, types of plant and equipment proposed, character and likelihood of noise being generated, anticipated effect on traffic flow to and from the site. An example of an Out-of-Hours request form is included in Appendix B.

Noise management levels outside of standard construction hours are given in Table 6. Work that is likely to exceed this level shall not be approved and alternative times shall be arranged. Activity during these times

should be limited to those which do not involve the use of heavy vehicles, heavy machinery or other mechanical plant or activities that involve, or result in, increased traffic flow through residential areas.

In the event that it is unavoidable to conduct work outside of standard construction hours and work is likely to include noisy activities, an acoustic assessment shall be required to determine the extent of potential exceedance, recommendations for reasonable and feasible noise mitigation measures to be employed and predicted levels at the nearest sensitive receptors.

The relevant local council, residential areas and other sensitive receivers and stakeholders that are potentially affected by any work approved to be conducted outside of standard construction hours shall be notified at least 7 days prior to the commencement of work. Methods of notification may include letter drops, door-knocking, publications in local media and on the SIMTA website (www.simta.com.au). The Community Liaison Officer shall promptly be informed of all work approved outside of standard construction hours to allow appropriate time to arrange community notifications.

5.13 Amendments to this Noise and Vibration Plan

Should changes to the Conditions of Consent, schedule, nature of the works, equipment used during the works or locations of work change significantly during the course of the project, amendments to this plan and the calculations and recommendations contain herein, may be amended to reflect the changes.

A review should be carried out once a month by the Construction Contractor Project Manager and be revised if necessary.

This NVMP should be viewed as a live document and updated as necessary, noting that revision of the NVMP may result in the monitoring regime increasing or decreasing.

5.14 Noise Monitoring

Noise monitoring shall be conducted at the most affected residence at each receptor location, as listed in Table 1, within the first four weeks from the commencement of works at each Phase. If compliance with the NMLs is demonstrated and no complaints are received, noise logging will be discontinued.

If exceedances are measured during the initial logging periods for each Phase, it shall be determined from the time code of the recorded data as to which specific activities are causing the exceedance. Noise mitigation strategies and methods shall be implemented to reduce noise to within acceptable levels at the nearest sensitive receptors.

In the event of a noise complaint following the initial noise monitoring periods for each Phase, monitoring shall be resumed at the complainant's residence to determine which activities are generating excessive noise. If practicable, noise mitigation measures, such as those outlined above, shall be implemented and further monitoring shall then be employed to determine the efficacy of noise mitigation.

5.15 Non-compliance, Non-conformance and Actions

It is the responsibility of all site personnel to report non-compliances and non-conformances to the Site Supervisor and/or the Contractor's EM.

Non-compliances, non-conformances and corrective and preventative actions will be managed in accordance with Section 10.3 of the CEMP.

5.16 Vibration Monitoring

Given the distances to the nearest sensitive receptors, it is not anticipated that vibration levels will approach those shown in Table 3 & Table 4. However, if high impact activities, such as rock hammering or piling are to be conducted at any time during each Phase, vibration measurements shall be carried out at a residence within each of the nearest receptor locations at the commencement of high impact activities to determine the maximum levels of vibration during these peak vibration generating events.

In the event of an exceedance of the Peak Particle Velocity (PPV) vibration criteria as defined in Table 4 above, unattended vibration monitor or monitors shall be installed at each residential location where an exceedance was measured.

Unattended vibration monitors shall have the capability to trigger an alert to make the site manager and/or plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alert when the overall PPV exceeds the criteria within each frequency range, as stipulated in Table 4, at the nearest residential building.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage vibration causing works should cease immediately and alternative methods shall be considered.

APPENDIX A **PROPOSED SITE LAYOUT AND DEMOLITION PLANS**

Construction Noise and Vibration Management Plan



LEGEND

- | | |
|--|--|
|  MPW site |  Access road |
|  Benching Works |  Internal haul road |
|  Main compound |  Existing railway |
|  Water body used for storage of PFAS contaminated water |  Additional compounds |
|  Existing hardstand and road |  Car park |
| |  Site access via Chatham Avenue |

ARCADIS AUSTRALIA PACIFIC PTY LTD
 ABN 70 104 485 288
 Level 16, 500 George St, Sydney NSW 2000
 P: +61 (0) 2 9907 9600 | F: +61 (0) 2 9907 9801
 Coordinate System: GDA 1984 MGA Zone 56
 Aerial Imagery supplied by GeoMap (Sep. 2016)

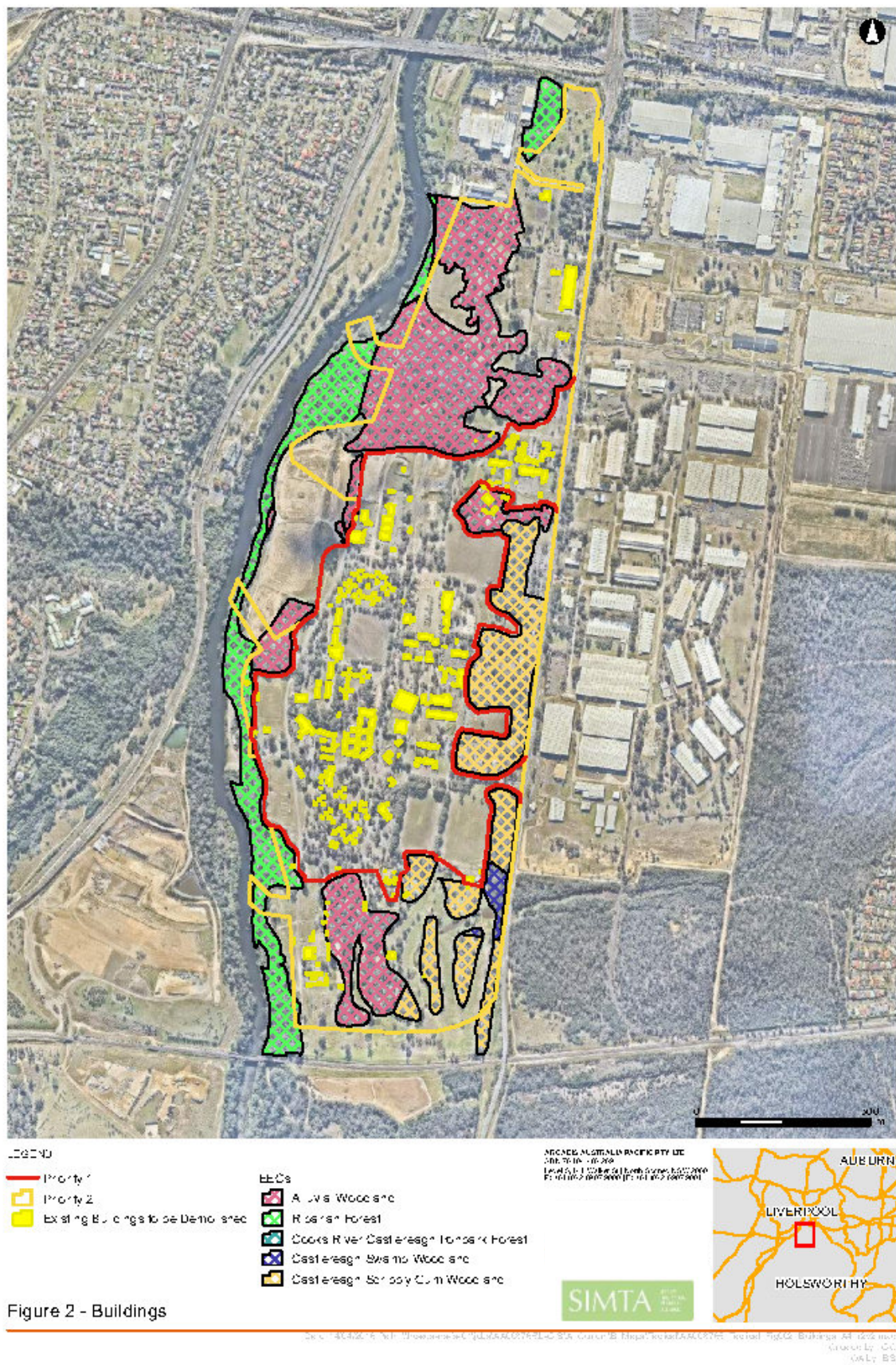
1:15,000 at A4

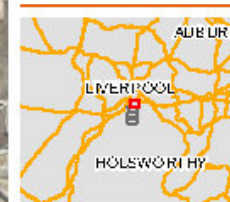




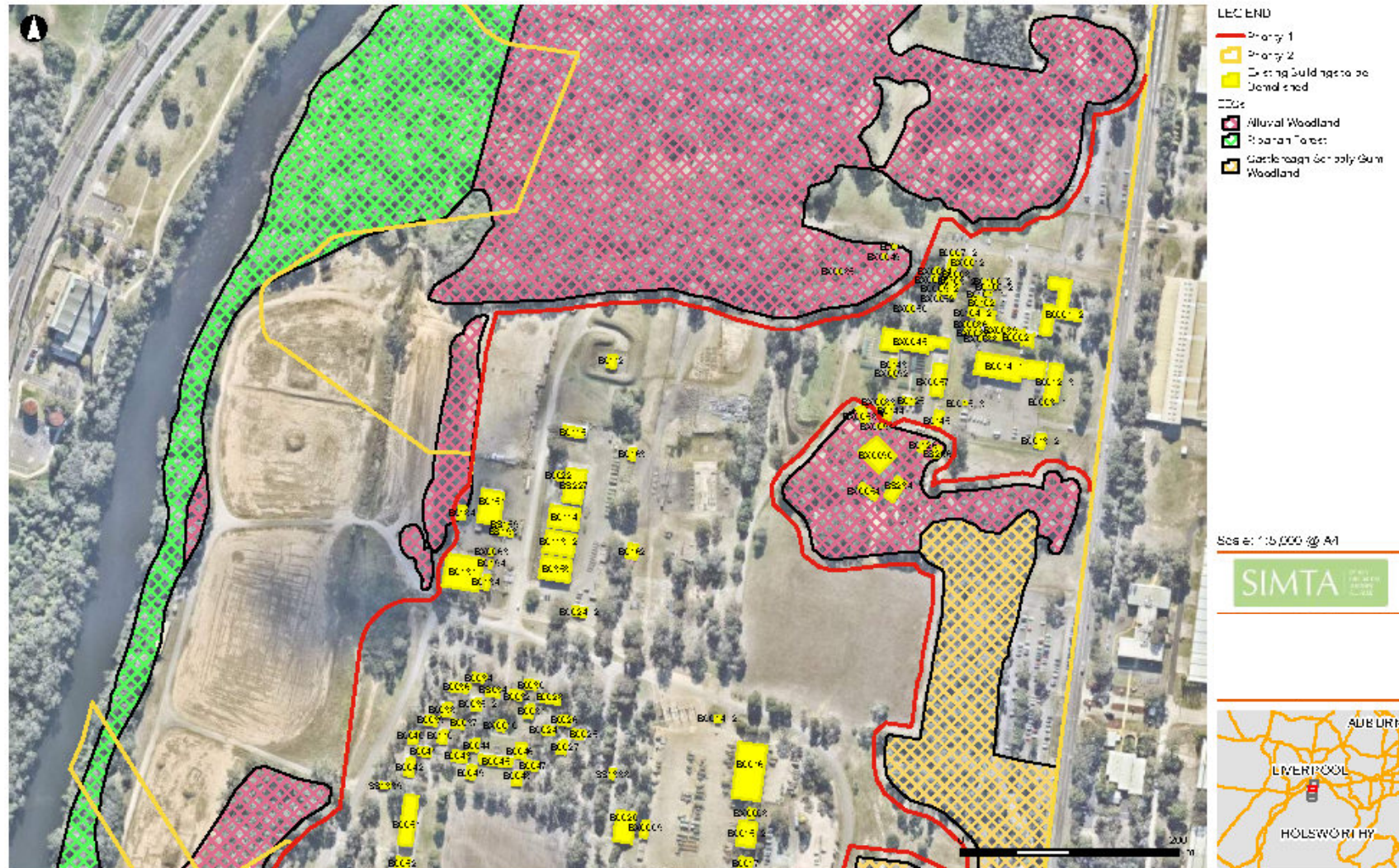
Appendix A: Site Layout

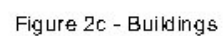
Date: 01/11/2019 Path: G:\a-us-rs-01\pba\AA01875SL-025A_CurrentSL_Maps\MPW_CONCEPT\MPW_EWCEMPC\CHMP\SIMTA_MPWS1_CNVMP_001_SiteLayout_A4P_v4.mxd
 Created by: EM
 QA by: RB

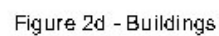




Doc: 4032676 Path: /Users/arsa67/pulsar/4032676/C-815/Contour B Map/Archived/4032676/Revised/Fig/Contour Buildings A4.jpg (2x) max
 Date by: C.C.
 Date: 6/1/01







APPENDIX B SAMPLE OUT-OF-HOURS WORK REQUEST

Out of hours request No. 1		Application Date
Name of person requesting the work:		Why Out of hours work is proposed

Item	Description	Information /Comments
1	Description Of works	
2	Plant and equipment to be used: (list all plant and noise generating equipment to be used during the work activities) e.g. hand tool generators crane etc.	
	Details on any concurrent demolition activities being undertaken OOWH adjacent to the proposed	
3	Names of Foremen Supervising the work	
4	Subcontractors Details (if applicable)	
5	Location of work	
6	Proposed Dates/Duration:	
7	Start Time:	
8	Finish Time:	
9	NOISE: Will the work generate noise audible at the nearest residence?	
	Attach map	
	What measures are being taken to reduce impacts Proposed noise & Vibration Monitoring	
10	Traffic Will the work require traffic control	
	Describe the location and Nature of disruption to traffic	
	Who is planning the traffic control	
	Who will be responsible for the traffic control during the work	
11	What lighting is to be provided	
12	Does the work team comprise a minimum of two persons	
13	Who in the work team holds a current first aid certification	
14	Where is the first aid to be located	
15	What means of communications is to be used to summon assistance in an emergency	

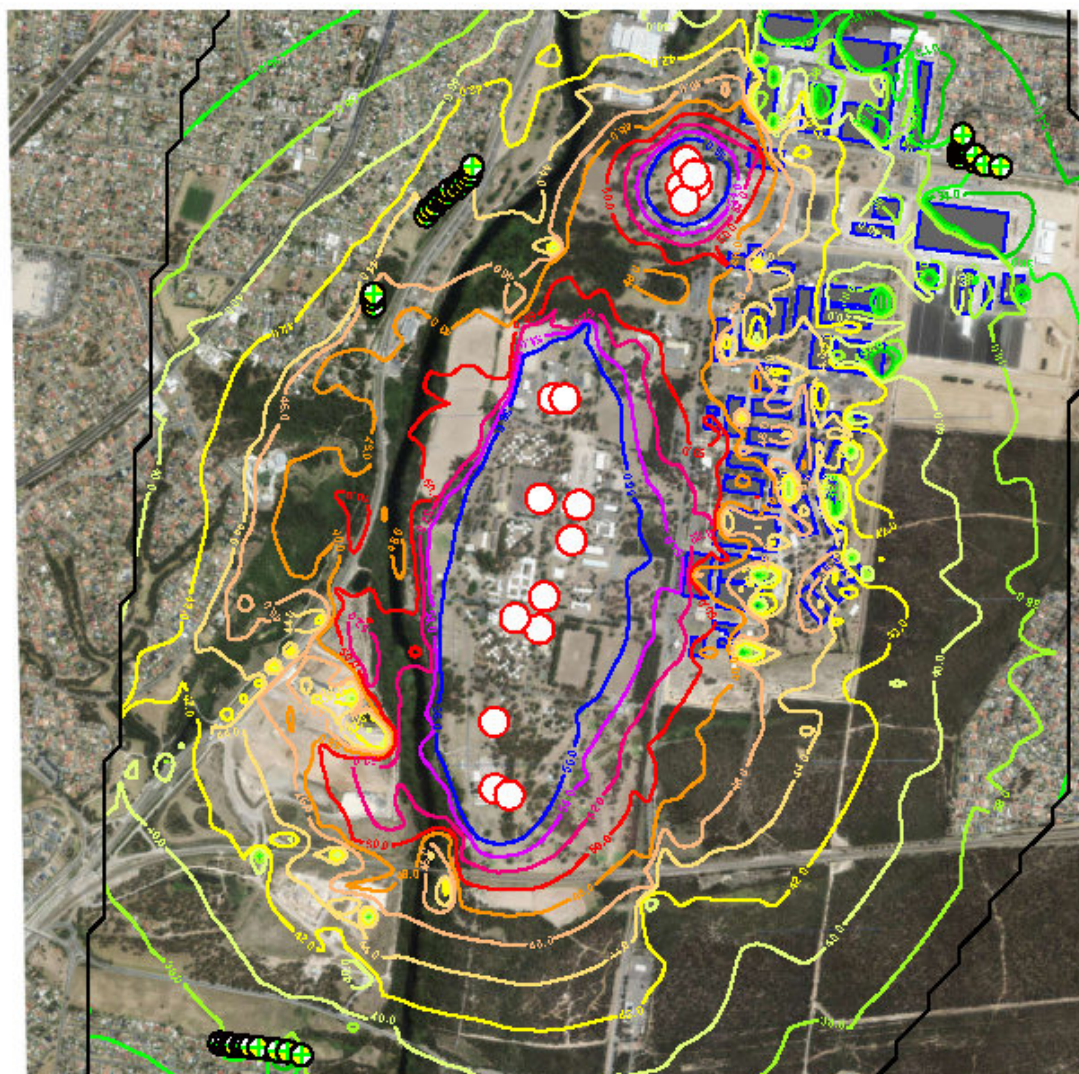
Out of hours request No. 1	Application Date
Name of person requesting the work:	Why Out of hours work is proposed

Item	Description	Information /Comments
16	Has a check of the Functionality of the proposed emergency means been made?	
17	Who from the project team will be supervising the work	

Assessment	
Acoustic Assessment prepared to determine if works are above RBL+5dB(A) at closest receiver	☐ Less than RBL +5dB(A) ☐ Above RBL +5dB(A)
Noise Report Required	☐ Yes ☐ No less than 5dB(A)

Approvals		
1	Environmental	NAME
		SIGNATURE Date
2	Community	NAME
		SIGNATURE Date
3	Traffic	NAME
		SIGNATURE Date
4	Safety	NAME
		SIGNATURE Date
5	Project Manager	NAME
		SIGNATURE Date

APPENDIX C **SOUNDPLAN NOISE PROPAGATION CONTOURS**



Noise levels dB(A)

< 34	Dark Green
34 <=	Green
36 <=	Light Green
38 <=	Yellow-Green
40 <=	Yellow
42 <=	Orange-Yellow
44 <=	Orange
46 <=	Red-Orange
48 <=	Red
50 <=	Dark Red
52 <=	Magenta
54 <=	Purple
56 <=	Dark Purple

Signs and symbols

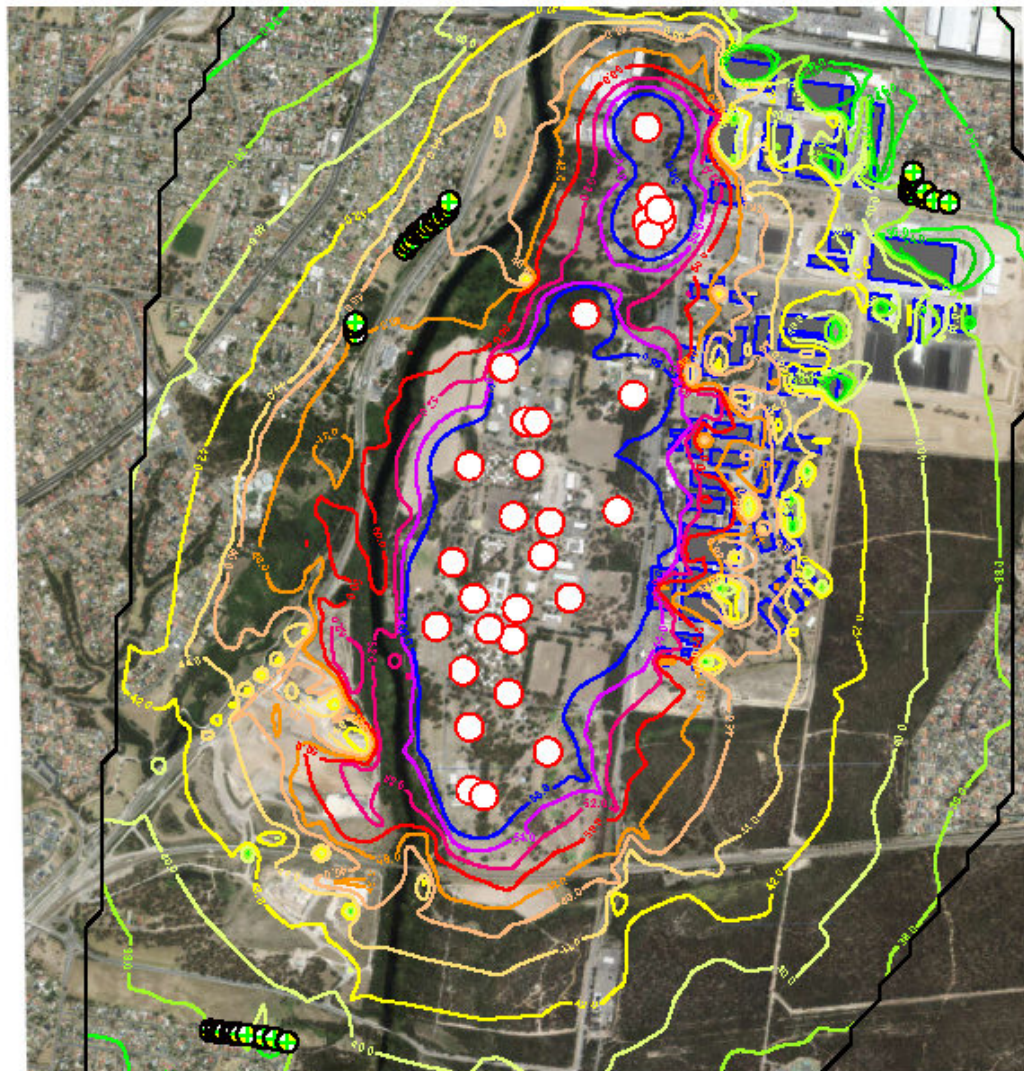
- Surface
- Point source
- Point receiver

Date: 31 August 16

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 m



DAY DESIGN PTY LTD
 Suite 17, 803 Forest Road
 Parramatta, Sydney NSW 2210
 Phone: 02 9584 2639
 Fax: 02 9584 2618

**Noise levels dB(A)**

<	34
34 <=	< 36
36 <=	< 38
38 <=	< 40
40 <=	< 42
42 <=	< 44
44 <=	< 46
46 <=	< 48
48 <=	< 50
50 <=	< 52
52 <=	< 54
54 <=	< 56
56 <=	

Signs and symbols

- Surface
- Point source
- Point receiver

Date: 31 August 16

0 50 00 200 300 400 500 600
m

DAY DESIGN PTY LTD
 Suite 17, 808 Fines Road
 Parramatta, Sydney NSW 2210
 Phone: 02: 9534 2639
 Fax: 02: 9534 2619

APPENDIX D **ASSESSED RECEIVER LEVELS**

Moorebank Intermodal Assessed receiver levels

Receiver	Fl	Dir	LrD dB(A)	Suburb
24 Glenelg Court	GF	W	35.9	Wattle Grove
25 Buckland Road	GF	SE	45.1	Casula
27 Buckland Road	GF	SE	44.4	Casula
29 Buckland Road	GF	SE	45.6	Casula
29 Glenelg Court	GF	W	35.8	Wattle Grove
31 Buckland Road	GF	S	46.1	Casula
31 Glenelg Court	GF	W	35.9	Wattle Grove
33 Buckland Road	GF	S	45.7	Casula
33 Glenelg Court	GF	W	36.0	Wattle Grove
35 Buckland Road	GF	S	46.1	Casula
35 Glenelg Court	GF	W	35.4	Wattle Grove
37 Glenelg Court	GF	W	36.0	Wattle Grove
39 Glenelg Court	GF	S	37.5	Wattle Grove

Key:	Day Decibel Fl = Floor level GF = Ground Floor F1 = First Floor	Dir = Direction of Noise Source from Receptor LrD = Predicted Level at Receptor	2
------	---	--	---

Moorebank Intermodal Assessed receiver levels

Receiver	Fl	Dir	LrD dB(A)	
5 Goodenough Street Glenfield	GF F 1	N	38.5 39.2	
6 Goodenough Street Glenfield	GF F 1	N	38.5 39.3	
7 Goodenough Street Glenfield	GF F 1	N	38.2 39.1	
8-10 Goodenough Street Glenfield	GF F 1	N	38.6 39.4	
9 Goodenough Street Glenfield	GF F 1	N	38.2 39.1	
11 Buckland Road Casula	GF	E	46.1	
11 Goodenough Street Glenfield	GF F 1	N	37.5 38.9	
12-22 Goodenough Street Glenfield	GF F 1	N	39.6 40.2	
12 Dunmore Crescent Casula	GF	E	47.8	
13 Buckland Road Casula	GF	E	45.6	
13 Goodenough Street Glenfield	GF F 1	N	38.0 38.9	
14 Dunmore Crescent Casula	GF	E	44.8	
15 Buckland Road Casula	GF	E	46.3	
15 Goodenough Street Glenfield	GF F 1	N	38.0 39.0	
16 Dunmore Crescent Casula	GF	E	49.3	
17 Goodenough Street Glenfield	GF F 1	N	37.8 38.8	
17 Namoi Court Wattle Grove	GF	S	37.1	
17A Buckland Road Casula	GF	SE	47.1	
18 Namoi Court Wattle Grove	GF	S	36.7	
19 Buckland Road Casula	GF	SE	46.5	
19 Goodenough Street Glenfield	GF F 1	N	37.7 38.8	
21 Buckland Road Casula	GF	SE	47.2	
22 Glenelg Court Wattle Grove	GF	W	37.2	
23 Buckland Road Casula	GF	SE	47.0	
24-30 Goodenough Street Glenfield	GF F 1	N	38.7 39.6	

Key:	Day D₁ Fl = Floor level Dir = Direction of Noise Source from Receptor LrD = Predicted Level at Receptor GF = Ground Floor F1 = First Floor	1
------	---	---

Moorebank Intermodal Assessed receiver levels

Receiver	Fl	Dir	LrD dB(A)	
24 Glenelg Court Wattle Grove	GF	W	37.5	
25 Buckland Road Casula	GF	SE	46.6	
27 Buckland Road Casula	GF	SE	45.8	
29 Buckland Road Casula	GF	SE	47.0	
29 Glenelg Court Wattle Grove	GF	W	37.4	
31 Buckland Road Casula	GF	S	47.2	
31 Glenelg Court Wattle Grove	GF	W	37.5	
33 Buckland Road Casula	GF	S	46.9	
33 Glenelg Court Wattle Grove	GF	W	37.6	
35 Buckland Road Casula	GF	S	47.3	
35 Glenelg Court Wattle Grove	GF	W	36.9	
37 Glenelg Court Wattle Grove	GF	W	37.5	
39 Glenelg Court Wattle Grove	GF	S	38.7	

Key:	Fl = Floor level Dir = Direction of Noise Source from Receptor LrD = Predicted Level at Receptor GF = Ground Floor F1 = First Floor	2
------	---	---

APPENDIX E **HIGH ENERGY IMPACT COMPACTION TRIAL, INITIAL ASSESSMENT**

MOOREBANK INTERMODAL - MOOREBANK HIGH ENERGY IMPACT COMPACTION TRIALS

We understand that the Contractor has scheduled trials for High Energy Impact Compaction (HEIC) rolling in three locations within the Moorebank Precinct West (MPW) site, Moorebank.

These trials will include the operation of a Caterpillar 'Challenger' 85E tractor with a HEIC attachment. The operation of the attachment, and the nature of the trials, has not been specifically addressed in the Construction Noise and Vibration Management Plan (CNVMP) issued by Day Design (report number 6033-1.1R Rev G, dated 6 March 2017). These trials have the potential to generate high levels of noise and vibration.

The operation of the HEIC roller will involve making several passes over a 12 metre strip of soil, compacting fill at speeds between 10 - 14 km/h. We have modelled the noise from HEIC rolling occurring in three locations within the MPW site. The trial locations and a full description of the proposed HEIC trial operations are given in the Technical Memorandum by Golder Associates (Project Number 1774119_003_M_Rev A dated 19 May 2017), attached as Appendix B.

Noise levels from the operation of the tractor and HEIC attachment have been calculated at the four nearest residential locations to determine compliance with the noise management levels (NML's) established in the CNVMP, shown in Table 1. The residential locations are as follows:

- R1 - 111 Leacocks Lane, Casula (from HEIC Trial Location 1)
- R2 - 2 Rushton Place, Casula (from HEIC Trial Location 2 & 3)
- R3 - 39 Glenelg Court, Wattle Grove
- R4 - 30 Goodenough Street, Glenfield

A site layout with receptor and HEIC locations and fill thickness contours is shown in Figure 1.

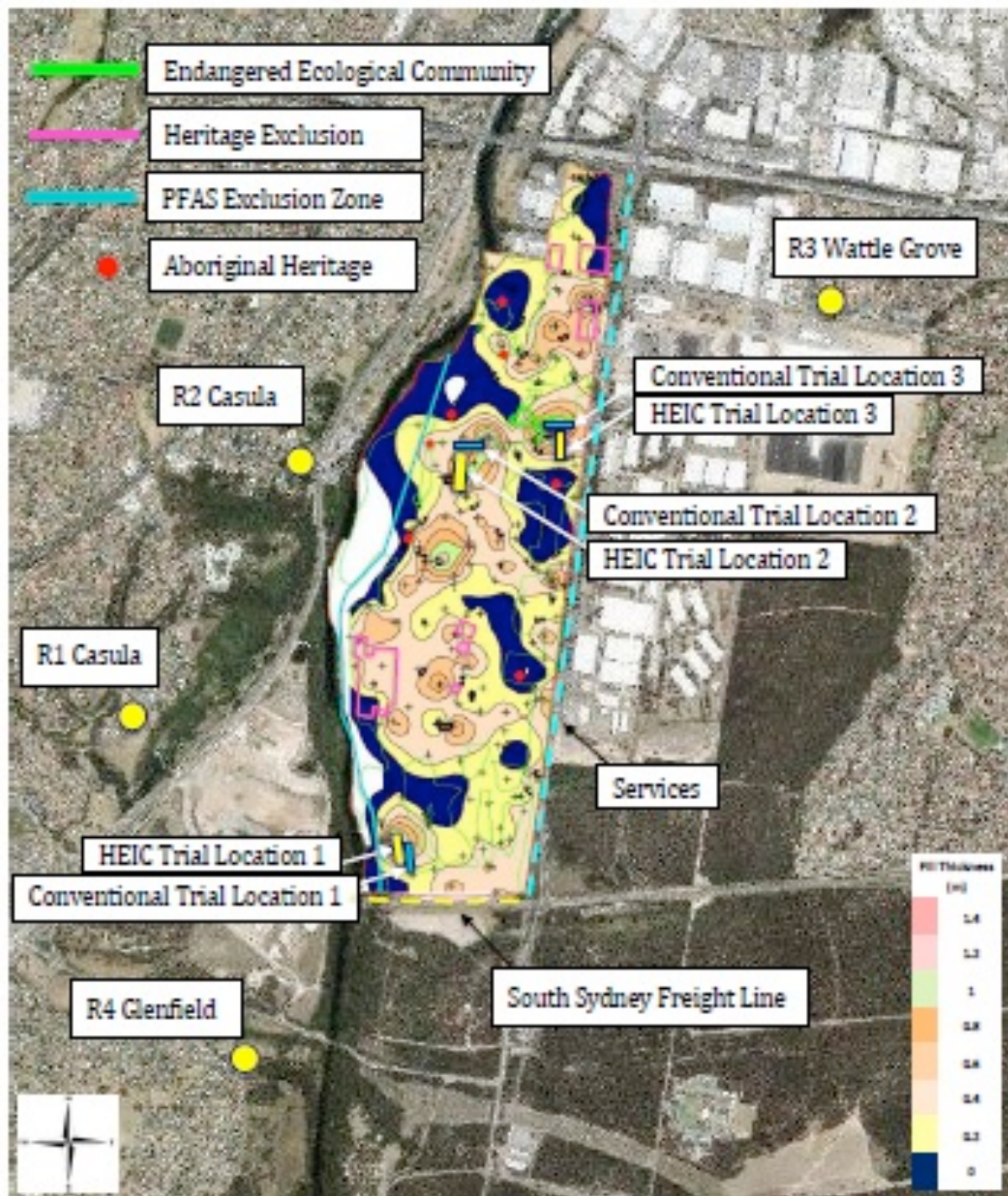


Figure 1. Site Layout HEIC Trial Locations, MPW, Moorebank.

Table 1 Calculated Noise Levels at Nearest Residential Receptors

	HEIC Trial Location 1	HEIC Trial Location 2	HEIC Trial Location 3
Distance to Receptor R1	1,200 m	1,500 m	2,000 m
Calculated Leq Noise Level at R1 – Casula	42 dBA	40 dBA	37 dBA
NML	49 dBA	49 dBA	49 dBA
Compliance	✓	✓	✓
Distance to Receptor R2	1,500 m	600 m	1,000 m
Calculated Leq Noise Level at R2 – Casula	40 dBA	49 dBA	44 dBA
NML	49 dBA	49 dBA	49 dBA
Compliance	✓	✓	✓
Distance to Receptor R3	2,600 m	1,500 m	1,000 m
Calculated Leq Noise Level at R3 – Wattle Grove	35 dBA	40 dBA	44 dBA
NML	45 dBA	45 dBA	45 dBA
Compliance	✓	✓	✓
Distance to Receptor R4	950 m	2,200 m	2,600 m
Calculated Leq Noise Level at R4 – Glenfield	45 dBA	36 dBA	35 dBA
NML	45 dBA	45 dBA	45 dBA
Compliance	✓	✓	✓

Noise Level Calculation Assumptions

1. Calculated Sound Power Levels

As noise data for this specific item of plant is unavailable until the specific items of plant are brought onto the MPW site, spectral sound power levels for use in this initial assessment have been derived from the Department for Environment, Food and Rural Affairs (DEFRA) - UK document 'Noise Database For Prediction Of Noise On Construction and Open Sites', 2005.

Table 2 shows the DEFRA sound pressure levels, measured at 10 metres, for a 100 kW tractor towing equipment.

Table 2 DEFRA Sound Pressure Levels

Description	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	63	125	250	500	1k	2k	4k	8k
100 kW Tractor (Towing Equipment)	80	79	71	78	75	78	70	61	55

This spectrum has been used to derive a sound power level and adjusted to 110 dBA for use in this initial assessment of the HEIC trials. 110 dBA is the maximum sound power level that can be used in order to comply with the NML's. The sound power levels are shown below in Table 3.

Table 3 Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	63	125	250	500	1k	2k	4k	8k
100 kW Tractor (Towing Equipment)	110	109	101	108	105	108	100	91	85

2. Attenuation

With regard to mechanisms of noise attenuation, a conservative approach has been used in this initial assessment. Distance attenuation has been included in noise calculations only, with no consideration for attenuation provided by barriers, structures or atmospheric and ground absorption.

Structures are present on site and in surrounding areas that will provide additional attenuation, and, given the distances to the nearest residential receptors, further attenuation is likely due to atmospheric and ground absorption.

As can be seen from Table 1, compliance is met at all residential receptors with the aforementioned assumptions in place. In practice, noise levels are likely to be considerably lower.

Vibration levels are difficult to predict given the various factors involved such as rock densities and large distances. While such calculations can be performed, predicted vibration levels can vary significantly from those measured on site due to the number of assumptions required. For the purposes of this initial investigation, the accuracy of such predictions is considered to be too poor to be of any practical use.

However, with reference to the SLR letter to LandPac Technologies (ref: 610.14971 Site Law 20150325, dated 25 March 2015), after vibration measurements were conducted of impact rollers, a site law is determined showing the reduction in Peak Particle Velocity (PPV) with increasing distance.

Prior to vibration measurements being conducted within the MPW site during the HEIC trials, the site law, determined by SLR, shall be considered the most reliable source of data when predicting how vibration levels diminish with distance, despite the differing soil types between the MPW site and the SLR test site. This letter is attached as Appendix A.

In Section 4.4 of the CNVMP, PPV criteria is established for residential receptors summarised as follows;

- Peak Particle Velocity values for residential premises, as measured at the foundations of the structure for structural damage of: 5mm/s below 10Hz, 5 – 15mm/s between 10 – 50 Hz, 40 – 50mm/s between 50 – 100Hz. For multi-storey residential structures, 15mm/s measured on the horizontal plane of the highest floor.

The Site Law, as determined by SLR, indicate that the PPV criteria is met at distances of over 30 metres from the impact roller. Given the distances to the nearest sensitive receptors are at least 600 metres, it is unlikely that vibration from the HEIC trials will approach the PPV criteria.

Vibration Impacts

Given the large intervening distances to the nearest residential receptors and taking into account the site law, determined empirically from measurements conducted onsite by SLR, an exceedance of the vibration criteria for both human comfort and structural damage at residential receptors, is considered unlikely.

Vibration criteria have been established in the CNVMP with an emphasis on residential receptors and structures. No consideration has yet been given to rail infrastructure or services such as pipelines and water mains due to the significantly higher criteria and large distances. However, the following provides guidance on relevant vibration criteria for such situations.

Guideline vibration values are given in the German Standard DIN 4150-3:1999 '*Effects of Vibration on Structures*', summarised in Table 4 below:

Table 4 *Guideline Values of Vibration Velocity: Evaluating the Effects of Short Term Vibration - DIN 4150*

Line	Type of Structure	Guideline values for velocity, v (mm/s)			
		Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40

Line 1 values shall be adopted for assessing vibration at the rail line or as close as possible to the rail line. German Standard DIN 4150-3:1999 also notes that;

'For civil engineering structures...the values in line 1...may be increased by as much as a factor of two...'

The values in Line 1 above may therefore be doubled when assessing vibration affecting the rail corridor. The rail corridor is more than 100 metres from the Location 1 trial areas, and with reference to the SLR Site Law and the guideline vibration values presented in Table 4 above, it is considered unlikely that vibration from the HEIC trials will approach these levels at the rail corridor.

¹ At frequencies above 100Hz, the values given in this column may be used as minimum values.

We understand that service pipelines exist on the eastern boundary of the MPW site, running parallel with Moorebank Avenue. German Standard DIN 4150-3:1999 also provides guideline vibration values for buried pipework, which is summarised as follows in Table 5;

Table 5 Guideline Values For Vibration On Buried Pipework

Line	Pipe Material	Guideline Values For Velocity Measured On The Pipe – mm/sec
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, plastic	50

These values shall be adopted when assessing vibration levels for services and pipework in areas close to the HEIC trial locations, most notably at Location 3, approximately 100 metres to the east.

Given the relatively high guideline vibration values and the distances from the HEIC trial areas to the services and pipework running along Moorebank Avenue, it is unlikely that any services or buried pipework will be exposed to vibration levels approaching these values.

Noise and Vibration Monitoring

In accordance with Section 6 of the CNVMP, attended noise monitoring ($L_{Aeq,15 \text{ minute}}$) will be conducted at each residential receiver, as established above, during the HEIC trial. Further, a sound level meter will be positioned 10 meters from the machine during typical HEIC operations to determine sound power levels.

If noise levels are in excess of NML's established in the CNVMP, the trial shall be discontinued until mitigation measures can be introduced which provide noise attenuation sufficient to achieve compliance with NML's at each residential receptor.

Notwithstanding the unlikelihood of exceedance of vibration criteria at any residential receptor or areas containing rail infrastructure, services or pipework, vibration levels generated by HEIC equipment shall also be measured at distances of 10, 20 and 30 metres from the machine to validate the site law determined by SLR (see Appendix A).

If required, further vibration compliance measurements may be conducted in close proximity to the rail line. Vibration measurements may also be conducted directly on any pipework or services if access is available via grilles or cover plates.

Based on the initial noise calculations and, with reference to the available vibration test data and relevant vibration criteria, it is our opinion that HEIC trials can be conducted on the MPW site, in the locations specified by Golder Associates, and comply with the noise and vibration criteria established in the CNVMP.

We trust that this information is satisfactory.



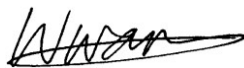
Alexander Mendoza MDesSc (Audio and Acoustics)

Acoustic Consultant

For and on behalf of Day Design



The undersigned hereby certifies that this Report has been checked and approved in accordance with our Quality Management System.



20/7/2017

Attachments:

Appendix A – Vibration Site Law, SLR Consulting Australia Pty Ltd.

Appendix B – Operation Procedure HEIC Compaction Trial, Landpac Technologies Australia Pty Ltd.



25 March 2015

610.14971 Site Law 20150325

LandPac Technologies
134 PO BOX 132
SEVEN HILLS NSW 1370

Attention: Mr Matthew Clenton

Dear Matthew

Vibration Site Law

**Captain Cook Drive, Kurnell
17 March 2015**

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) was engaged by LandPac Technologies Pty Ltd (LandPac) to undertake impact roller vibration measurements at Captain Cook Drive, Kurnell on 17 March 2015.

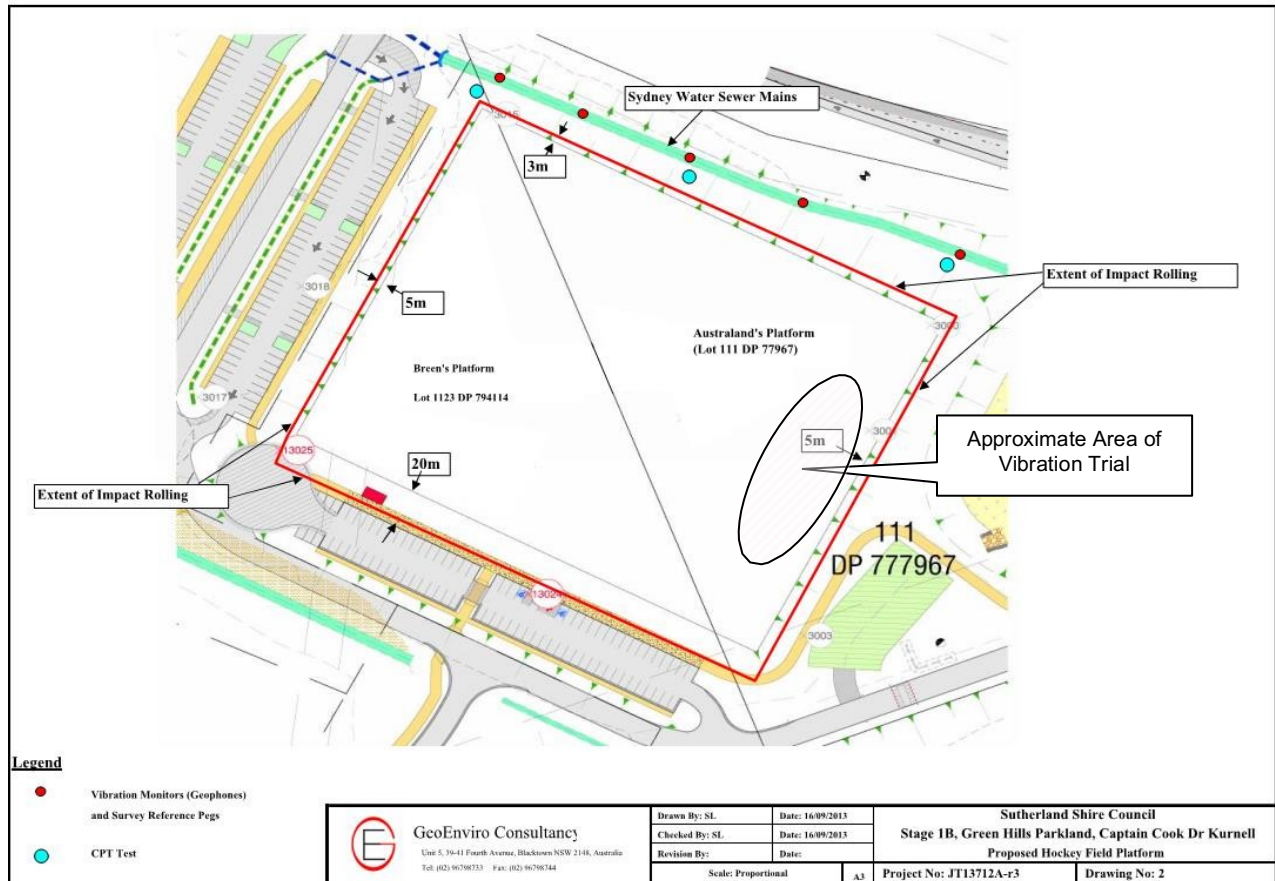
The purpose of this assessment was to establish a site specific vibration site law in order to determine the allowable impact roller distance in relation to the potential to cause vibration induced damage to nearby Sydney Water sewer mains.

2 Site Description and Work Operations

Soil compaction works were conducted in the trial area using a three-sided impact roller. Vibration measurements were carried out in the ground at various offset distances from the impact rolling works.

The area of impact rolling and Sydney Water sewer mains are shown in **Figure 1**.

Figure 1 Site Area



3 Vibration Damage Criteria

In terms of the most recent relevant vibration damage criteria for evaluating the effects of transient vibration on buried pipework, German Standard DIN 4150 Part 3 -1999 "*Structural Vibration - Part 5.3: Effects on Buried Pipework*" provides the guideline values reproduced in **Table 1**.

Table 1 Vibration Guideline Values for Buried Pipework

Pipe Material	Guideline Values for Velocity Measured on the Pipe
Steel (including welded pipes)	100 mm/s
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s

It should be noted that the guideline values above refer to velocity measured on the pipe. Appendix D.1 of the Standard states that where it is difficult to measure vibration on the pipe itself, such as in this case, measurements can be made on the ground surface. Furthermore that *“vibration measured on the ground surface is usually greater than that measured directly on pipes.”*

Additionally, the guideline values relate to transient vibration, which does not give rise to resonant responses in structures and/or is not likely to induce fatigue failure of the structure. Subclause 6.3 of the Standard states that where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, then the guide values may need to be reduced by up to 50%. It should be noted that impact rolling works are not generally considered to have the potential to cause dynamic loading in buried pipework.

For “clay, concrete, reinforced concrete, pre-stressed concrete and metal” pipelines, the guideline value of 80 mm/s is recommended.

Where vibration measurements cannot be undertaken directly on the pipe, the vibration measurements can be undertaken in the ground immediately adjacent to the pipeline or on the ground surface above the pipeline. The criterion nominated above would still apply to the measured level. It is noted that this approach is likely to be conservative since it does not take into account the likely lower (attenuated) vibration levels to be expected on the pipe structure.

Notwithstanding the above, it is noted that the site “*Earth Management Plan*” (prepared by GeoEnviro Consultancy Pty Ltd, September 2013) have nominated a vibration control criterion of 10 mm/s.

4 Vibration Measurements

Soil compaction works were conducted in the trial area using a three-sided impact roller. Operator- attended vibration measurements were undertaken in the ground at a number of offset distances from the impact roller operations. During each passby of the impact roller, the highest vibration level was recorded as the impact roller was at the nearest point to the vibration monitor.

5 Vibration Monitoring Results

Figure 2 presents the maximum orthogonal vibration levels measured at all measurement locations at various offset distances from the three-sided impact roller. The maximum vibration trendline versus distance (site law) for the measured data is also shown.

Figure 3 presents the same data on a log-log plot for easier interpretation. The percentage probability exceedance levels are also shown.

Figure 2 Site Law for Impact Roller Trials – Linear Scale

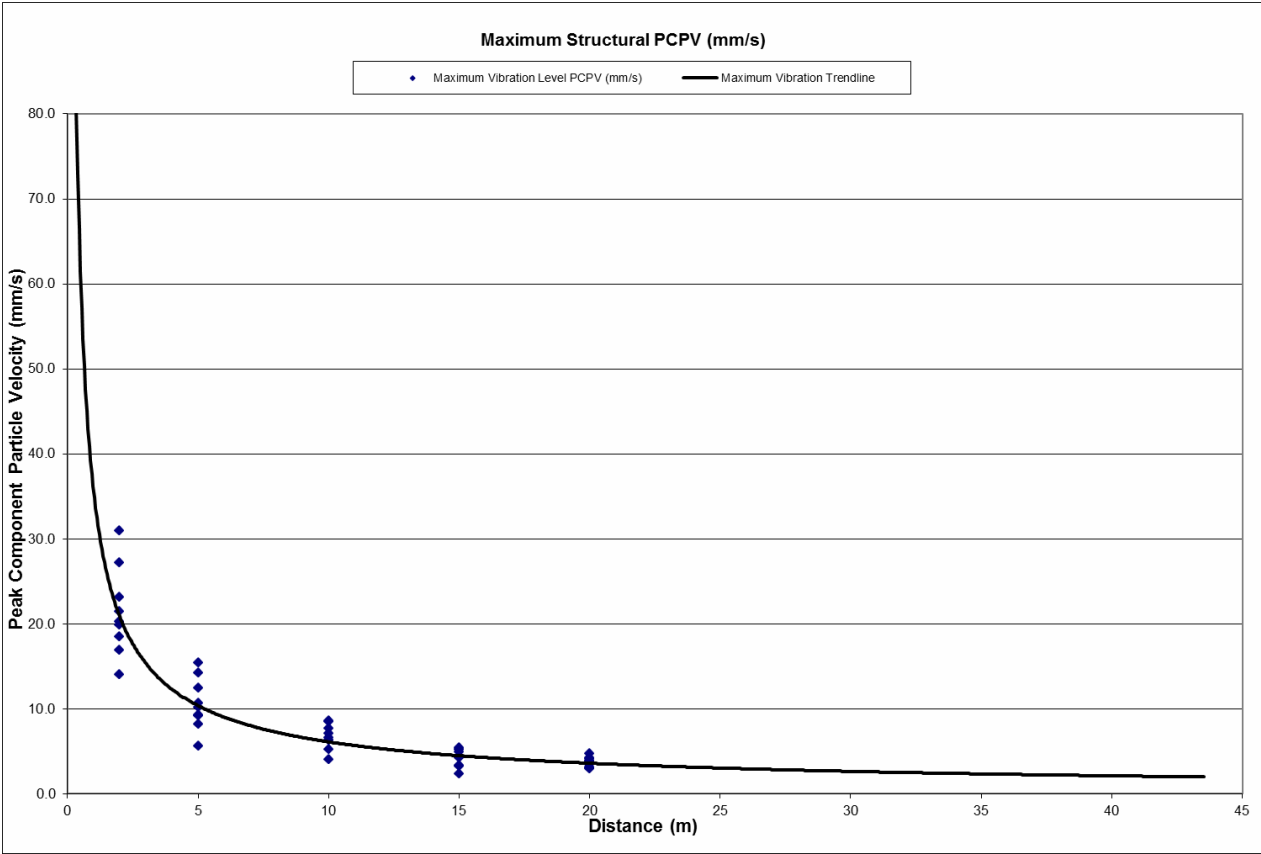
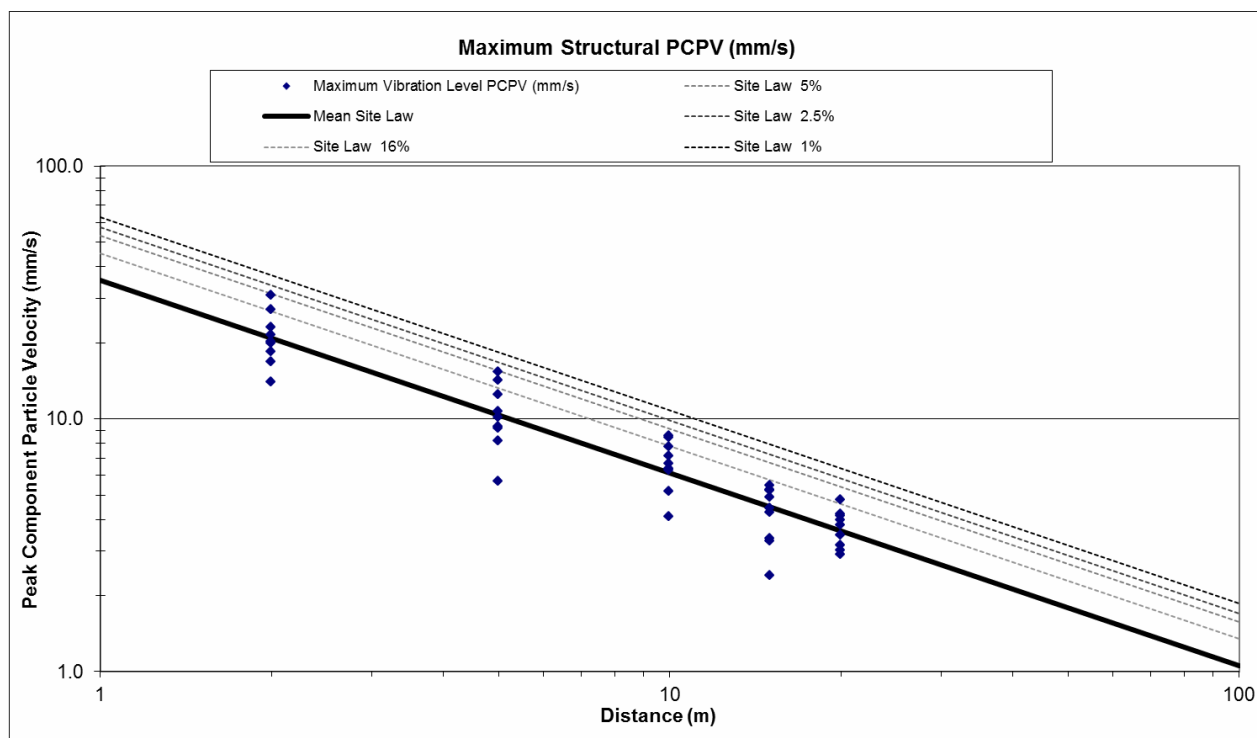


Figure 3 Site Law for Impact Roller Trials – Logarithmic Scale



6 Vibration Impact Assessment

It is noted that the vibration trial was conducted in ground which was denser than the loose sand in which the Sydney Water sewer mains are located. As such, it is expected that an amplification factor of up to 2 may be applied to the site law presented above.

Based on the above information and the 1% vibration level exceedance site law developed for the subject works and the criteria presented in **Section 3**, the three-sided impact roller can safely be operated at distances greater than 24 m from the Sydney Water sewer mains.

7 Conclusion

Vibration measurements were undertaken at Captain Cook Drive, Kurnell during impact rolling works conducted on 17 March 2015.

Based on the vibration site law the three-sided impact roller can safely operate at distances greater than 24 m away from the Sydney Water sewer mains.

I trust that the above report meets your current requirements. Should you have any questions or require any additional information, please contact me on 9427 8100.

Yours sincerely



RYAN WAKELING

Associate – Acoustics and Vibration

Reviewed by: MB



Ground Engineering

AUSTRALIA – NEW ZEALAND – MALAYSIA – USA – SOUTH AFRICA – EUROPE – MIDDLE EAST

OPERATING PROCEDURE

HEIC Compaction Trial

Moorebank Intermodal Terminal (MIT)

This document is subject to the copyright of Landpac and its contents should not be used without written permission from Landpac

PO BOX 132, SEVEN HILLS, NSW 1730 ---- PO BOX 454,
OXENFORD, QLD 4210, Australia:

A.B.N. 12 069 528 696

Tel 1300 237 045; +61 (0)2 9838 7044 info@landpac.com.au;



HIGH ENERGY IMPACT COMPACTION TRIAL PROCEDURE

Moorebank Intermodal Terminal (MIT)

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to ensure the trials conducted onsite comply with the trial methodology and objectives defined by Golder Associates in the technical memorandum dated 19 May 2017.

1.2 Scope

This procedure defines the HEIC (High Energy Impact Compaction) trial preparation, compaction methodology and monitoring and testing requirements interpreted by Landpac to meet the trial methodology and objectives defined by Golder Associates in the technical memorandum dated 19 May 2017.

2. APPLICABLE DOCUMENTS

- Technical Memorandum – HEIC Trail Methodology: Golder Associates dated 19 May 2017.

3. TRIAL OBJECTIVES

The primary objective of the trials are to:-

1. Establish whether a method based, performance based or a combination of both should be used for the production works.
2. Verify that the compaction methodologies applied meet the Benching Criteria defined in Memo 006 with respect to:
 - Identification of “soft spots”
 - Acceptable surficial layer stiffness
 - Acceptable surficial layer strength
3. Establish correlations between dynamic response and soil stiffness for the soil types in the trial locations.
4. Record ground borne vibrations and noise levels emitted during impact compaction on a trial area.

4. TRIAL AREAS

Three trial areas are nominated on the Moorebank Precinct West (MPW) site in the Golder Associates Technical Memorandum – HEIC Trail Methodology, dated 19 May 2017 (See Figure 1) and are briefly described as follows:

- Location 1: Approximately 40m x 130m with estimated fill thickness ranging from 0.4m to 1.8m
- Location 2: Approximately 40m x 145m with estimated fill thickness ranging from 0.1m to 1.7m
- Location 3: Approximately 40m x 115m with estimated fill thickness ranging from 0.6m to 1.7

Ref:	Authorised By:	Date:	Rev No:	Doc No:	Page:
----	K.McCann	30/5/17	Draft 1	OP1096	1

5. PLANT AND EQUIPMENT REQUIRED

The following equipment is required to conduct the HEIC compaction trials.

- 4.1. Three-Sided Impact Compactor (Kinetic Energy rating – 135kJ/Potential Energy rating – 25kJ): - Supplied by Landpac.
- 4.2. Tractor minimum power 220 kW: Supplied by Landpac
- 4.3. Dynamic Ground Response (CIR) system: Supplied by Landpac
- 4.4. Compaction Pass Monitoring (CPM) system – Supplied by Landpac
- 4.5. Water Cart: – Supplied by Liberty Industrial
- 4.6. Cone Penetrometer test equipment to test to 4m depth – Supplied by others
- 4.7. Plate Load test equipment (760mm Dia plate) and plant (example 36 Tonne excavator) to provide sufficient reaction – Supplied by others



6. COMPACTION REQUIREMENTS

The depth of fill over each trial area varies. It won't be practical to vary the number of passes in each strip in a longitudinal direction so to assess the compaction requirements relative to the compaction work done, the number of passes have been varied for each 12m strip in each trial area (See flow diagram paragraph 8) as follows:

- Location 1- West 12m strip-15 Passes; Centre 12m strip-10 Passes; East 12m strip-25 Passes
- Location 2- West 12m strip-15 Passes; Centre 12m strip-10 Passes; East 12m strip-20 Passes
- Location 3- West 12m strip-15 Passes; Centre 12m strip-10 Passes; East 12m strip-30 Passes

7. TRIAL AREA PREPARATION

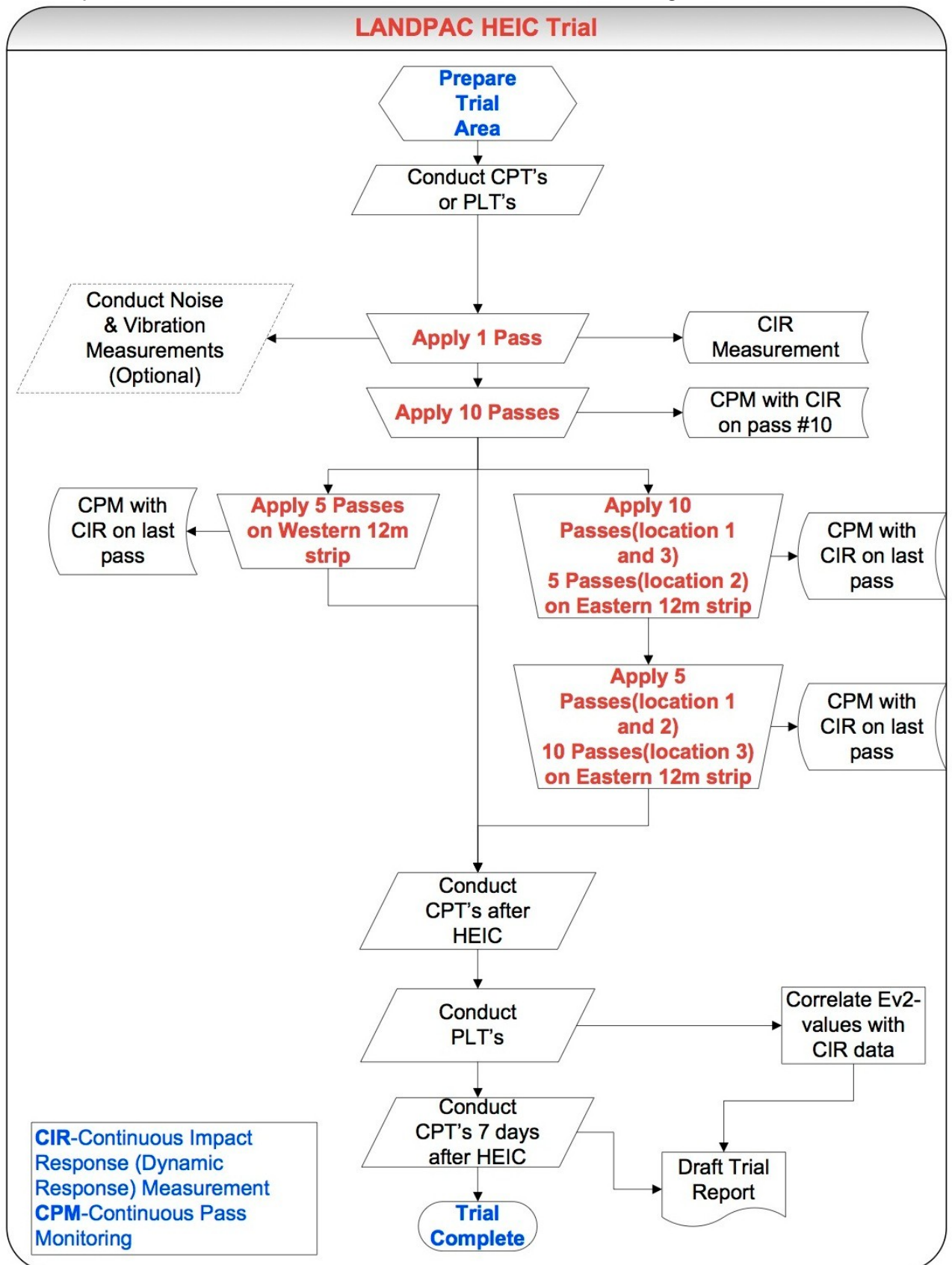
The topsoil shall be stripped off the nominated trial areas and the surface leveled with a dozer or similar to the allow operation of the impact compactor at around 12k/h.

Ref:	Authorised By:	Date:	Rev No:	Doc No:	Page:
------	----------------	-------	---------	---------	-------

----	K.McCann	30/5/17	Draft 1	OP1096	2
------	----------	---------	---------	--------	---

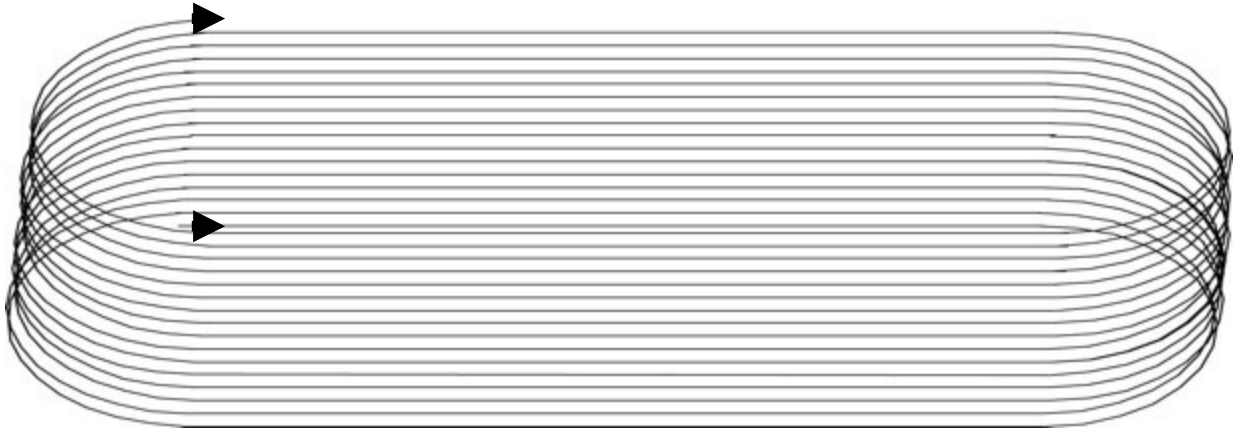
8. TRIAL METHODOLOGY

The sequence for the execution of the trial is outlined in the diagram below:-



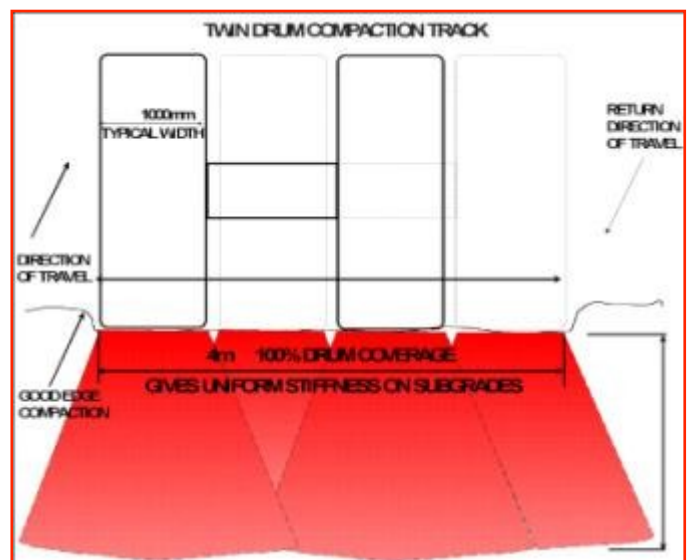
Ref:	Authorised By:	Date:	Rev No:	Doc No:	Page:
----	K.McCann	30/5/17	Draft 1	OP1096	3

The Impact Compactor shall be operated at around 10-14km/h (See <https://www.youtube.com/watch?v=zsXTND3L9Ls>). To facilitate this the compaction should be carried out in a continuous interlocking manner so that the operating speed can be maintained.



With a split mass Impact Compactor the compaction is applied with an interlocking drum pattern (surface pass) across the worked area to ensure that the whole surface area is subject to a consistent number of impact blows. The application of a **surface pass** methodology as indicated is preferred to a machine pass methodology.

The number of passes required will vary according to the depth of fill, nature of the fill and the required compaction densities.



Undulations are created during the impact compaction. To enable the impact compactor to travel at operating speed a scraper attachment is fitted to the impact compactor. If the undulations become excessive the operator shall engage the scraper attachment to trim the undulations.

Ref:	Authorised By:	Date:	Rev No:	Doc No:	Page:
----	K.McCann	30/5/17	Draft 1	OP1096	4

9. COMPACTION CONTROL AND MONITORING

Impact Compaction during the trials shall be controlled and monitored principally using:

- Compaction Pass monitoring (CPM) to record the number of surface passes completed.
- Dynamic Ground Response (CIR) measurements at the commencement of the trial and after each set of passes (i.e. 0, 5, 15, etc)

The ground response will not change significantly from one pass to the next. Therefore ground response monitoring will not be done during each compaction as noted in the Golder Associates technical memorandum dated 19 May 2017. The ground response measurements shall be processed and presented as plot in a pdf file showing the ground response ranges in 3 or 4 colours for each trial area (See example in Figure 2)

10. GEOTECHNICAL TESTING

Cone Penetrometer Testing (CPT) at nominal 25m spacing in the center of each 12m strip shall be used as the primary means of assessing the compacted sub-grade. Allowing for the turning areas at the end of each trial area a nominal spacing of 25m would allow 3 CPT's in each 12m strip, resulting in 9 CPT's in each trial area. CPT testing is required immediately after completion of the HEIC and 7 days after completion of the HEIC.

It is generally accepted CPT readings at shallow depths (about 0.3m for cohesive soils and 0.5m for cohesionless soils) are not reliable. Conventional density testing should be conducted for verification of the compacted shallow soils.

Plate load test (PLT) are required at the completion of the HEIC compaction to establish correlations between the Ev2 values and the (CIR) ground response. To adequately assess the stiffness of the deeper fill (1.7m) layers a 760mm diameter plate shall be used and a reaction load to provide a maximum load on the plate of 250kN). The PLT locations shall be determined from CIR plots at the completion of the HEIC compaction.

11. VIBRATION MEASUREMENT

If the ground borne vibrations emitted by the Impact Compactor are measured they shall be measured at one trial area in accordance with BS 7385.2-1993 with the machine operating normally on representative ground conditions.

12.NOISE MEASUREMENT

If the noise levels emitted by the Impact Compactor tractor are measured they shall be measured in accordance with AS2012.1-1990 with the background noise levels reduced to a minimum.

Ref:	Authorised By:	Date:	Rev No:	Doc No:	Page:
-----	K.McCann	30/5/17	Draft 1	OP1096	5