

APPENDIX B3

Construction Noise and Vibration Management Sub Plan

SANCROX TRAFFIC ARRANGEMENT

[JUNE 2014]



Document control

File name	Construction Noise and Vibration Management Sub Plan JUNE 6 (Rev 9.0)_ERMtrackchanges_nl.docx
Report name	Construction Noise and Vibration Management Plan
Revision number	9.0

Plan approved by:

[signed]

[signed]

[signed]

Name

Name

Name

Ferrovial Agroman
Project Manager

Ferrovial Agroman
Q&E Manager

Roads and Maritime
Services Representative

Revision history

Revision	Date	Description	Approval
0	19/4/13	Draft Document from Roads and Maritime Services	
1		Initial Post-Tender Version – For Roads and Maritime Services Formal Review	
2	2/01/2014	ERM Revision	
3	21/03/2014	ERM Revision for comments for Ferrovia Agroman	
4	03/04/2014	ERM Revision for comments for Ferrovia Agroman	
5	07/04/2014	ERM Revision for comments for Ferrovia Agroman	
6	09/04/2014	ERM Revision for comments by Roads and Maritime	
7	17/04/2014	FAA Revision for comments by Roads and Maritime	
8	2/06/2014	FAA Revision for comments by EPA (13/05/2014)	
8.1	6/6/2014	FAA Revision for comments by Roads and Maritime (04/06/14)	
9.0	26/6/2014	FAA Revision for comments by EPA	
9.1	3/07/2014	FAA Revision for comments by DP&E	

Distribution of controlled copies

Copy no.	Issued to	Version
1		

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 3/48 Last Updated: 17 September 2014
--	--	---

Copy no.	Issued to	Version
2		
3		

Contents

1	Introduction	7
1.1	Context	8
1.2	Background.....	8
1.3	Environmental management systems overview	8
2	Purpose and objectives	9
2.1	Purpose.....	9
2.2	Objectives	9
2.3	Targets.....	9
3	Environmental requirements.....	10
3.1	Relevant legislation and guidelines.....	10
3.2	Minister's Conditions of Approval (CoA).....	10
3.3	Statement of commitments	14
4	Existing environment	15
4.1	Sensitive receivers	15
4.2	Background noise	19
5	Noise and vibration criteria for NSW	20
5.1	Construction noise and assessment objectives.....	20
5.2	Project noise management levels	23
5.3	Vibration criteria.....	25
5.4	Blast criteria	27
6	Environmental aspects and impacts	28
6.1	Environmental aspects.....	28
6.2	Impacts	28
7	Construction noise and vibration assessment.....	29
7.1	Construction activities	29
7.2	Construction noise impacts.....	30
7.3	Construction vibration assessment	38
7.4	Building Condition Inspections.....	39
7.5	Out of Hours Works	39
8	Environmental control measures	41
9	Compliance management.....	48
9.1	Roles and responsibilities	48
9.2	Training.....	48
9.3	Inspections & monitoring.....	48
9.4	Non-conformances.....	49
9.5	Complaints	49
9.6	Auditing	50
9.7	Reporting	50

I0	Review and improvement	51
I0.1	Continuous improvement.....	51
I0.2	CNVMP update and amendment	51

Tables

Table 3-1	Conditions of Approval relevant to noise and vibration	11
Table 3-2	Statements of commitment relevant to this CNVMP	14
Table 4-1	Noise catchment areas for the Project	15
Table 4-2	Ambient noise levels for NCA21 and NCA22 (Monitoring Period: Dec 2006)	19
Table 5-1	Noise at residents using quantitative assessment	20
Table 5-2	Noise at sensitive land uses (non-residents) using quantitative assessment.....	22
Table 5-3	Project-specific construction noise objectives.....	24
Table 5-4	Continuous vibration acceleration criteria (mm/s) 1-80Hz.....	25
Table 5-5	Impulsive vibration acceleration criteria (mm/s) 1-80Hz.....	26
Table 5-6	Acceptable vibration dose values for intermittent vibration (m/s ^{1.75}).....	26
Table 5-7	Structural damage criteria	27
Table 7-1	Construction scenarios and associated plant and equipment	29
Table 7-2	Likely construction facilities and associated attributes	30
Table 7-3	Noise impact on representative sensitive receivers	32
<i>Table 7-4</i>	<i>Sleep disturbance assessment including comparison of sound power level (LW) and distance to receiver.....</i>	<i>37</i>
Table 7-5	Typical construction equipment vibration levels (PPV, mm/s).....	38
Table 7-6	Typical construction equipment vibration levels (eVDV, m/s ^{1.75})	38
Table 7-7	Structural damage criteria	39
Table 8-1	Noise and vibration management and mitigation measures.....	42

Appendices

Appendix A	Plant and Equipment Sound Power Levels
Appendix B	Out of Hours Works Procedure (OOHW)

Glossary/Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change (now EPA)
DECCW	NSW Department of Environment, Climate Change and Water. <i>Note: DECC is a defunct name. Now it is responsibility of The New South Wales Office of Environment and Heritage (OEH).</i>
EA	Environmental Assessment
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
ECRTN	Environmental Criteria for Road Traffic Noise
Environmental impact	Defined by AS/NZS ISO 14001:2004 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
ENMM	RTA <i>Environmental Noise Management Manual</i>
Environmental objective	Defined by AS/NZS ISO 14001:2004 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2004 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ER	Environmental Representative
ESR	FAA Environmental Site Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Extended Hours	Extended hours apply to construction works undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints.
FAA	Ferrovial Agroman Australia
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.

ICNG	Interim Construction Noise Guideline
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NMLs	Noise Management Levels
OEH	NSW Office of Environment and Heritage
OOHW	Out of Hours Works
PM	FAA Project Manager
Project	Sancrox Traffic Arrangement
Q&E	FAA Quality and Environmental Manager
RBL	The Rating Background Level for each period is the medium value of the assessment background level values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night).
Roads and Maritime	Roads and Maritime Services
RTA	Roads and Traffic Authority Note: RTA is a defunct name. Now it is responsibility of Roads and Maritime Services.
SoC	Statement of Commitments
SWL	Sound Power Level
SPL	Sound Pressure Level

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 8/48 Last Updated: 17 September 2014
--	--	---

1 Introduction

1.1 Context

This Construction Noise and Vibration Management Sub Plan (CNVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Sancrox Traffic Arrangement (the Project) works which is part of the upgrade of the Pacific Highway from the Oxley Highway and Kempsey.

This CNVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the Roads and Maritime Statement of Commitments (SoC), the mitigation measures listed in the Oxley Highway to Kempsey Environmental Assessment (EA) and all applicable legislation.

1.2 Background

The *Oxley Highway to Kempsey – Upgrading the Pacific Highway – Environmental Assessment* (RTA 2010) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project.

As part of EA development, a detailed construction and operational noise and vibration assessment was prepared to address the Environmental Assessment Requirements issued by the then Department of Planning. The noise and vibration assessment was included in the EA Volume 3 as a Working Paper as well as a summary in Chapter 16.

The EA concluded that there will be some noise and vibration impacts during construction and the extent will vary depending on the type of activity in progress and the proximity to sensitive receivers. During the ongoing design development further background noise monitoring was undertaken and new receivers have been identified.

1.3 Environmental management systems overview

The overall Environmental Management System for the Project is described in the Construction Environmental Management Plan (CEMP).

The CNVMP is part of the Ferrovial Agroman Australia (FAA) environmental management framework for the Project, as described in Section 4.1 of the CEMP. In accordance with CoA B31(c), this Plan has been developed in consultation with the NSW Environment Protection Authority (EPA).

Management measures identified in this Plan will be incorporated into site or activity specific Environmental Work Method Statements (EWMS). EWMS will be developed and signed off by environment and management representatives prior to associated works and construction personnel will be required to undertake works in accordance with the identified requirements and associated mitigation measures.

Used together, the CEMP, strategies, procedures and EWMS form management guides that clearly identify required environmental management actions for reference by FAA personnel and contractors.

The review and document control processes for this Plan are described in Section 1.6 and Chapter 10 of the CEMP.

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how FAA proposes to manage potential noise and vibration impacts during construction of the Project.

The management of noise and vibration impacts in this Plan is based on the assessment of construction noise and vibration undertaken as part of the EA. The assessment in the EA considered the following relevant NSW Government guidelines and standards:

- *Environmental Criteria for Road Traffic Noise (ECRTN)* (EPA 1999).
- *NSW Industrial Noise Policy* (EPA 2000).
- *RTA Environmental Noise Management Manual (ENMM)* (RTA 2001).
- *Interim Construction Noise Guideline (ICNG)* (DECC 2009).
- *Assessing Vibration: A Technical Guideline* (DEC 2006).
- British Standard 7385: Part 2 – *Evaluation and measurement of vibration in buildings*.
- German Standard *DIN 4150-3: 1999 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground-borne vibration*.
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* Australian and New Zealand Environment and Conservation Council (ANZECC1990).
- Australian Standard *AS2187.2-2006: Explosives – Storage, Transport and Use*.
- Australian Standard *AS2436-2010: Guide to noise and vibration control on construction, demolition and maintenance sites*.

2.2 Objectives

The key objective of the CNVMP is to ensure that impacts to the local community and the built environment from noise and vibration are minimised. Specific objectives include:

- Identifying sensitive receivers and ensure appropriate environmental controls and procedures are implemented during construction activities.
- Minimising potential adverse noise and vibration impacts to the environment and community.
- Managing impacts if they occur through a systematic analysis of mitigation strategies.
- Ensure appropriate measures are implemented to address the relevant CoA and SoC outlined in Table 3.1 and Table 3.2, and the mitigation measures detailed in the EA.
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 of this Plan.

2.3 Targets

Targets have been established for the management of noise and vibration impacts during the Project to ensure:

- Full compliance with the relevant legislative requirements, CoA and SoC.
- Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the ICNG (DECC, 2009).
- Complaints from the community and stakeholders are minimised.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to noise and vibration management includes:

- NSW Protection of the Environment Operations Act 1997 (POEO Act).
- NSW Protection of the Environment Operations (Noise Control) Regulation 2008.

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- Roads and Maritime Services QA Specification G36 – Environmental Protection (Management System).
- NSW DECC, Interim Construction Noise Guideline (ICNG) (DECC 2009).
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 – “Evaluation and measurement of vibration in buildings”.
- German DIN 4150: Part 3 – 1999 “*Effects of Vibration on Structure*” (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

3.2 Minister’s Conditions of Approval (CoA)

The CoA relevant to this Plan are listed **Table 3-1** below. A cross reference is also included to indicate where the condition is addressed in this Plan or other Project management documents.

CoA related to blasting are not included as this activity is not proposed during the construction works during the Project.

Table 3-1 Conditions of Approval relevant to noise and vibration

CoA No.	Condition Requirements	Document Reference
B31 c)	<p>As part of the Construction Environment Management Plan for the project required under condition B30 of this approval, the Proponent shall prepare and implement the following:</p> <p>A Construction Noise and Vibration Management plan to detail how construction noise and vibration impacts will be minimised and managed. The plan shall be developed in consultation with the EPA and include, but not necessarily be limited to:</p>	This plan
	i. identification of nearest sensitive receptors and relevant construction noise and vibration goals applicable to the project;	Chapter 4, Chapter 5
	ii. identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to impact on surrounding sensitive receivers including expected noise/ vibration levels;	Chapter 7, Appendix A
	iii. identification of feasible and reasonable measures proposed to be implemented to minimise construction noise and vibration impacts (including construction traffic noise impacts);	Chapter 8
	iv. procedure for dealing with out-of-hour works in accordance with condition C4, including procedures for notifying the Director General concerning complaints received in relation to the extended hours approved under condition C4(d);	Appendix B
	v. procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, 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),	Chapter 8, Section 9.3
	vi. procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints; and	Chapter 8,
	vii. a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where significant exceedances of relevant noise and vibration goals are detected;	Section 9.3, Section 8.3 of the CEMP
C3	<p>The Proponent shall only undertake construction activities associated with the project during the following standard construction hours:</p> <p>a. 7:00am to 6:00pm Mondays to Fridays, inclusive; and</p> <p>b. 8:00am to 1:00pm Saturdays; and</p> <p>c. at no time on Sundays or public holidays.</p>	Chapter 8

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 12/48 Last Updated: 17 September 2014
--	--	--

CoA No.	Condition Requirements	Document Reference
C4	<p>Works outside of the construction hours identified in conditions C3 may be undertaken in the following circumstances:</p> <ul style="list-style-type: none"> d. works that generate noise that is <ul style="list-style-type: none"> i. no more than 5 dB(A) above rating background level at any residence; or ii. no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive land uses; or e. for delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or f. where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or g. construction works undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints; or h. with the approval of the Director General in accordance with condition C5. 	Chapter 8
C5	<p>Construction activities (Out of Hours work) may be allowed to occur outside the construction hours specified in condition C3 with the prior written approval of the Director General. Requests for Out of Hours approval will be considered for construction activities which cannot be undertaken during the construction hours specified in condition C3 for technical or other justifiable reasons and will be considered on a case by case or activity-specific basis. Request for Out of Hours work must be accompanied by details of the nature and need for activities to be conducted during the varied construction hours;</p> <ul style="list-style-type: none"> a. details of the nature and need for activities to be conducted during the varied construction hours; b. written evidence to the EPA and the Director General that activities undertaken during the varied construction hours are justified, appropriate consultation with potentially affected receivers and notification of the relevant Council has been undertaken, issues raised have been addressed, and all feasible and reasonable mitigation measures have been put in place; and c. evidence of consultation with the EPA on the proposed variation in standard construction hours. <p>Despite the above, Out of Hours work may also occur in accordance with an approved Construction Environmental Management Plan or Construction Noise and Vibration Management Sub-plan for this project, where that plan provides a process for considering the above on a case by case or activity specific basis by the Proponent, including factors (a) to (c) above.</p>	Chapter 8
C7	<p>The Proponent shall implement all feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009) during construction activities, Any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Sub- Plan required under condition B31.</p>	Chapter 8, Section 9.3, Section 9.4

	<p style="text-align: center;">Ferrovia Agroman Australia</p> <p style="text-align: center;">CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN</p> <p style="text-align: center;">SANCROX TRAFFIC ARRANGEMENT</p>	<p>Code: SCX-ENV-P-004</p> <p>Revision: 8.0</p> <p>Page: 13/48</p> <p>Last Updated: 17 September 2014</p>
--	--	---

CoA No.	Condition Requirements	Document Reference
C8	<p>The Proponent shall implement all feasible and reasonable mitigation measures with the aim of achieving the following construction vibration goals:</p> <ul style="list-style-type: none"> a. for structural damage, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures; and b. for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (DECC, 2006). (C8.1) 	Chapter 8, Appendix B

3.3 Statement of commitments

Relevant SoC are listed **Table 3-2** below. This includes reference to required outcomes, the timing of when the commitment applies; relevant documents or sections of the environmental assessment influencing the outcome and implementation.

Table 3-2 Statements of commitment relevant to this CNVMP

Outcome	Ref #	Commitment	Timing	CNVMP Reference
Minimise construction noise and vibration impacts.	CN1	All feasible and reasonable mitigation and management measures to minimise construction noise and vibration at sensitive receivers will be investigated. Noise and vibration will be monitored to measure against predicted levels. Where required, feasible and reasonable mitigation measures will be implemented.	Construction	Chapter 8
Minimise construction noise and vibration impacts.	CN3	<p>Construction will normally be limited to the following hours:</p> <ul style="list-style-type: none"> • Between 6 am and 6pm Monday to Friday. • Between 7am and 4pm Saturday. <p>There would be no works outside these hours, or on Sundays or public holidays, except:</p> <ol style="list-style-type: none"> a. For works that do not cause construction noise to be audible at any sensitive receivers. b. For the delivery of materials required outside these hours by the Police or other authorities for safety reasons. c. Where work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. d. For any other work as agreed through negotiations between the Roads and Maritime Services and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works. e. Where the work is identified in the construction noise and vibration management plan and approved as part of the construction environmental management plan. f. As otherwise agreed by the OEH. Local residents and the OEH will be informed of the timing and duration of work approved under items (d) and (e) at least 48 hours before that work commences. Hours of work will be addressed in the construction noise and vibration management plan, which will be finalised in consultation with the Department of Planning and the OEH. 	Construction	Chapter 8

4 Existing environment

4.1 Sensitive receivers

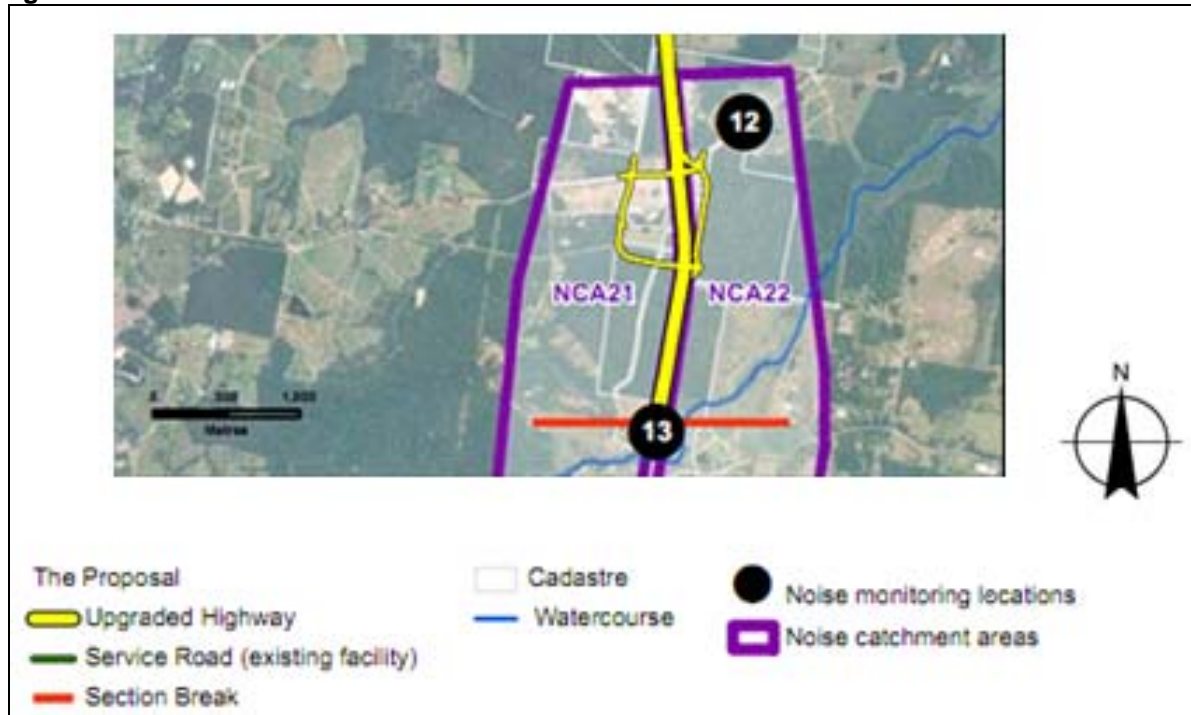
The Project is located within the Port Macquarie local government area. Land use is characterised by a mix of agricultural land uses, bushland; rural residential and commercial/industrial facilities. Situated within the centre of the Project is a large industrial area which is located to the west of the existing Pacific Highway.

The Oxley Highway to Kempsey – Upgrading the Pacific Highway – Environmental Assessment (RTA 2010) presented Noise Catchment Areas for the assessment of operational road traffic noise levels associated with this section of the Pacific Highway road alignment. Based on review of aerial photos and Project data available at the time of this assessment, and with due regard to the RTA 2010 defined catchment areas the closest and/or potentially most affected receptors situated in near proximity to construction works have been identified. The noise catchment areas are described within **Table 4-1** and shown in Figure 1.

Table 4-1 Noise catchment areas for the Project

Noise Catchment Areas	Location
NCA21	Oxley Highway interchange to Sancrox Road area (western side)
NCA22	Oxley Highway interchange to Fernbank Creek (eastern side)

Figure 1 Noise Catchment Areas



These locations are referred to as "sensitive receivers" in this CNVMP as both noise and vibration impacts are considered. It is not practical or the intent of the CNVMP to assess

emissions at all known receptors (e.g. at every dwelling in or adjacent to the construction site). Accordingly, these “sensitive receivers” have been selected as they are representative of the closest or most affected locations where worst-case emissions may be generated at. Project noise emissions are predicted at these locations and impacts determined based on those levels. It was identified that the residential sensitive receivers are situated further than 150 metres from the proposed construction areas.

There are no other sensitive receivers (e.g. schools or churches) likely to be impacted by construction noise from the Project. The location of the project is shown below in Figure 2 with the residential sensitive receivers (R01 to R18) and construction noise monitoring locations (CNL_1 to CNL_5) shown in Figure 3.

Figure 2 Project Surroundings

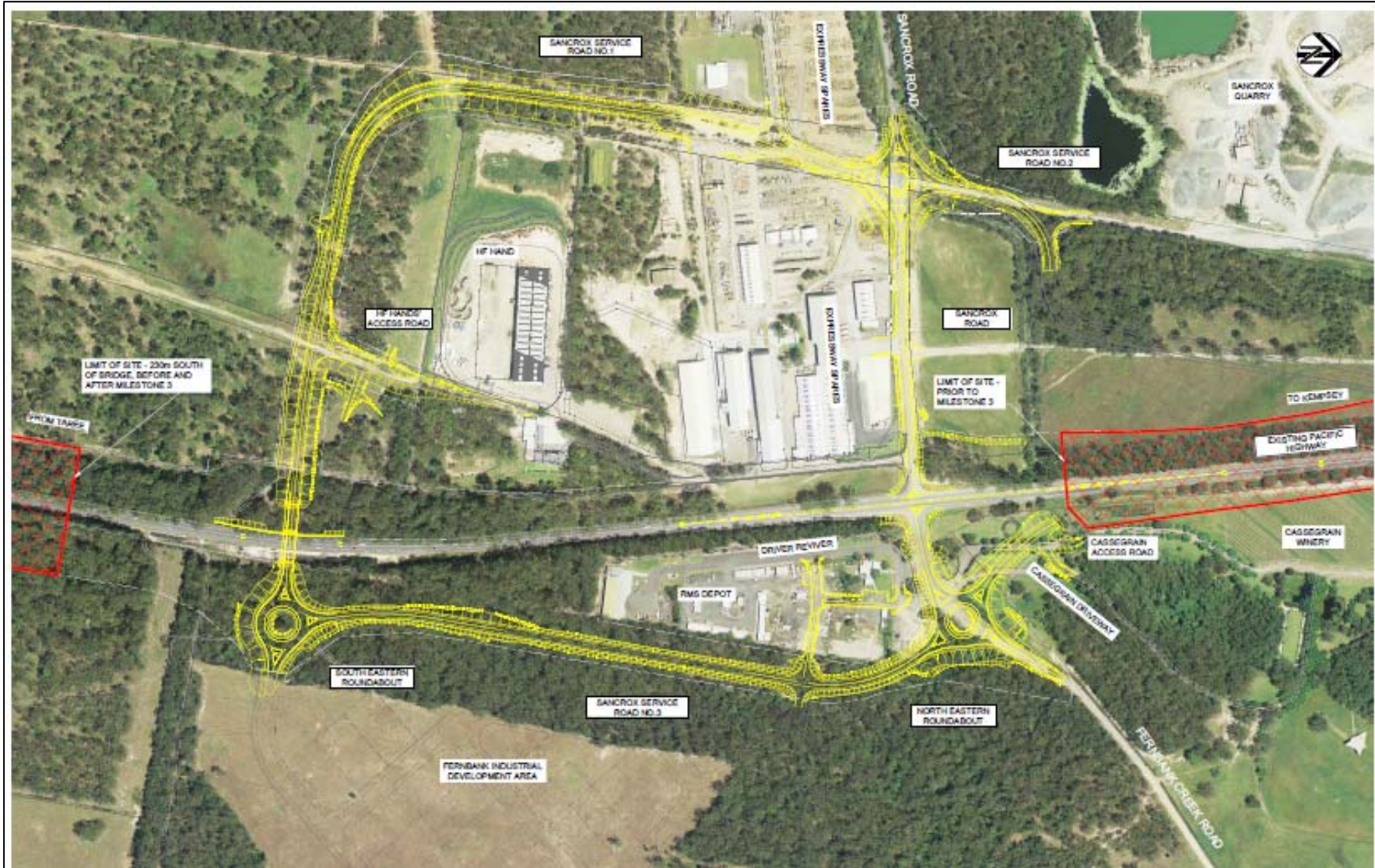


Figure 3 Distance to residential sensitive receivers.

Note 3 : Figure 3 was compiled by FAA surveyor on the 22nd April 2014. There were not residential homes within 200m of the Sancrox Project Construction corridor.



4.2 Background noise

Ambient and background noise assessments were completed as part of the EA in December 2006, where long term noise monitoring was completed at a total of 13 representative locations.

Table 4-2 summarises the measured noise levels undertaken in 2006 for the Environmental Assessment and subsequently for the Concept Design review in 2012. Locations were selected to be representative of receivers that would experience a noise impact from the existing highway or from the Project. A summary of noise monitoring results for NCA21 and NCA22 is provided below in **Table 4-2**; the location of the noise monitoring locations as shown in the EA report is provided in Figure 1.

Table 4-2 Ambient noise levels for NCA21 and NCA22 (Monitoring Period: Dec 2006)

Site	NCA	Daytime L _{eq} , 15hr (dBA)	Night L _{eq} , 9hr (dBA)	Rating Background Level (RBL) (dB(A))		
				Day	Evening	Night
12	NCA22	58.5	58.0	49	44	42
13	NCA21	64.0	62.5	51	44	40

The noise monitoring completed at Site 13 is considered not representative of the residential receivers due to the monitoring being completed adjacent to the Pacific Highway within the road reserve. For the purposes of this CNVMP the RBLs associated with Site 12 will be adopted.

The corresponding Rating Background Level (RBL) representative of the residential sensitive receivers for this project as established in the EA is 49dB(A) during day, 44dB(A) during the evening and 42dB(A) during the night and are provided above in **Table 4-2**.

Table 4-2 incorporates NSW EPA requirements that the RBLs be assessed separately for the daytime, evening and night-time periods. These periods are defined as follows:

- Day is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays and Public Holidays.
- Evening is defined as 6:00 to 10:00pm, Monday to Sunday and Public Holidays.
- Night is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays and Public Holidays.

5 Noise and vibration criteria for NSW

The EPA recommends management levels and goals when assessing construction noise and vibration. These are outlined in:

- The Interim Construction Noise Guideline (ICNG).
- Assessing Vibration: A Technical Guideline (DEC 2006) (includes British and German Standards).
- The ANZECC, Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC 1990).

Relevant elements of these documents are summaries and discussed in this Chapter.

Section 6.7 of the NSW Roads and Maritime *G36 Environmental Protection* for the project nominates noise management criteria for which the project is not to exceed unless permitted to by the Principal. These requirements are detailed in Clause 5.1.3 below.

5.1 Construction noise and assessment objectives

5.1.1 ICNG

The ICNG (DECC 2009) provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts.
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours.
- Reduce time spent dealing with complaints at the Project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

5.1.2 Quantitative noise assessment criteria

Construction noise assessment goals presented in the ICNG are referenced to Noise Management Levels (NMLs) for residential, sensitive land uses and commercial/ industrial premises.

Residential Premises

Table 5-1 sets out NMLs for noise at residences and how they are to be applied. The Rating Background Level (RBL) is used when determining the management level; it is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA, 2000).

As a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation.

Table 5-1 Noise at residents using quantitative assessment

Time of day	Management level $L_{Aeq(15min)}$ *	How to apply
Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured $L_{Aeq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Additionally, at night time there is a requirement to try to meet sleep disturbance criteria outlined in the *Environmental Noise Control Manual* (EPA 1994) for the intermittent noise at night. The criterion for this type of noise, which applies to maximum noise level (defined as the $L_{A1(1min)}$), is the Rating Background Level (RBL) + 15 dBA.

Other Land Uses

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). **Table 5-2** presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed.

Consultation should be undertaken with noise sensitive land use occupants likely to be affected by noise from the works to schedule the Project's work hours to achieve a reasonable noise outcome.

Internal noise levels are assessed at the centre of the occupied room. External noise levels are assessed at 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 the difference between internal and external noise levels is 10dB for buildings other than residences.

Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened).

Table 5-2 Noise at sensitive land uses (non-residents) using quantitative assessment

Land use	Noise assessment location	Noise management level ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Hospitals and operating theatres		
Places of worship		
Active recreation areas ¹	External	65
Passive recreation areas ²	External	60
Community centres	Dependent on intended use	Maximum internal levels recommended in AS2107 for specific use
Industrial premises	External	75
Office, retail outlets	External	70
Other noise sensitive businesses	Investigation to determine suitable noise levels on Project-by-Project basis	

Notes:

- Active recreation areas are characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.
- Passive recreation areas are characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg. reading, meditation).

5.1.3 NSW Roads and Maritime G36

The Project specific noise goals outlined within the NSW Roads and Maritime G36 Environment Protection document include the following:

Construction activities are to be managed so the L10 level measured over a period of not less than 15 minutes does not exceed the background level by more than 5dB(A) (RBL+5dB(A)) unless authorised by the Principal.

Activities which result in impulsive or tonal noise generation close to noise sensitive receptors must only be undertaken between the following hours:

- 9am to 3pm, Monday to Friday; and
- 9am to 12pm, Saturday

If the noise is substantially tonal or impulsive in nature (as described in the NSW Industrial Noise Policy), 5dB(A) must be added to the measured construction noise level when comparing to the noise objective.

Where activities are undertaken for a continuous three hour period and are audible to noise sensitive receivers require a minimum of a one hour respite prior to the recommencing of the construction activities.

The implementation of all reasonable and feasible noise mitigation measures are required to achieve the construction noise objectives. Activities that with the potential to exceed the construction noise objective must be identified; managed and approved in accordance with the Construction Noise Management Plan.

5.2 Project noise management levels

Based on measured noise levels described in Section 4.2 and the NSW Roads and Maritime G36 requirements, the Project-specific construction noise objectives for each representative monitoring location have been determined and are presented in **Table 5-3** below.

Considering the possibility of works outside standard construction hours additional management levels for these times are also included in the construction noise objectives.

Figure 3 in Section 4.1 identifies sensitive receivers and the proposed noise monitoring locations.

Table 5-3 Project-specific construction noise objectives

Location	Rating Background Level L _{A90} (period) dB(A)			ICNG Noise Management Levels L _{Aeq} (15 min) dB(A)					NSW Roads and Maritime G36 L _{A10} (15 min) dB(A)	Sleep Disturbance Criteria L _{A1} (1min) dB(A)
				Standard Hours		Non- Standard Hours				
	Day	Evening	Night	Noise Affected	Highly Noise Affected	Noise Affected				
						Day	Evening	Night		
Residence	49	44	42	59	75	54	49	47	47	57

Note:

- Standard Hours refers to Standard Construction Hours, i.e. Daytime 7am to 6pm Monday to Friday, 8am to 1pm Saturday, As defined in 4.2.
- Non Standard (Out of Hours) refers to work outside the Standard Construction Hours i.e. non-standard daytime is Saturday 7am to 8am, 1pm to 6p; Sundays and Public Holidays 7am to 6pm. Evening is 6pm to 10pm and night time is 10pm to 7am. As defined in 4.2.

5.3 Vibration criteria

Effects of ground vibration on buildings resulting from construction may be segregated into the following three categories:

- Human comfort – disturbance to building occupants: vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents – vibration where the building contents may be affected.
- Effects on building structures – vibration in which the integrity of the building or structure itself may be prejudiced.

Vibration criteria relating to human comfort that are applicable to this Project are taken from the DEC (2006) document Assessing Vibration – A Technical Guideline and include the following.

- Continuous vibration – from uninterrupted sources (see **Table 5-4**).
- Impulsive vibration – up to three instances of sudden impact eg dropping heavy items, per monitoring period (see **Table 5-5**).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (see **Table 5-6**).

Two standards by which building damage from construction-induced vibration are commonly assessed include:

- British Standard 7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI 1993)
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).

The German standard provides the most stringent criteria and will be used in this CNVMP. The DIN guideline values for peak particle velocity (mm/s) measured at the foundation of the building are summarised in **Table 5-7**. The criteria are frequency dependent and specific to particular categories of structure.

Table 5-4 Continuous vibration acceleration criteria (mm/s) 1-80Hz

Location	Assessment period	Peak Particle Velocity (mm/s)	
		Preferred Value	Maximum Value
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night-time	0.56	1.10
Workshops	Day or night-time	1.10	2.20

Table 5-5 Impulsive vibration acceleration criteria (mm/s) 1-80Hz

Location	Assessment period	Peak Particle Velocity (mm/s)	
		Preferred Value	Maximum Value
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices, schools, educational institutions and places of worship	Day or night-time	18.0	36.0
Workshops	Day or night-time	18.0	36.0

Table 5-6 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime		Night-time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

The EPA Vibration Guideline (2.4.1), for determining vibration dose data has been used to calculate the dose values given in Table 5.6 above.

Calculating vibration dose value

Where vibration comprises repeated events, each of a similar value and duration, a VDV may be calculated. The following formula requires the overall weighted rms acceleration as determined in Section 2.3 over the frequency range 1 to 80 Hz: where VDV is the vibration dose value in $m/s^{1.75}$, $a(t)$ = frequency-weighted acceleration (m/s^2) and T is the total period of the day (in seconds) during which vibration may occur.

Table 5-7 Structural damage criteria

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

* For frequencies above 100Hz, at least the values specified in this column shall be applied.

5.4 Blast criteria

Blasting is not permitted for the Sancrox Traffic Arrangement as deemed not required due to geotechnical advice at the time of writing this plan. Thus blasting criteria and management is not included within this plan.

6 Environmental aspects and impacts

6.1 Environmental aspects

The Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in a number of locations across the Project. In order to assess the level of potential impact on noise and vibration sensitive receivers, the broad categories of construction activity likely to interact with these receivers are identified below.

- Site establishment;
- Clearing and grubbing;
- Utilities Service Relocation;
- Pavement removal;
- Earthworks
- Drainage Infrastructure
- Bridgeworks (piling);
- Bridgeworks; and
- Paving.

6.2 Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors. Typically these might include:

- The type of equipment in use;
- The number of equipment simultaneously in use;
- Ground condition;
- Topography and other physical barriers;
- Proximity to sensitive receivers;
- The condition of sensitive receivers;
- hours/duration of construction works; and
- Proximity of heavy traffic areas such as the highway.

Relevant aspects and the potential for related impacts have been considered in a risk assessment at *Section 3.4 / Appendix A2* of the CEMP.

Noise and vibration impacts attributable to the Project are anticipated. Chapter 8 provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

7 Construction noise and vibration assessment

A range of plant and equipment will be required to undertake activities associated with the Project. A summary of anticipated construction scenarios and predicted noise levels are provided below. This information will be used to determine potential impacts on the receiving community. An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community.

7.1 Construction activities

Table 7-1 provides a summary of construction scenarios, and associated plant and equipment required for the works. Plant and equipment may be used in isolation or simultaneously. Appendix A provides a list of equipment and a correlating sound pressure level.

Table 7-1 Construction scenarios and associated plant and equipment

Scenario Reference	Construction Scenario	Location	Timing	Typical Plant and Equipment Required
A	Site establishment	Ancillary site 1 north of Sancrox Road	March 14- April 14	Excavators, grader, roller, truck and dog, backhoe, cranes, flat-bed trucks
B	Clearing and grubbing	All project	July 14- Aug14	Excavator, chainsaw, trucks, skidder, mulcher, water cart
C	Utilities	Sancrox Road and Fernbank Creek Road	Aug 14 - Dec14	Excavator, trucks, grader, combination backhoe front end loader, concrete vibrator, compactors, directional driller
D	Pavement removal	Sancrox Road and Fernbank Creek Road	Aug 14 - Dec14	Excavator, trucks, road sweeper, road saw, water truck
E	Earthworks	Service road 1, Sancrox Road	Aug 14 - Nov 14	Bulldozers, excavators, dump trucks, road trucks, compactors, loaders, graders, vibratory roller (multi tyre, pad foot, smooth drum), backhoe, sweeper, water cart, compressors, generators, rock hammer
F	Earthworks	Service road 2 and 3, Sancrox Road, Fernbank Creek Road	Dec 14 – Feb 15	Bulldozers, excavators, dump trucks, road trucks, compactors, loaders, graders, vibratory roller (multi tyre, pad foot, smooth drum), backhoe, sweeper, water cart, compressors, generators, rock hammer
G	Drainage infrastructure	Service road 1, Sancrox Road	Aug 14 – Oct 14	Excavator, trucks, grader, combination backhoe front end loader, concrete vibrator, compactors, water truck
H	Drainage infrastructure	Service road 2 and 3, Sancrox Road, Fernbank Creek Road	Nov14 – Jan 15	Excavator, trucks, grader, combination backhoe front end loader, concrete vibrator, compactors, water truck
I	Bridge piling	Bridge over Pacific Highway	Aug 14 - Sep 14	Piling rigs, drill rig, compressor, concrete pumps, concrete vibrators

Scenario Reference	Construction Scenario	Location	Timing	Typical Plant and Equipment Required
J	Bridge works	Bridge over Pacific Highway	Aug 14 – Dec 14	Crane, concrete pumps, concrete vibrator, welding equipment, pneumatic jackhammer, water pump, lighting tower
K	Paving saw cutting	Sancrox Road and Fernbank Creek Road	Dec 14 – Mar 15	Paving saw (concrete and asphalt), light vehicles, road sweeper
L	Paving	All Project	Nov 14 – Dec 14, Feb15 – Mar 15 and Aug15 – Sep 15	Hot asphalt pavers, hot bitumen equipment, compactors, trucks, compressors, generators, rubber tyre rollers, drum rollers, formwork system, light vehicles, sweeper, concrete trucks

7.2 Construction noise impacts

7.2.1 General construction

For all applicable scenarios, predictions include emissions associated with general construction (refer Table 7-1) and the Project main site compound, ancillary facilities and stockpile sites. These compound and ancillary facilities will accommodate a range of activities, plant and equipment including, but not limited to:

- Office accommodation.
- Staff amenities.
- Light vehicle parking and access.
- A plant and equipment maintenance workshop.
- Material and chemical storage.
- Equipment storage.
- Material storage.

Not all sites will serve the same purpose and may include only one, or many combinations of the activities listed above. **Table 7.2** summaries the likely combination of activities, plant and equipment anticipated at facilities for the Project. Appendix A4 of the CEMP and Appendix I of the SWMP provide a list and assessment of all ancillary facilities and stockpile sites on the Project, respectively.

Table 7-2 Likely construction facilities and associated attributes

Facility reference no.	Facility type	Activities	Typical plant and equipment required
A	Main compound	<ul style="list-style-type: none"> • Staff and worker parking. • Office accommodation. • Equipment maintenance and storage. 	<ul style="list-style-type: none"> • Trucks • Light vehicles • Generator
B	Stockpile Facility	<ul style="list-style-type: none"> • Material storage and handling 	<ul style="list-style-type: none"> • Loader • Excavator • Trucks • Light vehicles

Assessing Noise Level Impacts

Table 7.3 presents the predicted L_{Aeq} (15min) noise levels for each related construction scenario, inclusive of emissions associated with the main site compound, ancillary facilities and stockpile sites.

Noise management level thresholds for each key sensitive receiver location have been provided. Predicted noise levels for each construction scenario have been derived by calculating the combined noise output from the sound power levels of each piece of equipment listed in Appendix A.

Sound power levels (L_w) of construction plant and equipment were also obtained from Australian Standard AS2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (refer to *Table A1* within *Appendix A* of AS2436-2010).

Predictions are summarised with the following highlights for quick analysis:

<i>no highlight</i>	predicted noise impacts below all criteria
	expected to exceed the night non-standard hours NML
	expected to exceed the evening non-standard hours NML
	expected to exceed the standard hours and nonstandard hours NML

It shows that exceedances of the project noise management levels are likely for a number of scenarios and sensitive receivers, and results are discussed for each work area below.

Noise impacts as a result of operation of the compound and stockpiling facilities were included on all scenarios listed in Table 7-1 with the exception of activities completed prior to excavation works (e.g. excluding Scenario B clearing and grubbing).

All predicted noise levels are in L_{Aeq} for the general assessment. The G36 L_{A10} levels will be captured during monitoring and additional measures considered if necessary. Noise Management Level exceedances detailed will be managed according to the management mitigation measures outlined in Table 8-1. Refer to Appendix B Out of Hours Works Procedure (OOHW).

Table 7-3 Noise impact on representative sensitive receivers

Scenario	Noise Management Level dB(A)			A	B-1	B-2	C-1	C-2	D-1	D-2	E	F-1	F-2	
	Location	Day	Evening	Night	Site establish-ment	Clearing and grubbing	Clearing and grubbing	Utilities	Utilities	Pavement removal	Pavement removal	Earthworks	Earth Works	Earth Works
					Receiver	Northern Compound - Sancrox Road	Sancrox Service Rd 1 SW Area	Sancrox Service Rd 2 NE Area	Sancrox Road	Fernbank Road	Sancrox Road	Fernbank Road	Sancrox Service Rd 1 SW Area	Sancrox Service Rd 2 NE Area
1		59	49	47	46	49	49	58	55	58	55	58	61	56
2		59	49	47	45	53	46	56	52	56	52	64	59	54
3		59	49	47	42	52	44	52	49	52	49	60	55	51
4		59	49	47	42	57	44	52	50	52	50	62	55	51
5		59	49	47	34	44	37	44	42	44	42	50	47	45
6		59	49	47	42	41	48	50	58	49	58	49	52	63
7		59	49	47	40	40	46	48	56	48	56	48	51	59
8		59	49	47	40	48	43	51	48	52	48	57	55	50
9		59	49	47	39	47	41	49	47	49	47	55	52	48
10		59	49	47	40	51	41	50	47	50	47	57	54	49
11		59	49	47	39	50	41	49	47	49	47	56	52	49
12		59	49	47	39	50	40	49	46	49	46	56	52	48
13		59	49	47	35	46	38	47	44	47	44	53	51	46
14		59	49	47	37	48	40	48	46	48	46	55	51	48
15		59	49	47	35	44	36	44	42	44	42	50	47	45
16		59	49	47	34	43	36	44	42	44	42	50	47	44
17		59	49	47	32	41	35	43	41	43	41	49	46	43
18		59	49	47	32	41	36	43	41	43	41	49	46	43

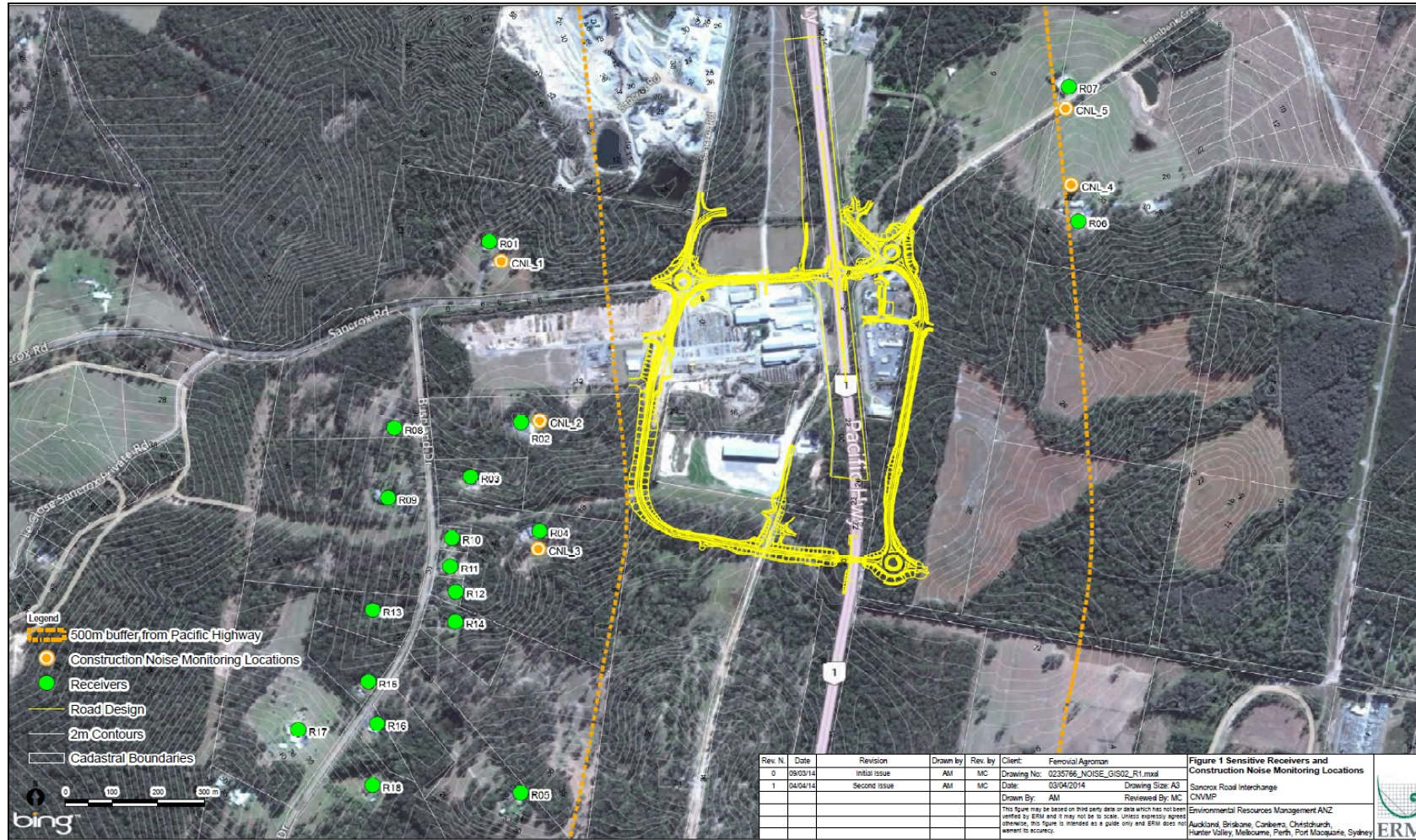
Notes: 1. Results from the above scenarios include cumulative noise impacts associated with the compound and stockpile locations where applicable (i.e. stockpiling not included for clearing and grubbing activities)

Table 7-3 Noise impact on representative sensitive receivers (continued)

Scenario	Noise Management Level dB(A)			G	H-1	H-2	I	J	K-1	K-2	L-1	L-2	L-3
	Day	Evening	Night	Drainage infrastructure	Drainage infrastructure	Drainage infrastructure	Bridge piling	Bridge works	Paving saw cutting	Paving saw cutting	Paving	Paving	Paving
Location				Sancrox Service Rd 1 SW Area	Sancrox Service Rd 2 NE Area	Fernbank Road	Pacific Hwy	Pacific Hwy	Sancrox Road	Fernbank Road	Sancrox Road	Fernbank Road	Sancrox Service Rd 1 SW Area
Receiver													
1	59	49	47	56	58	55	56	55	58	45	57	46	45
2	59	49	47	60	56	52	56	54	57	45	56	46	54
3	59	49	47	59	52	50	56	53	53	43	52	44	53
4	59	49	47	63	52	50	58	55	53	43	52	44	58
5	59	49	47	51	44	42	55	51	43	38	42	39	45
6	59	49	47	47	49	58	54	51	48	57	46	58	37
7	59	49	47	46	48	55	51	48	48	53	46	54	36
8	59	49	47	54	52	48	53	50	51	41	50	42	48
9	59	49	47	54	49	47	53	50	50	40	49	41	48
10	59	49	47	57	51	47	55	52	50	41	49	42	52
11	59	49	47	57	49	47	55	52	50	41	49	42	51
12	59	49	47	56	49	46	55	51	48	40	47	41	51
13	59	49	47	53	48	44	52	49	47	38	46	39	47
14	59	49	47	55	48	46	55	51	48	40	47	41	49
15	59	49	47	51	44	43	52	48	45	38	44	39	45
16	59	49	47	50	44	42	52	48	44	36	42	37	44
17	59	49	47	48	43	41	49	46	43	36	41	37	42
18	59	49	47	48	43	41	50	46	43	36	41	37	42

Notes: 1. Results from the above scenarios include cumulative noise impacts associated with the compound and stockpile locations where applicable (i.e. stockpiling not included for clearing and grubbing activities)

Figure 4 Sensitive Receiver Locations and Construction Noise Monitoring Locations



Discussion

West of Pacific Highway

The majority of sensitive receivers for the Project to the west of the Pacific Highway are located along Bushland Drive, Sancrox. In addition there is one receiver identified along Sancrox Road. These receivers are located between 200m and 900m from the proposed construction works.

Construction work activities along Sancrox Road and Sancrox Road Service Road #1 are likely to impact these receivers. The earthworks are predicted to exceed at three receivers during standard hours (day period) and at all receivers during the non-standard hours/out of hours works.

Exceedances above the standard hours (day period) were also noted at two receivers for Scenario G of drainage infrastructure and one exceedance during Scenario F-1. All of the remaining construction work activities were predicted to have exceedances of the non-standard hours/out of hours NML for works completed along Sancrox Road, Sancrox Road Service Road #1 and during the bridge piling and other bridge works.

The effect of the stockpiling works which are proposed for the Facility B on Sancrox Road adjacent to Sancrox Service Road #2 results in exceedances at receivers to the west of the Pacific Highway during the non-standard hours in the evening period for the majority of Scenarios. The stockpiling activities also completed during works whilst works progress to the west of the highway also results in exceedances during the evening period/out of hours NML.

The works will need to be managed accordingly and in close consultation with receivers to advise them of predicted noise impacts especially for any proposed works during non-standard hours. Refer to Appendix B Out of Hours Works Procedure (OOHW).

East of Pacific Highway

There are two receivers situated along Fernbank Creek Road which are located approximately 300m to 500m from the proposed construction works.

Construction work activities along Fernbank Road will potentially impact the residential receivers to the east of the Pacific Highway mainly during earthworks during standard and non-standard hours. Other construction activities (scenarios) such as works on utilities, pavement removal, drainage infrastructure, paving and paving saw cut are identified as potentially impacting residential receivers during non-standard hours in both the evening and night periods.

Construction works along Sancrox Road, Sancrox Service Road #2 and the Bridge works on the Pacific Highway are predicted to exceed the NML for receivers east of the Pacific Highway during non-standard hours in both the evening and night periods.

The works will need to be managed accordingly and in close consultation with receivers to advise them of predicted noise impacts especially for any proposed works during non-standard hours. The works will need to be managed accordingly and in close consultation with receivers to advise them of predicted noise impacts especially for any proposed works during non-standard hours. Refer to Appendix B Out of Hours Works Procedure (OOHW).

Existing ground level vs. future and distance of source to receivers

The change in topography within the construction corridor as construction progresses will have some effect on predicted noise levels. Cuttings will add some shielding to the noise emissions during construction. Increased topographical shielding is predicted to reduce noise levels by 5dB(A) to 10dB(A). The larger cuttings will provide the higher levels of shielding (approximately 10dB(A)).

Working on exposed areas and raised fill areas will reduce shielding and increase noise levels at the receivers; as seen in Figure 3 the main cutting for the project is on Service Road 1, the areas surrounding the bridge abutments are subject to fill, however given the increase in distance from the nearest Sensitive receiver the increase in SPL is insignificant.

The greater the distance between the source and receiver, i.e. by moving the plant and equipment away from the receiver, the lower the resultant noise levels at the receiver. This is based on simple distance attenuation and ignoring other affects.

7.2.1 Sleep Disturbance

In addition to general construction noise associated with day to day works it is important to consider potential sleep disturbance impacts associated with impulsive or transient noise events. These could occur during approved night time (10pm to 7am) Project works.

Unlike general construction noise (which is assessed using the L_{Aeq} , and L_{A10} parameters) sleep disturbance impacts are assessed using either the $L_{A1\ 1(min)}$ or L_{Amax} statistical parameters. These values are broadly similar in use, the $L_{A1\ 1(min)}$ parameter generally considered to be the average of maximum noise levels over one minute. In this case a sleep disturbance criteria of 57 dB(A), $L_{A1\ 1(min)}$ has been determined for the Project.

Additional noise predictions were completed and have determined that a $L_{A1\ 1(min)}$ sound power level of 110 dB(A) received at a distance of 200m, will comply with the sleep disturbance criteria of 57 dB(A), $L_{A1\ 1(min)}$. This is an achievable management value for the activities proposed to be undertaken on this Project; it will be referred to when planning for any out of hours work. **Table 7-5** below presents the Project sleep disturbance assessment including comparison of sound power levels (LW) and distances to receivers.

Note that sleep disturbance impacts are not associated with a specific item of plant or equipment and are generally associated with noise events generated by a particular activity being undertaken e.g. an excavator breaking concrete; $L_{A1\ 1(min)}$ or L_{Amax} noise levels are generated by the act of breaking the concrete and not the excavator itself. To that end, this means that sleep disturbance impacts are more easily reduced by implementing management measures and operational practices (during any night time works) that will reduce the likelihood of any sleep disturbance noise events occurring, if any at all. Sleep disturbance impacts can be eliminated with successful management practices.

Table 7-4 Sleep disturbance assessment including comparison of sound power level (Lw) and distance to receiver

Sound Power Level (Lw)	Sleep disturbance criteria L _{A1} (1min) dB(A)	Resultant noise level at receiver corresponding to the distance from the point noise source L _{A1} (1min)										
		200m	225m	250m	275m	300m	325m	350m	375m	400m	425m	450m
120	57	<u>66</u>	<u>64</u>	<u>64</u>	<u>63</u>	<u>61</u>	<u>60</u>	<u>60</u>	<u>59</u>	<u>58</u>	<u>58</u>	56
118		<u>64</u>	<u>62</u>	<u>62</u>	<u>61</u>	<u>59</u>	<u>58</u>	<u>58</u>	57	56	56	54
116		<u>62</u>	<u>60</u>	<u>60</u>	<u>59</u>	57	56	56	55	54	54	52
114		<u>60</u>	<u>58</u>	<u>58</u>	57	55	54	54	53	52	52	50
112		<u>58</u>	56	56	55	53	52	52	51	50	50	48
110		56	54	54	53	51	50	50	49	48	48	46

- Notes:
1. Values underlined and in bold typeset indicate exceedances of sleep disturbance criteria
 2. Italicised values indicate compliance with the sleep disturbance criteria
 3. Total LW values assumes noise emissions are from a point source
 4. Cumulative effect of multiple noise sources would result in an increase in overall noise emissions. To avoid cumulative impacts of multiple noise sources a difference in LW values of 9dB(A) is required between the two pieces of plant and equipment.
 - Two noise sources of equal value result in a 3dB (A) increase in overall noise emissions
 - Three noise sources of equal value result in a 5dB(A) increase in overall noise emissions

7.3 Construction vibration assessment

7.3.1 Vibration assessment

Table 7-5 lists vibration intensive plant likely to be used during construction and provides predicted ground-borne vibration levels (Peak Particle Velocity (PPV, mm/s) at various distances from the plant. **Table 7-6** presents Estimated Vibration Dose Values (eVDV, $m/s^{1.75}$) for the same plant and equipment operating at a distance of 30 metres from a receptor. It is noted that there are no known residences within 200m of the proposed construction activities; however a conservative approach to these predictions has been taken to comprehensively inform and control, management and monitoring requirements.

The vibration levels are indicative only and will vary depending on the particular item of plant, the activity being undertaken and geotechnical conditions. If structural damage is detected (however unlikely), monitoring of the specific plant and soil conditions should be undertaken to more accurately assess the likelihood of damage, refer to Section 7.4.

Table 7-5 Typical construction equipment vibration levels (PPV, mm/s)

Plant description	Estimated vibration level (mm/s)		
	10 metres	20 metres	30 metres
Concrete sawing	0.5	0.3	0.2
4-tonne vibratory roller (high)	2.0-2.4	0.4-1.2	0.2-0.8
Hydraulic hammer (30 tonnes)	3	1.5	0.4

Table 7-6 Typical construction equipment vibration levels (eVDV, $m/s^{1.75}$)

Plant description	Estimated vibration level ($m/s^{1.75}$) at 30 metres
Concrete sawing	0.19
4-tonne vibratory roller (high)	0.18-0.77
Hydraulic hammer (30 tonnes)	0.38

The estimated PPV values presented in Table 7-5 identify that human comfort impacts associated with impulsive and continuous vibration are unlikely to occur for receivers situated more than 30m from vibration generating sources. Furthermore, these PPV values identify that structural damage is unlikely to occur during the project. These findings are as expected for the plant and equipment in use and activities being undertaken as part of the Project.

Human comfort associated with intermittent vibration is likely to be impacted within 30m of the assessed activities. This however is highly dependent on the activity being undertaken, management of the activity and practices employed by the plant operator.

Fortunately, there are no known residences within 200m of the proposed construction activities and actual Project human comfort and structural damage impacts are unlikely to

occur. At a distance of 200m all vibration levels are expected to be imperceptible i.e. below 0.2mm/s which is considered to be the human threshold for the perception of vibration. Any residents identified within this distance should be consulted and ‘monitoring undertaken.

Vibration impacts from the operation of compound and ancillary facilities are not anticipated.

7.4 Building Condition Inspections

Building condition inspections for each public utility, structure and building within the distance from the activities listed within **Table 7-7** below. Where the risk of damage to a building or other items is assessed to be very low, the requirement for a building Condition Inspection may be waived with the NSW Roads and Maritime agreement.

Table 7-7 Structural damage criteria

Activity	Distance
Concrete saw cutting	200 meters
Excavation by hammering or ripping	100 meters
Vibration Compaction >4 ton plant	100 meters

7.5 Out of Hours Works

7.5.1 Extended Hours

In accordance with the CoA C4(d) construction works are able to be undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints.

7.5.2 OOHW

While the project team will make all efforts to complete work within the approved construction hours, it is anticipated that there will be a need to undertake a range of works outside of the standard hours and the extended hours – Out of Hours Works (OOHW) - that are not necessarily approved by the Project CoA. These may include the following;

- Concrete works (including delivery) and saw cutting during paving works;
- Service relocation works;
- Works impacting highway and local road traffic;
- Use of ancillary facility sites during OOHW;
- Refueling during OOHW; and
- Security patrolling throughout the construction phase.

In order to manage these OOHW, an OOHW Procedure has been developed and is included as Appendix B to this CNVMP. The aim of the OOHW procedure is to ensure that all OOHW follow a rigorous process to ensure the following outcomes:

- Potential OOHW are identified as early as possible;
- Justification is provided for each OOHW proposed;
- Appropriate levels of consultation are undertaken for all the OOHW activities; and
- Environmental impacts from the OOHW are managed / mitigated in line with the approved CEMP documents to minimise impact on the surrounding environment & community.

It is essential that effective community consultation occurs for out of hours works. The OOHW Procedure outlines how the stakeholders will be approached prior to OOHW activities on the project. It identifies the stakeholders, the approach and tools that will be used to communicate the key messages and impacts to stakeholders, including predicted exceedances of the NMLs as indicated in Table 7-3.

8 Environmental control measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the EA, Statement of Commitments, Conditions of Approval and Roads and Maritime documents. Specific measures and requirements to address impacts from noise and vibration are outlined in **Table 8-1**.

Table 8-1 Noise and vibration management and mitigation measures

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
GENERAL					
NV1	Training will be provided to all Project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted awareness training. Noise and vibration training requirements will be as per Section 9.2 of this plan.		Pre-Construction, Site Establishment Construction	ESR/Site Engineer	G36, Section 9.2
NV2	Public address systems used at any construction site will not be used outside normal construction hours, except where prior consultation has been undertaken with affected residents. Public address systems would be designed to limit noise spillage off-site.		Construction	Site Engineer/Supervisor	
NV3	Work compounds, parking areas, equipment and material stockpile sites will be positioned be in accordance with ancillary facility and stockpile criteria detailed in Appendix A4 of the CEMP and Appendix I of the CSWMP, respectively.		Construction	ESR	G36, EA
NV4	Noise management measures, e.g. screening or cladding, will be implemented prior to use of ancillary facilities where necessary.		Construction	Site Engineer	EA
NV5	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.		Construction	Site Engineer/Supervisor	
NV6	Compounds, refueling areas and where possible sensitive works areas will be designed to promote one-way traffic so that vehicles reversing movements are minimised		Construction	Site Engineer/Supervisor	
NV7	Truck routes to and from the worksite will be via major roads where possible, in accordance with the Construction Traffic Management Plan.		Construction	Site Engineer/Supervisor	
NV8	Where possible operational noise mitigation measures, e.g. at property treatments, noise mounds, will be installed as early as possible during construction where they would assist in managing construction noise.		Construction	Site Engineer/Supervisor	SoC ON1, G36, EA
PLANT & EQUIPMENT					
NV9	Where feasible and reasonable, noisy equipment and/or construction processes will be substituted by alternative low noise emitting equipment and/or construction process.		Construction	Site Engineer/Supervisor	G36

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 43/48 Last Updated: 17 September 2014
--	--	--

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
NV10	Where necessary, place screening or enclosures prior to using fixed plant under regular operation that may impact upon noise-sensitive receivers.		Construction	Site Engineer/Supervisor	G36
NV11	Saw-cutting will not be undertaken at night and in periods longer than 1 hour with a minimum break of 15 minutes every hour. Shielding will be placed where possible to minimise possible noise.		Construction	Site Engineer/Supervisor	G36
NV12	Plant or machinery will not be permitted to 'warm up' before the nominated working hours.		Construction	Operators	
NV13	Switching off engines when equipment is not in use for extended periods (ie 30 minutes).		Construction	Site Engineer/Supervisor	
NV14	Where possible, the occurrence of consecutive works within the same locality, and coincidence of noisy plant/equipment working close together and adjacent to sensitive receivers will be minimised.		Construction	Site Engineer/Supervisor	G36
NV15	Unless required for technical reasons, undertake high noise generating work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents.		Construction	Site Engineer/Supervisor	G36
NV16	Manually adjustable or ambient noise-sensitive or 'quacker' type reversing alarms on plant and/or flashing lights will be used at night.		Construction	Site Engineer/Supervisor	G36
NV17	Where possible, maintenance work on construction plant will be undertaken away from noise-sensitive receivers.		Construction	Site Engineer/Supervisor	G36
NV 18	Vibration impacts will be monitored, as per Section 9.3.2. If monitoring indicates vibration levels exceed human disturbance criteria at the nearest sensitive receivers, consultation will be undertaken to determine whether further mitigation is required, such as respite periods or the scheduling of work to avoid sensitive time periods or to be conducted when people are not at home.		Construction	Site Engineer/Supervisor	CoA B31(c)(v)
NV19	<p>All construction plant and equipment used on the site will be, in addition to other relevant requirements:</p> <ul style="list-style-type: none"> Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications; Maintained in an efficient condition; Operated in a proper and efficient manner. 		Construction	Site Engineer/Supervisor	G36, EA

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 44/48 Last Updated: 17 September 2014
--	--	--

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
NV20	Loading and unloading will be carried out as far as practical away from sensitive receivers.		Construction	Site Engineer/Supervisor	
NV21	Truck movements will be kept to a minimum, i.e. that trucks are sufficiently utilised for each trip.		Construction	Site Engineer/Supervisor	
NV22	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7.00am start time unless required by road safety considerations.		Construction	Site Engineer/Supervisor	
NV23	Noisy plant working simultaneously close together will be avoided to the greatest extent practical adjacent to noise affected sensitive receivers.		Construction	Site Engineer/Supervisor	
NV24	Whenever practical, at the end of shifts, excavation and/or ripping plant will be taken from their work areas and left overnight away from the immediate vicinity of sensitive receivers. Warming up of the plant will then be conducted away from such receivers.		Construction	Site Engineer/Supervisor	
NV25	Truck drivers will limit compression braking as far as practical.		Construction	Operators	
NV26	Where possible, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce transmission of noise between work sites and receiver locations.		Construction	Site Engineer/Supervisor	
CONSTRUCTION HOURS					
NV27	<p>Construction works associated with the Project, other than blasting, will only be undertaken during the following hours:</p> <ul style="list-style-type: none"> • 7.00am to 6.00pm Mondays to Fridays, inclusive • 8.00am to 1.00pm on Saturdays. • At no time on Sundays or public holidays. <p>Unless carried out in accordance with NV28.</p>		Construction	PM/Site engineer/	CoA C3, CoA C4, CoA C5
NV28	<p>Works outside of the construction hours identified in NV27 will only be undertaken in the following circumstances:</p> <ul style="list-style-type: none"> • Works that generate noise that is <ul style="list-style-type: none"> (i) no more than 5 dB(A) above rating background level at any residence; or (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and 		Construction	PM/Site Engineer	CoA C4, SoC CN3

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 45/48 Last Updated: 17 September 2014
--	--	--

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	Climate Change, 2009) at other sensitive land uses; or <ul style="list-style-type: none"> For delivery of materials required outside these hours by the NSW Police Force 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 undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints; or With the approval of the Director General in accordance with CoA C5 (refer NV31) (see Appendix B). 				
NV29	Rock breaking, rock hammering, sheet piling, pile driving and any similar activity will be scheduled only between the hours of 7.00am to 6.00pm Monday to Friday; and 8.00am to 12.00pm Saturday, except where works are to be undertaken outside proposed construction hours as outlined above.		Construction	PM/Site engineer	Good Practice subject to community liaison
NV30	Where appropriate, negotiated agreements will be entered into with sensitive receivers when exceedances of noise criteria are predicted, and after all reasonable and feasible noise mitigation measures have been considered and implemented. Negotiated agreements will be implemented in accordance with the Interim Construction Noise Guideline (2009) and the NSW Industrial Noise Policy (2000).		Construction	-PM/Site Engineer	
NV31	Any proposal to undertake works outside of the standard working hours identified in NV27 will be subject to the processes and assessment requirement contained in Condition C5 and included in the Out of Hours Works Procedure (see Appendix B)		Construction	ESR	CoA C5
CONSULTATION & COMPLAINTS MANAGEMENT					
NV37	Residents/sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Communications Strategy. Information will include: <ul style="list-style-type: none"> the types of activities to be undertaken; 		Pre-Construction, Construction	ESR/Site Engineer	CoA B31©(vi), Good practice

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 46/48 Last Updated: 17 September 2014
--	--	--

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	<ul style="list-style-type: none"> the timing of activities, including expected start and finish; the location of activities; and details of the community information line and how to make an enquiry and/or complaint. 				
NV38	Consultation with affected education institutions during construction works in their vicinity will be undertaken in an attempt to limit audible construction works during important events, such as examination periods.		Pre-Construction, Construction	ESR	Good practice
NV39	All reasonable attempts will be made to contact sensitive receivers that will be affected by blasting. The contact will be at least 48 hours before a blast and will include a schedule of blast time(s), a phone contact name and number.		Pre-Construction, Construction	ESR	SoC-CN2
NV40	Where complaints relating to noise or vibration impacts as a result of extended working hours cannot be satisfactorily resolved with the affected residents then works hours will revert back to standard working hours at that particular location for that particular activity. Resident(s) will be consulted before recommencing any works outside standard working hours. The Director-General will be notified of any complaints received in relation to working outside of standard hours as outlined in Appendix B.		Construction	Site Engineer/ ESR/Supervisor	Good practice
NV41	Prior consultation and notification would be undertaken with nearby residents that may be affected by high levels of noise or vibration that exceed the relevant criteria. Ongoing consultation with all potentially affected residents will be carried out throughout construction.		Pre-Construction, Construction	ESR	EA
NV42	Circumstances may arise during construction where works outside of standard construction hours are essential and sensitive receivers are assessed with a sound level meter to be highly noise affected (ie experience noise levels greater than 75 dBA). Where this is the case, and works are approved in accordance with CoA C5, opportunities to minimize impacts on highly noise affected receivers, including the provision of alternative accommodation, would be considered in consultation with those affected receiver(s). Refer to Appendix B.	Sound Level Meter	Construction	ESR	Good practice
NV43	All complaints received will be managed in accordance with the Construction Community Liaison Management Plan		Construction	ESR	CoA B28
SURVEY, MONITORING & REPORTING					
NV44	Initial noise monitoring of plant and equipment will be undertaken with a sound level meter to ensure the noise performance levels predicted in this CNVMP are being met.	Sound Level Meter	Pre-Construction, Construction	ESR/ Noise Specialist	Good practice

	Ferrovial Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 47/48 Last Updated: 17 September 2014
--	--	--

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
NV45	Noise and vibration monitoring will be undertaken in accordance with Section 9.3. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where significant exceedances of relevant noise and vibration goals are detected.	Sound Level Meter and Camera	Construction	ESR/Noise Specialist	CoA B31 c) vii
NV46	<p>Building Condition Inspections for each public utility, structure and building will be carried out prior to construction where:</p> <ul style="list-style-type: none"> • blasting operations are within 500m or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2mm/s, whichever is the greater; • pile driving activities are within 250m or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2mm/s, whichever is the greater; • other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2mm/s. 		Prior to commencement of construction of HF Hand and Roads and Maritime Depot access roads. Dilapidation Reports to be prepared. No driven piles are proposed.	Engineer	G36/EA
NV47	<p>The Building Condition Inspection report will include as a minimum:</p> <ul style="list-style-type: none"> • floor plan of the subject building; • record site details – age, construction, site slope and provision of drainage, presence of trees; • type of defects and their positions and extends on the floor plan; • photo of external view and photo of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks; • how doors sit in the jambs – out of line may indicate foundation settlement; • external signs of reactive clay foundation soil; e.g. lifting of slabs, uneven kerbing. 		Pre-Construction, Construction	Engineer	G36

9 Compliance management

9.1 Roles and responsibilities

The FAA Project team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

9.2 Training

All employees, contractors and utility staff working on site will undergo site induction training that includes construction noise and vibration management issues. The induction training will address elements related to noise and vibration management including:

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Normal construction hours.
- The process for seeking approval for out of hours works, including consultation.
- Location of noise sensitive areas.
- Complaints reporting.
- General noise and vibration management measures.
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

Further details regarding staff induction and training are outlined in Chapter 5 of the CEMP.

9.3 Inspections & monitoring

Weekly and other routine inspections by the ESR, Roads and Maritime, ERG representatives and the Environmental Representative will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Chapter 8 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project. Monitoring will be undertaken by an Acoustic Consultant or the ESR during the construction phase of the Project.

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- Monthly attended noise monitoring will be undertaken at representative sensitive receivers to determine the effectiveness of mitigation measures against predicted impacts.
- Where complaints are received, additional attended noise monitoring may be undertaken at sensitive receivers to determine if the actual construction noise generated exceeds the predicted 'worst case' construction noise levels identified in Section 7.2 of this Plan.
- Ongoing spot checks of noise intensive plant and equipment will also be undertaken throughout construction.

	Ferrovia Agroman Australia CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN SANCROX TRAFFIC ARRANGEMENT	Code: SCX-ENV-P-004 Revision: 8.0 Page: 49/48 Last Updated: 17 September 2014
--	---	--

Where actual noise levels are found to exceed the predicted worst case levels, the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers.

Details of site activity and equipment usage will be noted during construction noise monitoring.

Acoustic instrumentation employed in the noise monitoring surveys will comply with the requirements of AS/IEC 61672.1. "Electroacoustics - Sound level meters – Specifications".

9.3.2 Vibration Monitoring

The following vibration monitoring will be undertaken:

- For the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work within 25 metres of buildings to ensure that safe vibration levels specified in Section 7.3.1 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out within the established buffer zones, or where there is considered to be a risk that levels may exceed the relevant structural damage goals.
- Vibration monitoring may be carried out in response to complaints, exceedances, or for the purpose of refining construction methods or techniques to minimise vibrations.
- Vibration monitoring will continue throughout construction, where appropriate, at nominated sensitive receiver locations to determine the effectiveness of mitigation strategies (as outlined in Chapter 8).

Where vibration is found to exceed safe levels, impacts will be avoided by changing work methods and/or equipment, or through the provision of building protection measures where possible. . In the event a complaint relating to property damage is received, an inspection of the property would be undertaken and an interim building condition survey prepared.

Vibration monitoring will be carried out in accordance with:

- For structural damage vibration – German Standard DIN 4150 and BS 7385: Part 2 – 1993.
- For human exposure to vibration – the evaluation criteria presented in the Environmental Noise Management *Assessing Vibration: A Technical Guideline* (DEC 2006).

9.4 Non-conformances

Non-conformances in general will be dealt with and documented in accordance with Section 8.6 of the CEMP.

9.5 Complaints

Complaints will be recorded in accordance with the Construction Community Liaison Plan (CCLP). Information to be recorded will include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in a timely manner and action taken recorded in accordance with the CCLP.

9.6 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, MCoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 8.4 of the CEMP.

9.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.4 of the CEMP.

Specific reports prepared in response to noise and vibration monitoring will capture detail including, but not limited, to:

- The locations and description of monitoring undertaken.
- A tabulation of results (eg for noise including L_{max} , L_{10} , L_{90} and L_{Aeq} noise levels) together with notes identifying the principle sources and operations.
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plant or operations causing these exceedances.
- Detail of any corrective actions and confirmation of their successful implementation.

10 Review and improvement

10.1 Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

10.2 CNVMP update and amendment

The processes described in this CNVMP may require revision as a result of the dynamic nature of the project. This will occur as needed. Refer to Section 1.6 of the CEMP for revisions to this document.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

Appendix A Plant and Equipment Sound Power Levels

L_{Aeq} (15min) Plant and Equipment Sound Power Levels

Plant	Sound Power Level (dB(A))	Sound Pressure Level at 7 m (dB(A))
Front end loader	111	86
Grader	107	82
Smooth drum roller	107	82
Spoil, materials or concrete truck	109	84
Tower crane or mobile crane	105	80
Truck-mounted shotcrete pump	106	81
Excavator or bobcat	107	82
Concrete pump	105	80
Concrete vibrator	103	78
Concrete cutter	109	84
Large bored drilling rig	112	87
Small bored drilling rig	108	83
Powered hand tools	109	84
30t excavator operating with hydraulic hammer	122	97
Rock saw	116	91
Water cart	110	85
Kerbing machine	99	74
Chainsaw	106	81
Forklift	106	81
Mulcher	106	81
Articulated dump truck	113	88
Handheld jackhammer	113	88
Air compressor (power tools)	98	73
Asphalt paving plant	114	89
Scraper	119	94

Source: *Noise and Vibration Assessment, Oxley Highway to Kempsey – Upgrading the Pacific Highway – Environmental Assessment (RTA, 2010)*

Appendix B Out of Hours Works Procedure (OOHW)

