



Transport
Roads & Maritime
Services

APPENDIX B3

Construction Noise and Vibration Management Plan

Additional Crossing of the Clarence River at Grafton Project


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Glossary / Abbreviations

BS	British Standard
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
CCS	Community Communication Strategy
CNVMP	Construction Noise and Vibration Management Plan
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
DECCW	The Department of Environment, Climate Change and Water
DIN	German Standard
DP&E	Department of Planning and Environment
ECRTN	NSW Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	Environmental Impact Statement
ENMM	RTA Environmental Noise Management Manual (RTA 2001a)
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.
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.
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
EWMS	Environmental Work Method Statements
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 (DECC 2009)
INP	NSW Industrial Noise Policy (EPA 2000)
L _{Aeq} (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.
LA90	Noise level exceeded for 90% of the measurement interval.
NATA	National Association of Testing Authorities, Australia
NCA	Noise Catchment Area
NML	Noise management level
OOHW	Out of Hours Work
POEO Act	<i>Protection of the Environment Operations Act</i>
Project, the	Additional Crossing of the Clarence River at Grafton
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is an RBL value for each period (day, evening and night).
RMS	Roads and Maritime Services
RNP	Road Noise Policy (EPA 2011)
Sound Pressure Level	The amount of sound at a specified point
SSI	The state significant infrastructure as generally described in Schedule 1 (SSI-6103) of the Infrastructure Approval.
TfNSW	Transport for New South Wales
VDV	Vibration Dose Value

1 Introduction

1.1 Context

This Construction Noise and Vibration Management Plan (CNVMP) forms part of the Construction Environmental Management Plan (CEMP) for the Additional Crossing of the Clarence River at Grafton Project (the Project).

This CNVMP has been prepared to address the requirements of:

- the Infrastructure Approval;
- the environmental management measures listed in the *Additional Crossing of the Clarence River at Grafton Environmental Impact Statement (EIS)* (ARUP, 2014); and the *Additional Crossing of the Clarence River at Grafton Submissions Report (RMS, 2014); and*
- all applicable legislation.

1.2 Background

As part of the development of the EIS, construction and operational noise and vibration assessments were prepared to address the Director-General's Requirements for the Project,. The EIS assessed the predicted noise and vibration impacts during the construction of the Project. The noise and vibration assessments were included as *Appendix F - Technical Paper Noise and Vibration Assessment*.

The EIS 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. These impacts will be mitigated through the implementation of the construction noise mitigation and management measures provided in this CNVMP.

1.3 Environmental management document system

The Project Environmental Management document system is described in the CEMP.

The CNVMP is part of Fulton Hogan's environmental management framework for the Project. In accordance with the requirements of CoA D46(a), this CNVMP has been developed in consultation with the NSW Environment Protection Authority (EPA). Further details of the consultation are provided in Chapter 4 of this CNVMP.

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

Used together, the CEMP, issue-specific plans, strategies, procedures and EWMS identify the required environmental management actions for implementation by Fulton Hogan's personnel and sub-contractors.

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

2 Purpose and objectives

2.1 Purpose

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

2.2 Objectives

The key objective of this 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 ensuring 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;
- ensuring appropriate measures are implemented to address the relevant CoAs outlined in Table 3-1 and the mitigation measures detailed in the EIS; and
- ensuring appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 of this CNVMP.

2.3 Targets

Targets established for the management of noise and vibration impacts during the Project include:

- compliance with the relevant legislative requirements, the EIS, the Submissions Report and the Infrastructure Approval;
- implementation of 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);
- minimisation of complaints from the community and stakeholders.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to noise and vibration management includes:

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

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

3.1.2 Guidelines

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

- NSW Industrial Noise Policy (INP) (EPA 2000);
- NSW Road Noise Policy (RNP) (EPA 2011);
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001a);
- Interim Construction Noise Guideline (ICNG) (DECC 2009);
- Assessing Vibration: A Technical Guideline (DEC 2006);
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC);
- German Standard DIN 4150 - Part 3 - Structural Vibration in Buildings - Effects on Structures;
- British Standards BS 7385 Part 2 'Evaluation and measurement for vibration in buildings'

3.2 Minister's Conditions of Approval

The CoAs relevant to this CNVMP are listed in 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.

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

CoA No.	Condition Requirements	Document Reference
Construction Hours		
CoA D2	Construction activities associated with the SSI shall be undertaken during the following standard construction hours: (a) 7:00 am to 6:00 pm Monday to Friday, inclusive; and (b) 8:00 am to 1:00 pm Saturday; and (c) at no time on Sunday or public holidays.	Section 8.1 Table 8-3 mitigation measure ID CNVMM1
CoA D3	Construction works outside the standard construction hours may be undertaken in the following circumstances: (a) construction works that generate noise and vibration that is: (i) LAeq(15 minute) noise levels no more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009); and (ii) LAeq(15 minute) noise levels no more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009) at other sensitive receivers; and (iii) continuous or impulsive vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.2 of <i>Assessing Vibration: a technical guideline</i> ; and (iv) intermittent vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.4 of <i>Assessing Vibration: a technical guideline</i> ; or (b) where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved; or (c) for the delivery of materials required outside the standard construction 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 (d) out-of-hours work in accordance with condition D4	Section 8.1 Table 8-3 mitigation measure ID CNVMM1 Annexure C – Out of Hours Work Approval Procedure

CoA No.	Condition Requirements	Document Reference
CoA D4	<p>Construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:</p> <ul style="list-style-type: none"> (a) process for obtaining the Environmental Representative's approval for Out of Hours work; (b) details of the nature and need for activities to be conducted during the varied construction hours; (c) justifies the varied construction hours in accordance with the <i>Interim Construction Noise Guideline</i> (DECC, 2009); (d) provides evidence that consultation with potentially affected receivers, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and (e) provides evidence of consultation with the EPA and Council on the proposed work outside the standard construction hours. 	<p>Section 8.1 Table 8-3 mitigation measure ID CNVMM1 Annexure C – Out of Hours Work Approval Procedure</p>
CoA D5	<p>Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken:</p> <ul style="list-style-type: none"> (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. <p>For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.</p>	<p>Section 8.1 Table 8-3 mitigation measure ID CNVMM20</p>
CoA D6	<p>The Proponent shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods.</p>	<p>Section 8.1 Table 8-3 mitigation measure ID CNVMM20</p>
Construction Noise and Vibration		
CoA D7	<p>The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the ICNG (DECC, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Plan required under condition D46 (a).</p> <p><i>Note: The Interim Construction Noise Guideline identifies 'particularly annoying' activities that require the addition of 5dB(A) to the predicted level before comparing to the construction Noise Management Level.</i></p>	<p>Section 6 Section 7</p>
CoA D8	<p>The SSI shall be constructed with the aim of achieving the following construction vibration goals:</p> <ul style="list-style-type: none"> (a) for structural damage to heritage structures, the vibration limits set out in the German Standard <i>DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures</i>; (b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard <i>BS 7385-1:1990</i> – 	<p>Section 6.3</p>

CoA No.	Condition Requirements	Document Reference
	<p><i>Evaluation and measurement of vibration in buildings - Guide for measurement of vibration and evaluation of their effects on buildings</i> (and referenced in Australian Standard 2187.2 – 2006 <i>Explosives – Storage and use – Use of explosives</i>); and</p> <p>(c) for human exposure, the acceptable vibration values set out in <i>Assessing Vibration: A Technical Guideline</i> (Department of Environment and Conservation, 2006).</p>	
CoA D9	Wherever feasible and reasonable, piling activities shall be undertaken using quieter construction methods, such as bored piles or vibrated piles rather than impact or percussion piling methods.	Section 7.3.1.8 Table 8-3 mitigation measure ID CNVMM9
CoA D10	During construction, affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.	Section 9.5 <i>Community Communication Strategy</i> (CoA C1) to be provided separately to the CEMP
Noise Mitigation Measures		
CoA D12	Where feasible and reasonable, operational noise mitigation measures shall be implemented at the start of construction (or at other times during construction) to minimise construction noise impacts.	Section 8.1 management measure NV19 At-house architectural treatments will be implemented during construction (by RMS). RMS is targeting completion of at-house treatments by the end of 2016/ first quarter of 2017.
Construction Environmental Management		
CoA D46(a)	As part of the CEMP for the SSI, the Proponent shall prepare and implement 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 shall be consistent with the guidelines contained in the <i>Interim Construction Noise Guidelines</i> (DECC, 2009) and shall include, but not necessarily be limited to:	This CNVMP Section 4
	(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	Section 5 Section 6
	(ii) details of construction activities and an indicative schedule for construction works; including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Section 7.1 Section 8.1 Annexure A – Indicative Plant and Equipment and

CoA No.	Condition Requirements	Document Reference
		Construction Scenario Sound Power Levels Annexure B - Predicted noise levels for construction activities
	(iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts);	Chapter 8
	(iv) procedures and mitigation measures to ensure relevant vibration criteria are achieved, including applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and	Chapter 8 Section 9.3
	(v) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified;	Section 9.3 Annexure D – Noise and Vibration Monitoring Plan
	(vi) an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition D4 by the Environmental Representative;	Annexure C – Out of Hours Work Approval Procedure
	(vii) 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;	Chapter 9.5 Community Communications Strategy
	(viii) 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 exceedances of relevant noise and vibration goals are detected; and	Section 9.3 Appendix D – Noise and Vibration Monitoring Plan Section 8.5 of the CEMP
	(ix) mechanisms for the monitoring, review and amendment of this Plan	Section 10

4 Consultation

In accordance with CoA D46(a), this CNVMP has been developed in consultation with the Environment Protection Authority (EPA).

A summary of consultation undertaken during the preparation of this CNVMP is provided in Appendix A2 of the CEMP.

4.1 Consultation Requirements under the Infrastructure Approval

CoA D4

Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:

- d) evidence that the issues raised through consultation with potentially affected receivers have been addressed and all feasible and reasonable mitigation measures have been put in place; and
- e) evidence of consultation with the EPA and Council on the proposed work outside the standard construction hours.

CoA D10

During construction, affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.

CoA D11d

The Proponent shall undertake a review of the operational noise mitigation measures proposed to be implemented for the SSI, within six months of commencing construction, unless otherwise agreed by the Secretary. The review shall be submitted for the approval of the Secretary, and be prepared in consultation with the EPA

CoA D46(a)

The CNVMP is to be developed in consultation with the EPA.

4.2 Consultation Requirements under the EIS

NV15

The Draft Community Consultation Strategy prepared for the project outlines methods for consultation with the community during construction which are to be followed including:

- advance notification of planned activities and expected disruption/effects;
- construction noise complaints handling procedure;
- effective monitoring of noise levels in and around potentially affected dwellings.

5 Existing environment

The main contributors to ambient noise in the Grafton area are:

- road traffic noise, including heavy vehicles, along the main arterial roads in and around Grafton;
- general road traffic in and around the city centre;
- passenger and freight rail along the Northern Railway Line;
- rural industry and machinery; and
- local insect and animal noise.

5.1 Noise sensitive land uses

Residential and non-residential noise sensitive land uses relevant to the Project are presented in Figure 5-1 and Figure 5-2. The majority of receivers relevant to the Project are residential with a small number of non-residential open space and educational (TAFE and Aboriginal pre-school) land uses adjacent to the Project area. Typical land use characteristics within each noise catchment area are shown in Table 5-1.

5.2 Noise Catchment Areas

Noise Catchment Areas (NCAs) that reflect land uses and the nature and types of receivers within each NCA were established as part of the EIS. Typical land use characteristics within each NCA are shown in Table 5-1. Figure 5-1 and Figure 5-2 show the locations and extents of the NCAs, in Grafton and South Grafton and the flood levee works area, respectively.

Table 5-1: Noise catchment areas (NCAs)

NCA	Description
NCA 1	Predominantly commercial and industrial with a few residential single storey detached dwellings.
NCA 2	Residential area consisting predominantly of single storey and high-set detached dwellings and aged care facilities.
NCA 3	A mixture of residential single storey and high-set detached dwellings and an area owned by the Catholic Church consisting of some two storey buildings used for a range of purposes such as education, places of worship and residential.
NCA 4	Largely made up of the TAFE and residential single storey and high-set detached dwellings.
NCA 5	Residential area consisting predominantly of single storey and high-set detached dwellings and the Gummaney Pre-School.
NCA 6	Residential area consisting predominantly of single storey and high-set detached dwellings.
NCA 7	Predominantly rural with a few isolated residential dwellings.
NCA 8	A mixture of rural land, commercial properties such as a petrol station and public open spaces.
NCA 9	A mixture of residential single storey and high-set detached dwellings, the main South Grafton commercial precinct, other commercial and industrial areas and rural land.
NCA 10	Predominantly rural with a few isolated residential dwellings.

NCA	Description
NCA 11	Predominantly rural with a few isolated residential dwellings. Includes part of Junction Hill which is predominantly residential.
NCA 12	This area is a mixture of residential single storey and high-set detached dwellings, some industrial areas and the Grafton racecourse.
NCA 13	This area is a mixture of residential single storey and high-set detached dwellings, the main Grafton commercial precinct, the TAFE and an area owned by the Catholic Church consisting of two storey buildings used for a range of purposes such as education, places of worship and residential.
NCA 14	This is a residential area consisting predominantly of single storey and high-set detached dwellings.

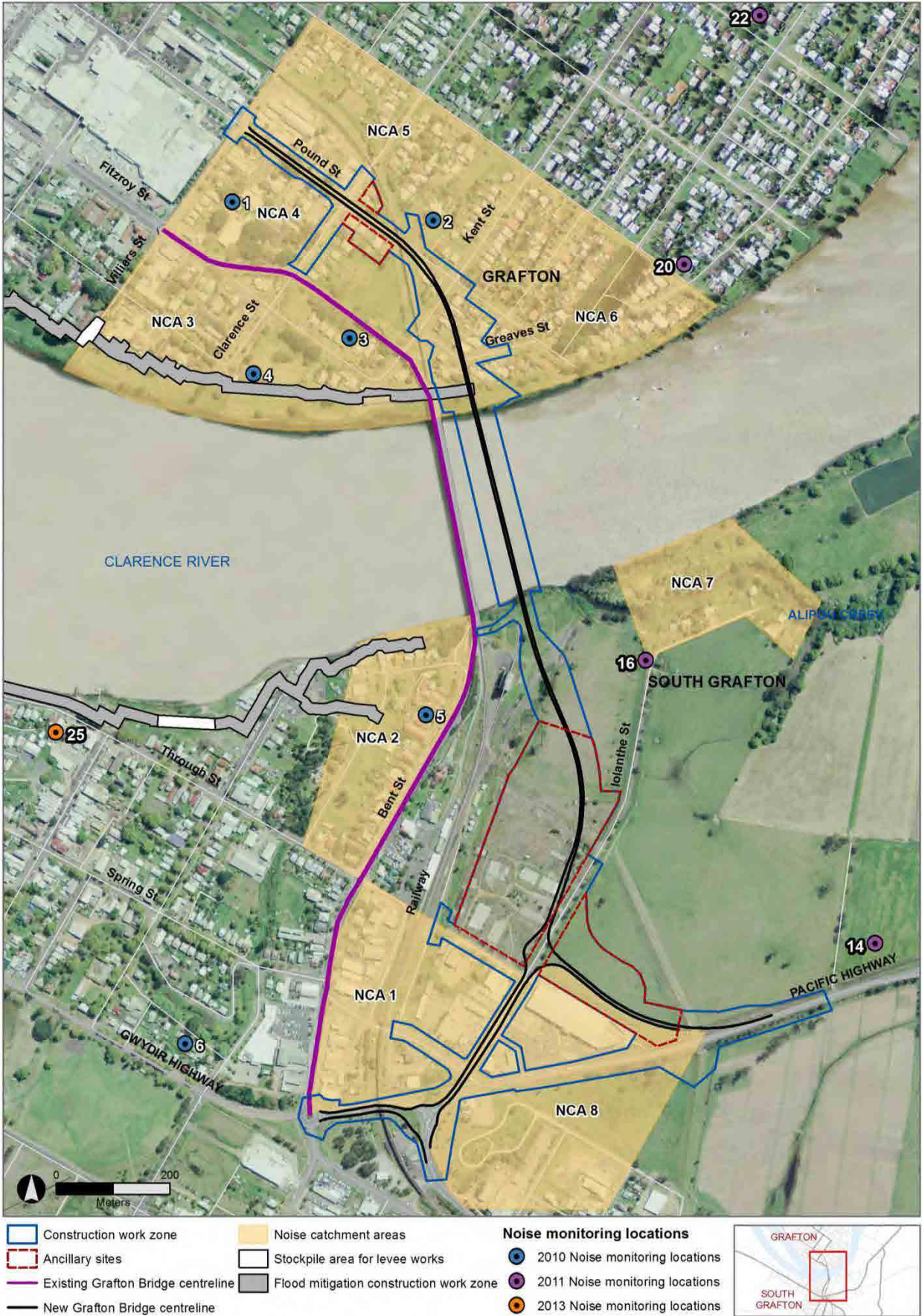


Figure 5-1: Noise catchment areas in Grafton and South Grafton

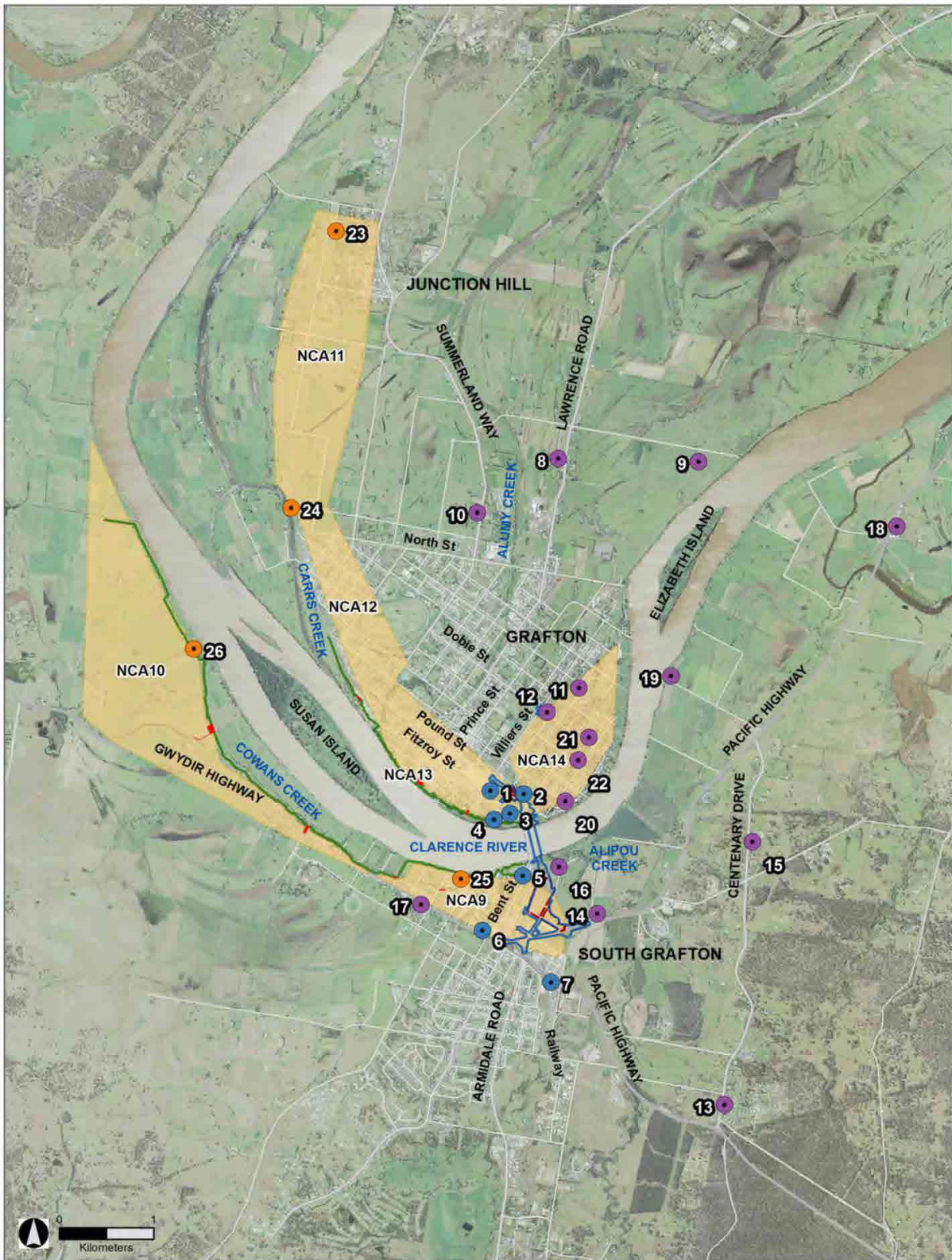


Figure 5-2: Noise catchment areas for flood mitigation works

5.3 Background Noise Levels

An extensive noise survey of the Grafton area was undertaken for the EIS to benchmark the existing acoustic environment. The noise survey incorporated noise data collected in August 2010, September 2011 and October 2013. Unattended noise monitoring was also undertaken at the locations shown in Figure 5-3.

In accordance with the requirements of the ICNG, the noise monitoring was used to establish the Rating Background Level (RBL), which represents the average minimum background sound level. Other noise monitoring data was also collected, such as energy-averaged L_{eq} noise levels and maximum L_{max} noise levels, with the measured traffic noise levels reported as $L_{eq,15hour}$ and $L_{eq,9hour}$ noise levels in accordance with the RNP.

A summary of the EIS background noise monitoring results is provided in Table 5-2. Attended noise measurements were used in favour of unattended noise logging data to derive road traffic noise levels where it was deemed on-site that other significant ambient noise sources extraneous to road traffic noise impacts would be measured. These instances are marked with an asterisk in Table 5-2.

The ICNG requires that the level of background and ambient noise be assessed separately for the day, evening and night periods which are defined as follows:

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

The RNP assessment time periods are:

- Day: 7am–10pm
- Night: 10pm–7am

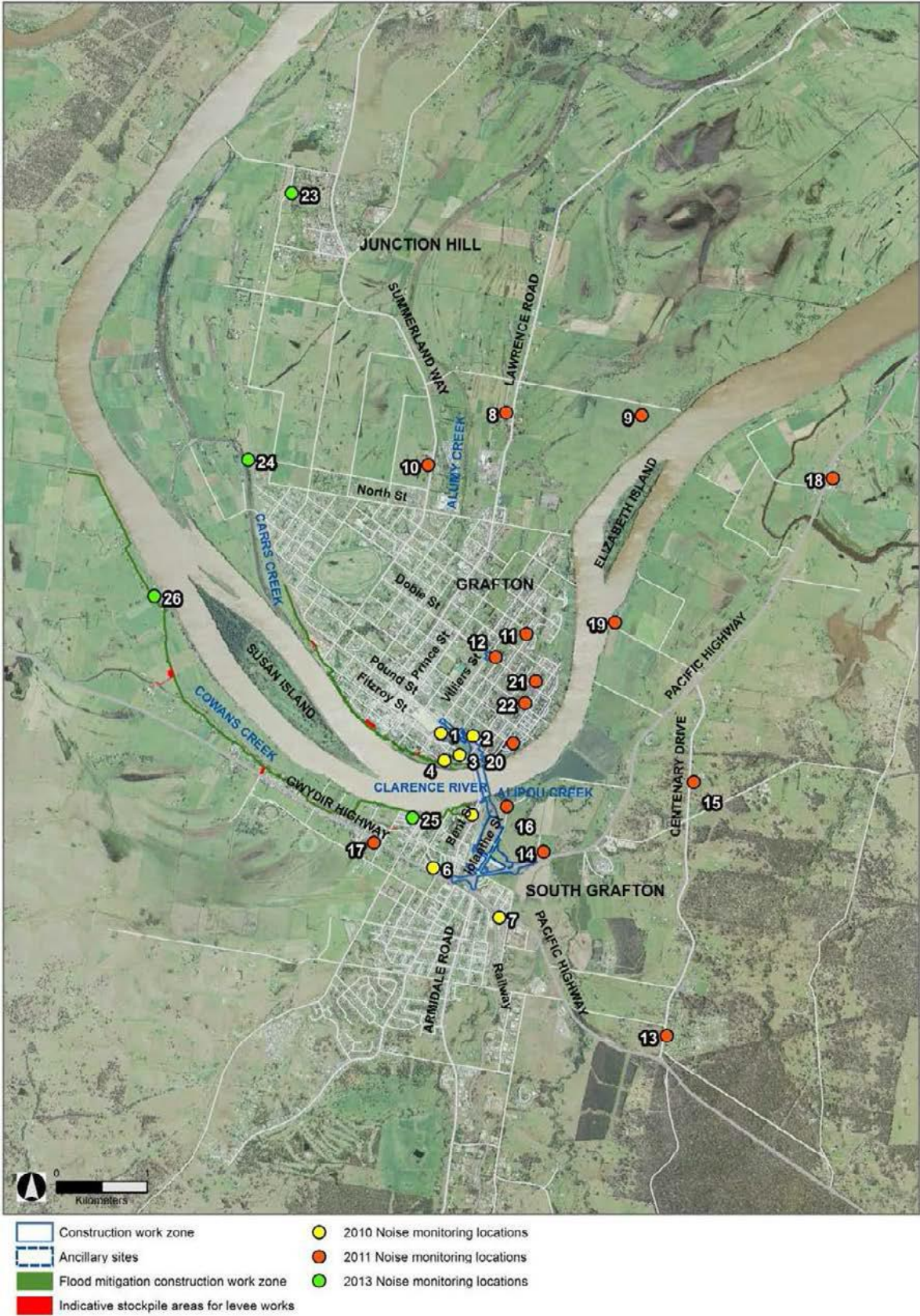


Figure 5-3: Noise monitoring locations

Table 5-2: Background noise monitoring

	Monitoring Location	NCA	Address	Measured Noise Level (dBA)							
				Road Traffic Noise		Ambient Background Noise					
				Day-time average L _{Aeq, 15 hour}	Night-time average L _{Aeq, 9 hour}	Day-time 0700-1800		Evening 1800-2200		Night-time 2200-0700	
		L _{Aeq(period)}	RBL	L _{Aeq(period)}	RBL	L _{Aeq(period)}	RBL				
2010 Noise Survey	1	4	Villiers Street, near TAFE, Grafton	66*	58*	55	48	51	42	48	35
	2	5, 6, 14	Gummaney Pre School, 30 Pound Street, Grafton	53*	43	55	44	54	39	54	35
	3	3, 13	8 Fitzroy Street, Grafton	59*	53	61	53	61	41	53	31
	4		St. Mary's Church, Clarence Street, Grafton	53	47	54	46	50	43	48	32
	5	2, 9	12 Bent Street, Grafton Aged Care Home, South Grafton	68	59	66	59	63	46	60	36
	6	1	8 Beatson Street, South Grafton	56	49	56	45	52	39	49	32
	7		España Hotel, Schwinghammer Street, South Grafton	66	66	66	53	67	46	66	42
2011 Noise Survey	8		245 Lawrence Road, Great Marlow	58	51	59	38	56	36	51	34
	9		86 Great Marlow Road, Great Marlow	66	45	67	30	50	32	45	31
	10		591 Summerland Way, Carrs Creek	65	59	65	44	61	34	59	28

	Monitoring Location	NCA	Address	Measured Noise Level (dBA)							
				Road Traffic Noise		Ambient Background Noise					
				Day-time average L _{Aeq} , 15 hour	Night-time average L _{Aeq} , 9 hour	Day-time 0700-1800 L _{Aeq} (period) RBL		Evening 1800-2200 L _{Aeq} (period) RBL		Night-time 2200-0700 L _{Aeq} (period) RBL	
11		Cnr Hoof and Clarence Streets, Grafton	49	45	50	35	47	35	45	32	
12		94 Dobie Street, Grafton	58	51	-	-	-	-	-	-	
13		81 Edward Ogilvie Drive, Clarenza	60	56	60	43	58	42	56	35	
14	8	Pacific Highway near Alipou Creek	71	70	71	49	71	48	70	41	
15		326 Centenary Drive, Clarenza	50	49	50	33	49	35	33	36	
16	7	Cnr Iolanthe Street & Butters Lane, South Grafton	52	49	53	39	49	42	49	37	
17		146-148 Ryan Street, South Grafton	63	56	64	45	60	40	56	29	
18		5 School Drive, Swan Creek	69	68	69	43	69	42	68	32	
19		Riverbank at end of Meona Lane, off Pacific Highway.	64	47	66	35	46	38	47	35	
20		4 Bacon Street, Grafton	-	-	72	37	76	39	76	34	
21		40 Dobie Street, Grafton	-	-	57	35	-	-	-	-	

	Monitoring Location	NCA	Address	Measured Noise Level (dBA)							
				Road Traffic Noise		Ambient Background Noise					
				Day-time average L _{Aeq} , 15 hour	Night-time average L _{Aeq} , 9 hour	Day-time 0700-1800		Evening 1800-2200		Night-time 2200-0700	
		L _{Aeq} (period)	RBL	L _{Aeq} (period)	RBL	L _{Aeq} (period)	RBL				
	22		22 Fry Street, Grafton	-	-	-	-	-	-	-	-
2013 Noise Survey	23	11, 12	320 Back Lane, Junction Hill	-	-	50	29	52	36	52	35
	24		235 Carr Street, Grafton	-	-	-	-	-	-	-	-
	25		98 Through Street, South Grafton	-	-	55	40	54	37	48	34
	26	10*	Maclennan's Lane, Waterview	-	-	54	30	66	41	47	37

* Attended noise measurements were used in favour of unattended noise logging data

6 Noise and vibration criteria

6.1 Construction noise and vibration goals

CoA D7 requires that all feasible and reasonable noise mitigation measures be implemented with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) during construction activities. 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; and
- provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

Under the Infrastructure Approval, “feasible and reasonable is defined as “*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 expectations and nature and extent of potential improvements.*”

In addition, the *Road Noise Policy* (RNP) (EPA, 2011) provides road traffic noise criteria for both residential and other non-residential noise sensitive receivers. The RNP provides both absolute noise level limits, dependent upon road category, and limits to control the relative increase in road traffic noise.

6.2 Construction noise criteria

6.2.1 Residential

The ICNG provides recommended noise levels for airborne construction noise at sensitive land uses. The guideline provides construction Noise Management Levels (NMLs) above which all feasible and reasonable work practices should be applied to minimise the construction noise impact. The ICNG works on the principle of a ‘screening’ criterion – if predicted or measured construction noise exceeds the ICNG NMLs then the construction activity must implement all ‘feasible and reasonable’ work practices to reduce noise levels.

The ICNG sets out management levels for noise at noise sensitive receivers, and how they are to be applied. Table 6-1 provides the ICNG’s approach for determining appropriate construction NMLs ($L_{Aeq(15\text{minute})}$). Noise levels apply at the worst affected property boundary of the residence, at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residences, the noise levels apply at the most noise-affected point within 30 m of the residence.

Table 6-1: Residential Noise Management Levels

Time of day	Noise Management Level $L_{Aeq} (15 \text{ min})^*$	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured $L_{Aeq} (15 \text{ min})$ is greater than the noise affected level, the Proponent should apply all feasible and reasonable work practices to meet the noise affected level. The Proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority 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 + 5 dB	<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 5 dB(A) above the noise affected level, the Proponent should negotiate with the community.

Notes:

- Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
- The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy.

For work within standard construction hours, if after implementing all ‘feasible and reasonable’ noise levels the site still exceeds the noise affected level, the ICNG does not require any further action as there is no further scope for noise mitigation.

6.2.2 ICNG sleep disturbance criteria

The ICNG recommends that the potential for sleep disturbance should be assessed using a screening criterion when works are planned for more than two consecutive nights adjacent to residential receivers.

Based on the RMS’s ENMM, the sleep disturbance criterion applies during the night-time period (10:00 pm to 7:00 am). The term ‘screening criterion’ indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. It is not a firm criterion to

be met, however where the criterion is met sleep disturbance is not likely. When the screening criterion is not met, a more detailed analysis is required.

As an initial screening criterion, reference has been made to the *NSW Road Noise Policy* (RNP), which advises that one possible screening criterion is that the L_1 noise level should not exceed the background level (L_{90}) by more than 15 dBA. For simplification in this CNVMP, and in accordance with the EIS, this screening criterion has been adapted such that the L_{max} level should not exceed the RBL by more than 15 dBA on the basis that the L_{max} will be marginally higher than the L_1 and the RBL is a representation of the typical lowest L_{90} level. Where the sleep disturbance screening criterion is exceeded, then further detailed analysis can consider the recommendation of the RNP that:

- maximum internal noise levels below 50 dBA to 55 dBA L_{max} are unlikely to cause awakening reactions; and
- one or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA L_{max} , are not likely to affect health and wellbeing significantly.

It is common to convert these internal levels to external noise levels by assuming a 10 dBA transmission loss across a window open for ventilation. Therefore, an internal noise level of 50 to 55 dBA L_{max} can also be assessed as an external noise level of 60 to 65 dBA L_{max} .

6.2.3 Construction NMLs and sleep disturbance criterion

Construction noise criteria are set based on noise catchment areas relative to proposed construction works. Measured noise data obtained at the logger location most representative of each noise catchment area has been used to derive appropriate noise management levels for the Project. Table 6-2 summarises the ICNG screening criteria and sleep disturbance criteria for residential receivers for each NCA.

For out-of-hours work, the ICNG uses a noise level 5 dB above the noise-affected level as a threshold where the Proponent should negotiate with the community. This level is addressed using the term 'highly-noise affected level' for brevity.

Table 6-2: ICNG screening criteria and sleep disturbance criteria

Construction Works	NCA	Noise Logger Reference	Time Period	Noise Affected Level	Highly Noise Affected Level	Sleep Disturbance Screening Criteria (L_{max})
Road works	NCA 1	8 Beatson Street, South Grafton	Day (standard hours)	55	75	-
			Day (outside hours)	50	55	-
			Evening	44	49	-
			Night	37	42	47
Road works	NCA 2	12 Bent St, South Grafton	Day (standard hours)	69	75	-
	Day (outside hours)		64	69	-	
Flood mitigation works	NCA 9		Evening	51	56	-
		Night	41	46	51	
Road works	NCA 3	8 Fitzroy St, Grafton	Day (standard hours)	63	75	-
	Day (outside hours)		58	63	-	
Flood mitigation works	NCA 13		Evening	46	51	-
			Night	36	41	46
Road works	NCA 4	29 Villiers St,	Day (standard hours)	58	75	-

Construction Works	NCA	Noise Logger Reference	Time Period	Noise Affected Level	Highly Noise Affected Level	Sleep Disturbance Screening Criteria (L _{max})
		Grafton	Day (outside hours)	53	58	-
			Evening	47	52	-
			Night	40	45	50
Road works	NCA 5 NCA 6	30 Pound St, Grafton	Day (standard hours)	54	75	-
			Day (outside hours)	49	54	-
Flood mitigation works	NCA 14		Evening	44	49	-
			Night	40	45	50
Road works	NCA 7	Cnr Iolanthe St and Butters Lane, South Grafton	Day (standard hours)	49	75	-
			Day (outside hours)	44	49	-
			Evening	47	52	-
			Night	42	47	52
Road works	NCA 8	Pacific Highway near Allipou Creek	Day (standard hours)	59	75	-
			Day (outside hours)	54	59	-
			Evening	53	58	-
			Night	46	51	56
Flood mitigation works	NCA 10	Maclennan's Lane, Waterview	Day standard hours)	40	75	-
			Day (outside hours)	35	40	-
			Evening	46	51	-
			Night	42	47	52
Flood mitigation works	NCA 11, NCA 12	320 Black Lane, Junction Hill	Day (standard hours)	39	75	-
			Day (outside hours)	34	39	-
			Evening	41	46	-
			Night	40	45	-

6.2.4 Non-residential sensitive land uses

NMLs adopted for sensitive receivers other than residential receivers are presented in Table 6-3. These NMLs are based on the criteria provided in the ICNG and AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors* or as recommended in the EIS.

Table 6-3: Noise management levels at non-residential sensitive land uses

Sensitive Land Use	Noise management level (when in use) L _{Aeq} (15 mins)
<ul style="list-style-type: none"> Classrooms at schools and other education institutions Hospital wards and operating theatres Places of worship 	45 dBA (internal)
Active recreational areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	65 dBA (external)

Sensitive Land Use**Noise management level (when in use)** $L_{Aeq}(15 \text{ mins})$ **Passive recreational areas**

(characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)

60 dBA (external)

Community centres

(based on the Maximum internal noise level for Reading Areas in public libraries in AS2107)

45 dBA (internal)

6.2.5 Commercial

The ICNG also gives recommended management measures for commercial premises. For commercial premises that are not very sensitive to noise, such as offices or retail outlets, an external $L_{Aeq,15\text{minute}}$ noise limit of 70 dBA is recommended.

6.2.6 Construction road traffic noise criteria

When trucks and other vehicles are operating within the construction site boundary, vehicle noise contributions are included in the overall predicted $L_{Aeq}(15\text{minute})$ construction site noise emissions. When construction-related traffic moves onto the public road network it is regarded as 'additional road traffic'.

Construction road traffic noise criteria are provided in the RNP. One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a project.

An increase of up to 2 dBA in noise levels represents a minor impact that is barely perceptible to the average person. Therefore, construction traffic NMLs set at 2 dBA above the existing road traffic noise levels during the daytime and night-time periods have been adopted to identify the onset of potential noise impacts.

Where road traffic noise levels increase by more than 2 dBA as a result of construction traffic, consideration will be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

Consideration will also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- existing freeway/arterial/sub-arterial roads: 60 dBA $L_{Aeq}(15\text{hour})$ day and 55 dBA $L_{Aeq}(9\text{hour})$ night; and
- existing local road: 55 dBA $L_{Aeq}(1\text{hour})$ day and 50 dBA $L_{Aeq}(1\text{hour})$ night.

6.3 Vibration goals

CoA D8 requires that the SSI shall be constructed with the aim of achieving the following construction vibration goals:

- for structural damage to heritage structures, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration - effects of vibration on structures*;
- for damage to other buildings and/or structures, the vibration limits set out in the British Standard BS 7385-1:1990 - *Evaluation and measurement for vibration in buildings - Guide for measurement of vibration and evaluation of their effects on buildings* (and referenced in Australian Standard 2187.2 – 2006 *Explosives – Storage and use – Use of explosives*); and

- for human exposure, the acceptable vibration values set out in *Environmental Noise Management Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).

Further details of each of these references are provided below and specific vibration criteria for the Project identified.

6.3.1 Heritage Structures

The standard by which building damage to heritage structures from construction-induced vibration is commonly assessed is the German standard DIN 4150: *Part 3 – 1999 Effects of Vibration on Structure* (DIN 1999). The DIN guideline values for peak particle velocity (mm/s) measured at the foundation of a heritage building are summarised in Table 6-4:. The criteria are frequency dependent.

Table 6-4: Structural damage criteria – Heritage Structures

Type of Structure	Peak Component Particle Velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 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 100 Hz, at least the values specified in this column shall be applied.

The most stringent limit recommended is 3 mm/s, which applies to heritage structures impacted by the Project.

6.3.2 Other buildings and structures

British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2 sets guide values for vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk is usually taken as a 95% probability of no effect. Limits for primarily transient vibration above which cosmetic damage could occur are provided in tabular and graphical form in the BS 7385 and reproduced in Table 6-5 and Figure 6-1 below.

Table 6-5: Transient Vibration Guide Values for Cosmetic Damage (BS 7385: Part 2:1993)

Line (see Fig 6.2)	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 to 15 Hz	15 Hz and above

1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes 1. Values referred to are at the base of the building
2: For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

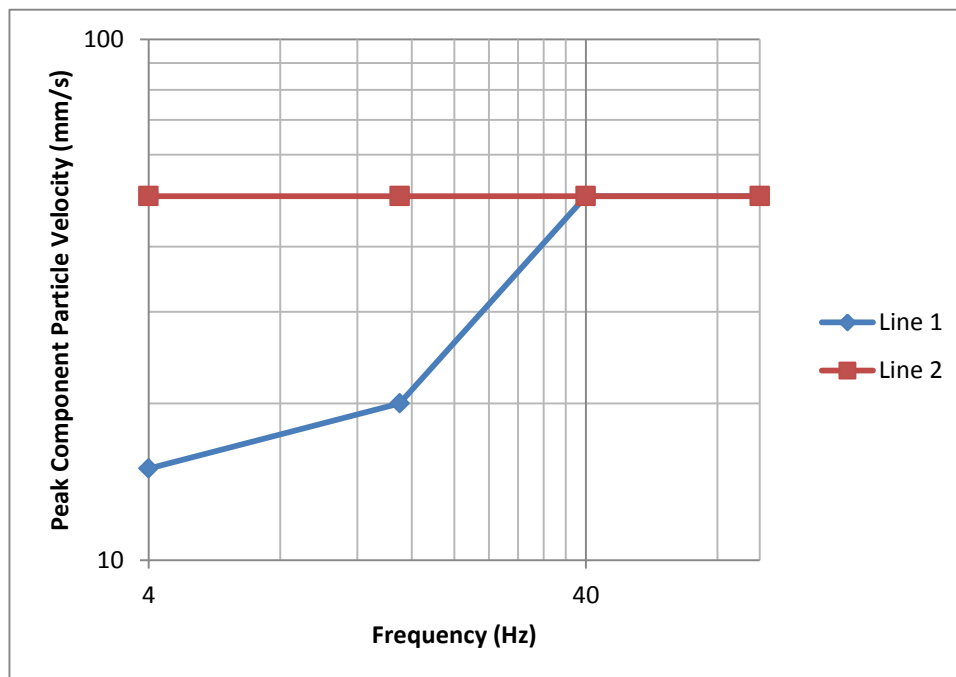


Figure 6-1: Summary of Damage Thresholds for transient vibration on domestic structures

The guide values relate mainly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. In the event that continuous vibration gives rise to magnification of vibration by resonance (specific conditions where the structure can readily store and transfer vibration energy), then the guide values may need to be reduced by up to 50%.

Rock breaking, rock hammering and sheet piling are considered to have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50% for these construction activities.

For most sources of intermittent vibration during construction, such as rock breakers, piling rigs, vibratory rollers and excavators, the predominant vibration energy occurs at frequencies usually in the 10 Hz to 100 Hz range. On this basis a vibration damage screening level of 7.5 mm/s has been adopted for the purpose of assessing potential impacts.

In the lower frequency region below 4 Hz the guide values for building types are reduced as a high displacement is associated with relatively low peak component particle velocity. To minimise risk of structural damage a guide value of 3.7 mm/s has been adopted.

BS 7385 indicates, for example, that for a residential building (line 2) a peak particle velocity (PPV) of greater than 15 mm/s at 4Hz or greater than 50 mm/s at 40 Hz or above, measured at the base of the building, may be expected to result in cosmetic damage.

The standard states in Annex A that *'the age and existing condition of a building are factors to consider in assessing the tolerance to vibration. If a building is in a very unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other ground-borne disturbance.'*

6.3.3 Human comfort and amenity

For most construction activities that generate perceptible vibration in nearby buildings, the character of the vibration emissions is intermittent. *Assessing Vibration: a technical guideline* (DEC 2006) nominates preferred and maximum vibration goals for critical areas, residences and other sensitive receptors as shown in Table 6-6. The Guideline advises a low probability of adverse comment or disturbance to building occupants would be expected at or below the preferred values.

The applicable human comfort vibration goal for intermittent vibration source is defined in terms of Vibration Dose Values (VDVs) where the permissible vibration level corresponding to the VDV varies according to the duration of exposure.

Table 6-6: Acceptable vibration dose values (VDV) for intermittent vibration

Building type	Preferred VDV (m/s ^{1.75})	Maximum VDV (m/s ^{1.75})
Residential daytime (7am-10pm)	0.20	0.40
Residential night-time (10pm-7am)	0.13	0.26
Offices, schools, educational institutions and places of worship (day and night time)	0.40	0.80

In applying the preferred and maximum VDV, the Guideline states that situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short term duration. An example is a construction or excavation project.

The Guideline also advises that where all feasible and reasonable measures have been applied to control potential ground vibration levels the maximum values may be used. For values above the maximum value the Contractor should negotiate directly with the affected community.

6.3.4 Safe working distances for vibration intensive plant

The propagation of vibration emitted from a source is site-specific with the level of vibration potentially experienced at a receiver dependent on the vibration energy generated by the source, the main frequencies of vibration, the localised geotechnical conditions and the interaction of structures and features which can dampen vibration.

The recommended safe working distances for construction plant provided in Table 6-7 are referenced from TfNSW's *Construction Noise Strategy* and in-house measurement data from Resonate Acoustics for excavation works. Consistent with the British Standard and the *Assessing Vibration* guideline, the recommendations are for the practical management of potential vibration to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance in humans. The human comfort safe working distances are conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions.

Table 6-7: Recommended safe working distances for vibration-intensive plant

Plant item	Rating/Description	Safe working distance	
		Cosmetic damage ¹	Human response ²
Vibratory roller	<50 kN (typically 1-2 t)	5 m	15-20 m
	<50 kN (typically 2-4 t)	6 m	20 m
	<50 kN (typically 4-6 t)	12 m	40 m
	<50 kN (typically 7-13 t)	15 m	100 m
	<50 kN (typically 13-18 t)	20 m	100 m
	<50 kN (typically >18 t)	25 m	100 m
Handheld compactor	Up to 300 kg	5 m	20 m
Small hydraulic hammer	300 kg – 18-34 t excavator	2 m	7 m
Medium hydraulic hammer	1600 kg – 5-12 t excavator	7 m	23 m
Large hydraulic hammer	1600 kg – 12-18 t excavator	22 m	73 m
Excavation works	12-18 t excavator	2 m	10 m
Vibratory pile driver	Sheet piles	2-20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Handheld	1 m (nominal)	Avoid contact with structure

1: Referenced from British Standard BS 7385 Part 2-1993.

2: Referenced from DECCW *Assessing Vibration: a technical guideline*.

7 Environmental aspects and impacts

7.1 Indicative Schedule

Construction of the Project will take approximately three years, commencing around mid-2016 with the end of 2019 as the targeted completion date. The indicative schedule is provided in Figure 7-1 below as per Section 2.2 of the CEMP.

Activities	2016			2017			2018			2019		
Project preliminaries and site establishment												
Flood mitigation												
Roadwork and drainage												
Bulk earthworks												
Bulk earthworks (soft soil treatments)												
Bridge work (rail viaduct replacement)												
Bridge work (Clarence River bridge)												
Road surfacing												
Finishing work												

Figure 7-1: Indicative schedule of construction works

7.2 Construction Activities

The main potential noise and vibration impacts associated with construction of the Project are expected to result the activities and plant listed in Table 7-1.

Table 7-1: Typical construction activities and plant

Component	Typical Activities	Typical Plant and Equipment
Preliminary activities and site establishment	<ul style="list-style-type: none"> Property acquisition and adjustments, including property access changes Detailed geotechnical investigations and survey Dilapidation surveys General site clearance, site establishment work, fencing and signage Establishment of temporary construction facilities and compound sites including the site office Temporary traffic management arrangements Progressive installation of environmental controls including temporary or permanent fencing, and erosion and sediment control measures Construction of temporary drainage controls Clearing and removal of vegetation Diversion of utilities 	<ul style="list-style-type: none"> Trucks Generators Light vehicles Excavators Chainsaws Mulchers Water carts Cranes Drilling rigs
Flood mitigation works	<ul style="list-style-type: none"> Clearing of vegetation (where required) Stripping of topsoil Placement and compaction of earthwork Reinstatement of topsoil and planting / grass seeding to establish vegetation 	<ul style="list-style-type: none"> Excavators Dump trucks Compactors Graders Loaders

Component	Typical Activities	Typical Plant and Equipment
	Upgrade of flood mitigation structures Adjustments to minor structures within built areas Adjustment of control gates and regulatory devices	Water carts Profilers Bulldozers Vibratory rollers
Roadwork and road surfacing	Stripping of topsoil, removal of trees and other vegetation Construction of temporary local traffic management diversions Placement and compaction of earthwork Road widening, including construction of box cuts and road surfaces Staged construction on local roads Installation of traffic signals, roadside furniture and lighting Installation of road markings Construction of any retaining walls and subsurface drainage Construction of road surface Construction of pedestrian and cycle path Progressive landscaping and tree planting	Chainsaw Graders Backhoes Trucks Water carts Vibratory compactors Bitumen sprayers Vibratory rollers Rubber tyred rollers
Drainage	Construction of drainage, including kerb and gutter (where required) Major drainage work – eg cross-drainage structures and Pound Street drainage, including the pump station Installation of cross-drainage, including culverts and inlet and outlet work, such as channel diversions and scour protection Installation of longitudinal and vertical drainage in cuttings and embankments Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required)	Trucks Bulldozers Excavators Concrete pumps Concrete trucks
Bulk earthwork	Stripping topsoil and stockpiling it for reuse in landscaping Materials haulage Soft soils treatment Construction of embankments Stockpiling	Trucks Bulldozers Excavators
Bridge work	Establishment of batching plant Preparation of bridge work areas including temporary piling pads, access platforms Installation of bridge foundations (driven or bored piles, pile caps and footings) Construction of new bridge superstructure and piers Replacement of ARTC rail viaduct at Pound Street Construction of bridge superstructure including deck and pavement work (cast in-situ or pre-cast bridge elements) Construction of noise barrier	Batching plant Piling rigs Concrete pumps Concrete trucks Cranes Barge(s) Excavators Trucks Small equipment
Finishing work	Remove temporary work Restoration and landscaping of temporary sites General site clean-up Restoration of topsoil and revegetation of batters Removal of temporary environmental controls Site clean-up and demobilisation, including restoration of ancillary sites and construction access roads (where required)	Trucks Generators Light vehicles Cranes
Operation of ancillary sites and facilities	Operation of ancillary sites during construction phase	Front end loader Excavator Truck Compressor Crane Vibratory roller Generator

Details of sound power levels for plant and equipment is provided in Annexure A and the predicted noise levels for these construction activities for each NCA are provided in Annexure B.

7.3 Construction Noise and Vibration Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors including:

- the type of equipment in use;
- the amount of equipment simultaneously in use;
- ground conditions;
- topography and other physical barriers;
- proximity to sensitive receivers;
- the condition of sensitive receivers;
- hours/duration of construction works;
- proximity of heavy traffic areas; and
- environmental conditions such as wind speed, temperature, humidity, and temperature inversions.

Relevant aspects and the potential for related impacts have been considered in a risk assessment contained in Section 3.4 / Appendix A3 of the CEMP.

Further details of the predicted noise and vibration impacts are provided in the sections below. Chapter 8 provides a suite of mitigation measures that will be implemented to avoid or minimise these impacts on the receiving community and the built environment.

7.3.1 Construction Noise Impacts

7.3.1.1 General Construction Works

Predictions conducted for the planned construction activities indicate that typical construction noise levels for bulk earthworks, roadwork, road surfacing and flood mitigation activities are predicted to be around 70–75 dBA $L_{eq(15min)}$ at a distance of 50 m from construction work zones, and 45–55 dBA $L_{eq(15min)}$ at a distance of 150 m.

The predicted construction noise levels at the most affected receiver within each NCA are provided in Annexure B. The typical distances from works to achieve different noise levels are presented in Table 7-2.

Table 7-2: Typical distance to achieve noise levels in m

Phase	Equipment	Typical distance to achieve noise level, m					
		75 dBA Highly noise affected	70 dBA	65 dBA	60 dBA	55 dBA	50 dBA
Preliminary activities and site establishment	Trucks	14	25	45	79	141	251
	Generators	13	22	40	71	126	224
	Light vehicles	4	6	11	20	35	63
	Excavators	11	20	35	63	112	200
	Chainsaws	30	53	94	168	299	531

Phase	Equipment	Typical distance to achieve noise level, m					
		75 dBA Highly noise affected	70 dBA	65 dBA	60 dBA	55 dBA	50 dBA
	Mulchers	45	79	141	251	447	794
	Water carts	14	25	45	79	141	251
	Drilling rigs	30	53	94	168	299	531
	Crane	18	32	56	100	178	316
	TYPICAL OVERALL	30	50	95	170	300	540
Flood mitigation works	Excavators	11	20	35	63	112	200
	Dump trucks	14	25	45	79	141	251
	Vibratory rollers	9	16	28	50	89	158
	Graders	18	32	56	100	178	316
	Front end loaders	18	32	56	100	178	316
	Water carts	14	25	45	79	141	251
	Profilers	28	50	89	158	282	501
	Bulldozers	22	40	71	126	224	398
TYPICAL OVERALL	20	40	70	125	220	400	
Roadwork and road surfacing	Chainsaw	30	53	94	168	299	531
	Graders	18	32	56	100	178	316
	Backhoes	14	25	45	79	141	251
	Trucks	14	25	45	79	141	251
	Water carts	14	25	45	79	141	251
	Vibratory rollers	9	16	28	50	89	158
	Excavators	11	20	35	63	112	200
	Pavers	18	32	56	100	178	316
	TYPICAL OVERALL	25	40	75	135	240	425
Drainage	Trucks	14	25	45	79	141	251
	Bulldozers	22	40	71	126	224	398
	Excavators	11	20	35	63	112	200
	Concrete pumps	8	14	25	45	79	141
	Concrete trucks	20	35	63	112	200	355
	TYPICAL OVERALL	20	40	65	120	200	350
Bulk earthwork	Trucks	14	25	45	79	141	251
	Bulldozers	22	40	71	126	224	398
	Excavators	11	20	35	63	112	200

Phase	Equipment	Typical distance to achieve noise level, m					
		75 dBA Highly noise affected	70 dBA	65 dBA	60 dBA	55 dBA	50 dBA
	TYPICAL OVERALL	15	30	55	95	170	300
Bridgework	Batching plant	32	55	100	176	315	560
	Bored piling rig	13	22	40	71	126	224
	Concrete pumps	8	14	25	45	79	141
	Concrete trucks	20	35	63	112	200	355
	Cranes	18	32	56	100	178	316
	Barges	27	47	84	150	266	473
	Excavators	11	20	35	63	112	200
	Trucks	14	25	45	79	141	251
	TYPICAL OVERALL	35	65	110	200	350	600
Finishing work	Trucks	14	25	45	79	141	251
	Generators	13	22	40	71	126	224
	Light vehicles	4	6	11	20	35	63
	Cranes	18	32	56	100	178	316
	TYPICAL OVERALL	15	25	40	75	135	240
Ancillary sites and facilities	Front end loader	18	32	56	100	178	316
	Excavator	11	20	35	63	112	200
	Truck	14	25	45	79	141	251
	Compressor	17	30	53	94	168	299
	Crane	18	32	56	100	178	316
	Vibratory roller	9	16	28	50	89	158
	Generator	13	22	40	71	126	224
	TYPICAL OVERALL	25	45	80	140	250	440

The construction noise levels at the most affected residences are likely to exceed the noise affected levels in a number of the catchment areas, due to the close proximity of existing residences to the construction works zones.

There is potential for noise impacts on sensitive receivers where they are in close proximity to construction works, particularly at residences within Grafton nearest to the roadworks at properties in Greaves Street, Pound Street, Clarence Street, Kent Street and Bromley Street.

In South Grafton, there are fewer sensitive receivers near construction works zones, with sensitive receivers in Butters Lane most likely to be impacted by general construction noise. Properties on Bent Street and Riverside drive are less likely to be impacted by construction noise, since they are already subject to relatively high levels of existing road traffic noise.

Where noise levels exceed the noise affected level for any works outside the recommended standard hours, there is a risk of additional noise disturbance, and alternative scheduling of the work or work methods used should be considered.

7.3.1.2 Flood Mitigation Works

The flood mitigation works involve raising the height of sections of the existing levee upstream from the new bridge in Grafton and South Grafton. Specifically, works will occur:

- along the southwest bank of the river between Friars Lane, running parallel to the Gwydir Highway through to the existing bridge;
- along the northern bank of the river starting near the western end of Bacon Street and running south to meet the existing bridge.

Noise sensitive locations around the flood mitigation works areas are typically isolated residences outside of Grafton, with higher density residential areas near the existing bridge and particularly on the northern side of the river.

Predicted noise levels for flood mitigation works are predicted to exceed the standard hours NMLs when works are occurring close to sensitive receivers. While individual receivers may not be affected for long periods of time as the works progress, the number of receivers adjacent to the flood mitigation works means that reasonable and feasible mitigation measures as detailed in Section 8 will be implemented throughout.

7.3.1.3 Ancillary Sites

The locations of ancillary facilities are shown on Figure 7-2. The main ancillary site is located in South Grafton, where there are fewer sensitive receivers, with a smaller ancillary site located in Grafton at the intersection of Clarence and Pound Streets. Noise associated with the ancillary sites will primarily be generated from vehicle movements as well as the concrete batching plant at South Grafton (if required). Noise from the construction compounds is likely to be generated for extended periods of the Project duration.

Properties within 100 to 150 m from the ancillary sites may be subject to construction noise at levels exceeding the standard hours NMLs established in Table 6-2. The noise from ancillary sites would therefore be most likely to affect several sensitive receivers in Clarence and Pound Streets in Grafton. The South Grafton site is not expected to have a major noise impact on sensitive receivers.

On this basis, reasonable and feasible mitigation measures for predicted noise levels exceeding NML as detailed in Section 8 will be implemented for ancillary and stockpile sites located north of the river in Grafton.



Figure 7-2: Location of Ancillary Facilities

7.3.1.4 Stockpile Areas

Stockpile areas are required for storage of fill material, mulch and spoil. Noise associated with the proposed flood mitigation works stockpile areas would mainly be from earthmoving equipment and heavy haulage vehicles loading and unloading.

Stockpiles will generally be located in the same areas as the ancillary sites. Given this, and the typical distance from stockpile areas to noise sensitive receivers, significant impacts from stockpile areas are not expected and management of stockpile areas will occur in the same manner as for management of the ancillary sites, with application of management measures as detailed in Section 8.

7.3.1.5 Concrete Batching Plant and Precast Yard

Noise associated with the concrete batching plant (if required) and precast yard, located in the South Grafton ancillary site, would primarily be generated from associated vehicle movements and use of plant and equipment. Based on the typical sound power level for the distances presented in Table 7-2, noise levels at the nearest NCAs adjacent to the batching plant and the precast yard are expected to comply with the NMLs for standard hours work, particularly when considering shielding from commercial structures surrounding the site.

7.3.1.6 Pound Street Viaduct

As part of the project, works will need to be undertaken in and around the Pound Street rail viaduct. Due to the need to generally maintain the rail line and protect worker safety, these works will need to be undertaken during a rail shutdown period which may extend for 24 hours continuous over a number of days.

The Pound Street viaduct is in close proximity to a number of residential land uses and therefore the NMLs will be exceeded during both standard hours and out of hours works. Reasonable and feasible mitigation measures for predicted noise levels exceeding NML as detailed in Section 8 will be implemented for standard hours works, with OOHW assessed in accordance with the procedure in Annexure C. This includes the application of OOHW-specific mitigation measures as detailed in Table 8-3 in Section 8.

7.3.1.7 Construction Traffic

Construction traffic will generate noise over a relatively wide area and beyond the construction site itself. It is expected that traffic noise will be greatest where there is a concentration of vehicle movements, such as at ancillary sites, batching plant locations and where construction is occurring at a given time.

The daily increase in road traffic due to the Project's construction would be relatively low compared to daily traffic demand on the existing road network. As a result, the associated change in road traffic noise during construction will be negligible and it is not expected to exceed the 2 dBA increase criterion from the RNP detailed in Section 6.2.6.

However, the construction schedule may require higher truck traffic volumes to certain ancillary facilities for short periods. While it is not expected that this would result in an increase above the RNP criterion in the long-term, this could result in significant, noticeable noise impacts for short periods for residential receivers near the ancillary sites proposed at the Clarence Street and Pound Street intersection. Noise from truck traffic to ancillary sites will be managed in accordance with the noise and vibration mitigation measures detailed in Section 8.

7.3.1.8 Piling

Construction of the new bridge will require piling for the installation of bridge foundations on the river bed and banks. This activity has the potential to cause significant noise impacts.

To reduce noise impacts from piling, and remove vibration impacts, bored piling will be used in favour of impact piling wherever feasible. With the residential areas on the northern side of the river, noise levels will still likely exceed the standard hours NMLs, particularly for bored piling works within 120 m of sensitive residential receivers. Therefore, reasonable and feasible mitigation measures for predicted noise levels exceeding NML as detailed in Section 8 will be implemented for bored piling works.

In the case that impact piling is required, such as for the jetty, then the noise impact area will increase. Due to the significant increase in noise level associated with impact piling, the standard hours NMLs may be exceeded at distances of up to 300 m from the works.

7.3.1.9 Highly noise affected receivers during construction

Predicted noise levels for flood mitigation works are predicted to exceed the standard hours NMLs when works are occurring close to sensitive receivers. While individual receivers may not be affected for long periods of time as the works progress, the number of receivers adjacent to the flood mitigation works means that reasonable and feasible mitigation measures as detailed in Section 8 will be implemented throughout. Table 7-3 summarises the number of highly noise affected receivers for various construction activities. Note that these predictions apply to highly noise affected residential receivers during standard hours (i.e. noise levels > 75 dBA).

Table 7-3: Number of highly noise affected residential receivers

NCA	Site establishment	Flood mitigation works	Road works	Drainage	Bulk earthworks	Bridge construction works	Finishing works	Ancillary sites
NCA - 01	0	-	0	0	0	0	0	0
NCA - 02	0	-	0	0	0	0	0	0
NCA - 03	0	-	0	0	0	0	0	0
NCA - 04	5	-	4	4	4	0	4	0
NCA - 05	4	-	4	4	4	0	4	0
NCA - 06	3	-	2	2	2	3	1	0
NCA - 07	0	-	0	0	0	0	0	0
NCA - 08	0	-	0	0	0	0	0	0
NCA - 09	-	1	-	-	-	-	-	-
NCA - 10	-	0	-	-	-	-	-	-
NCA - 11	-	0	-	-	-	-	-	-
NCA - 12	-	0	-	-	-	-	-	-
NCA - 13	-	6	-	-	-	-	-	-
NCA - 14	-	0	-	-	-	-	-	-

From Predicted noise levels for flood mitigation works are predicted to exceed the standard hours NMLs when works are occurring close to sensitive receivers. While individual receivers may not be affected for long periods of time as the works progress, the number of receivers

adjacent to the flood mitigation works means that reasonable and feasible mitigation measures as detailed in Section 8 will be implemented throughout., it is apparent that highly noise affected receivers are only expected to occur in NCA 4, NCA 5 and NCA 6 during the main works, and NCA 9 and NCA 13 during the flood mitigation works.

In each case, the number of highly affected receivers is predicted to be small and limited to those residences in close proximity to works. The predictions in Table 7-3 are based on the typical maximum predicted construction noise levels and for the majority of the construction period no noise sensitive receivers are expected to be highly noise affected.

Where noise sensitive receivers are in close proximity to works such that they are expected to be within the 75 dBA setback distance defined in Table 7-2, then construction noise mitigation measures will be implemented as specified in Section 8, including those specific mitigation measures for highly noise affected receivers.

7.3.1.10 Construction activities outside of standard hours

Construction activities that may require out of hours works include:

- Deliveries of materials to ancillary facilities and construction sites (such as oversize elements of plant and large construction equipment);
- Upgrading of local roads in Grafton and South Grafton to minimise impacts on road users, local businesses and the TAFE;
- Bridge construction (e.g. lifting and setting of bridge elements);
- Replacement of the Pound Street viaduct;
- Tying in the Project with the existing Pacific Highway;
- Managing traffic and traffic switches;
- Utilities relocations on existing roads;
- Construction compound operations to support any activities that may be undertaken out of hours;
- Refuelling of plant and machinery (to maximise operations during standard hours);
- Work required in an emergency to avoid the loss of lives, property and/or to prevent harm;
- Short-term major traffic diversions, including full or partial road closures;
- Work that would not cause construction noise disturbance at any sensitive receivers; and
- Work as agreed between Roads and Maritime and potentially affected sensitive receivers.

Where works are proposed outside of standard hours, they will be undertaken in accordance with the Out of Hours Work Approval Procedure in Annexure C.

7.3.1.11 Sleep disturbance

Sleep disturbance for works that potentially affect an individual receiver for more than two consecutive nights are assessed on the basis of maximum (L_{Amax}) noise levels. Table 7-4 presents typical maximum noise levels from potential night time construction activities with distance. The sound power levels are based on the TfNSW *Construction Noise Strategy*.

Table 7-4: Typical maximum noise levels from construction activities

Item	Typical sound power level,	Typical noise level at distance, dBA L_{max}
------	----------------------------	------------------------------------------------

	dBA L _{Amax}	10 m	20 m	40 m	60 m	80 m	100 m
Truck	108	80	74	68	64	62	60
Excavator	110	82	76	70	66	64	62
Bored piling rig	110	82	76	70	66	64	62
Vibratory roller	114	86	80	74	70	68	66
Bulldozer	120	92	86	80	76	74	72
Backhoe / loader	111	83	77	71	67	65	63
Water cart	108	80	74	68	64	62	60
Light tower	80	52	46	40	36	34	32
Generator	104	76	70	64	60	58	56

From Table 7-4 it is clear that noise levels are predicted to exceed the sleep disturbance screening criteria defined in Table 6-2 for most activities at distances of over 100 m from the works.

Where night time works are proposed that may affect individual sensitive receivers for more than two consecutive nights, a sleep disturbance assessment will be undertaken as part of the Out of Hours Work Approval Procedure defined in Annexure C of this CNVMP. If the sleep disturbance criteria are exceeded, then additional mitigation measures will be required in accordance with Section 8.

7.3.2 Construction Vibration Impacts

The main sources of construction vibration would include:

- piling in the river bed and banks (if impact or vibratory piling required); excavation;
- grading of existing roadways;
- demolition of houses and other structures; and
- vibratory compaction of new road surfaces.

7.3.2.1 Heritage Listed Structures

The nearest potentially affected heritage listed structures to the proposed construction works are shown in Figure 7-3. These receiver locations represent the structures potentially most sensitive to vibration impacts for the project.

The nearest potentially affected State listed non-aboriginal heritage structure to the proposed new river crossing is the existing bridge, located approximately 50 m away. At that distance, vibration from piling works will be well below the criteria identified in Section 6.3.1. It is also noted that the existing bridge is likely to be more structurally robust than most heritage buildings for which the vibration criteria were derived.

On this basis, no impact on heritage-listed structures is expected as a result of vibration from construction works.

7.3.2.2 Human comfort vibration impacts

Due to the nature of road construction works, there is a potential for works to occur within the safe working distance for human comfort identified in Table 6-7. Predominantly, this will involve compaction works with large vibratory rollers within approximately 40 to 50 m of residential receivers. In this case, ground vibration levels may potentially exceed the human

comfort criteria depending on the duration and nature of the construction activity. Any exceedances are expected to be of short duration.

Where vibratory compaction works are occurring within 50 m of residential structures, then mitigation measures will be implemented as detailed in Section 8.

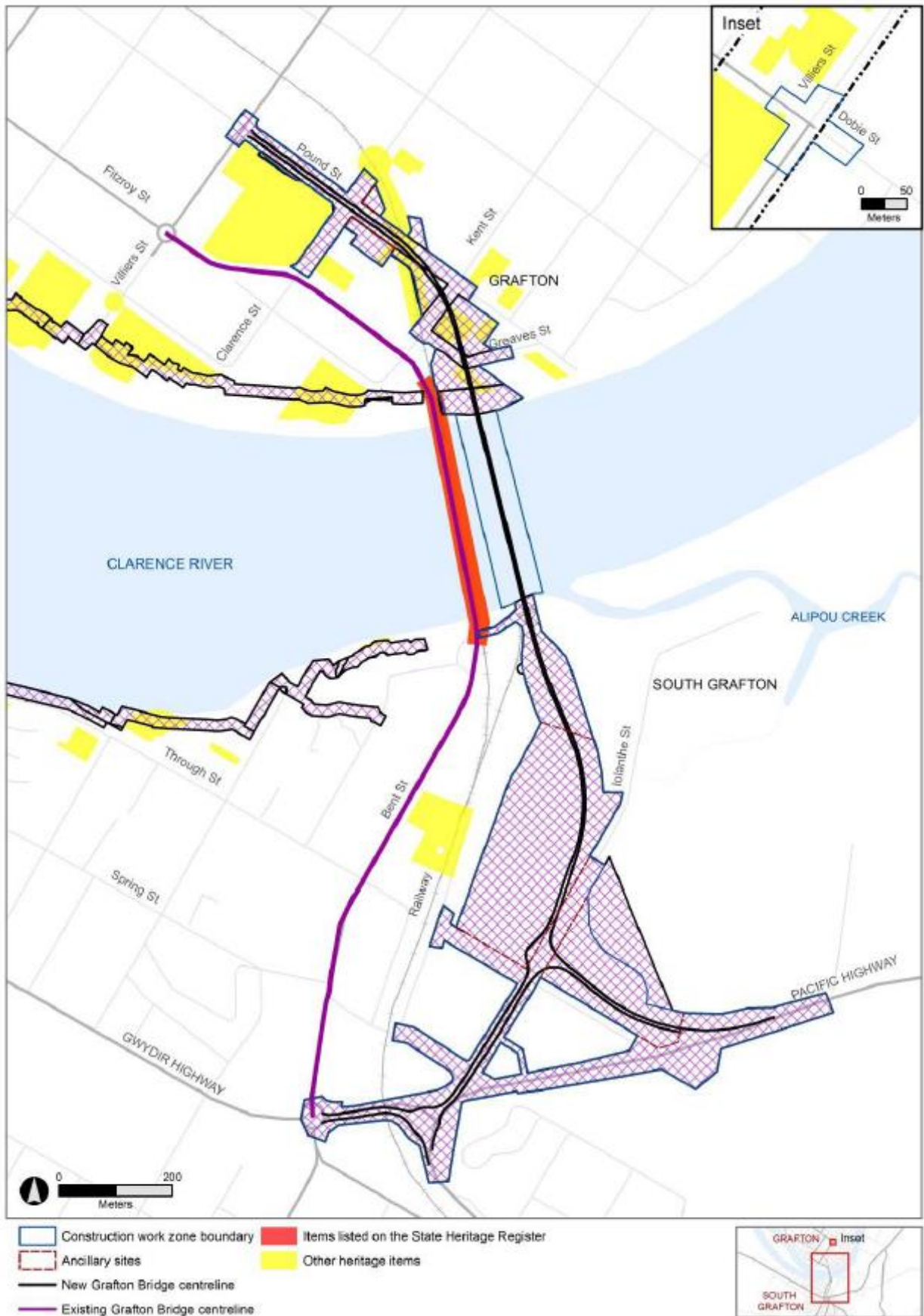


Figure 7-3: Location of non-aboriginal heritage items

8 Environmental control measures

A range of environmental requirements and control measures to address the noise impacts of the Project are identified in the EIS, Submissions Report, Conditions of Approval and RMS documents.

Where construction noise levels are predicted to exceed the NMLs, all feasible and reasonable work practices will be investigated to minimise noise emissions. Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts will be managed using the mitigation measures provided in this CNVMP.

The RNP provides additional context to feasible and reasonable with respect to noise mitigation that will be considered in the application of noise control measures:

- A noise abatement measure is feasible if it can be engineered and is practical to build, given project constraints such as safety and maintenance requirements.
- Reasonable mitigation measures are feasible measures that are judged to provide an overall noise benefit that outweighs the overall adverse social, economic and environmental effects, including cost. Consideration will be given to:
 - The level of reduction achieved by the measure at receivers – ideally a noise mitigation measure should be able to achieve a 5 dB reduction such that it is noticeable.
 - The existing levels of amenity at receivers prior to the construction works.
 - The amount by which the NMLs are exceeded and the number of people affected by the works.
 - The number of people protected by the mitigation measure.
 - The total cost of the mitigation measure, including with respect to the project costs.
 - Any costs of the measure that may be borne by the community, such as maintenance costs as well as economic costs if works are prolonged.
 - Community views, including the views of all affected landowners and not just those making complaints.

Potential noise reduction, where known, for typical construction noise mitigation measures are provided in Table 8-1. Specific environmental management measures to address noise and vibration impacts of the Project are outlined in Table 8-2 and Table 8-2. These measures have been identified in the EIS and Submissions Report, and include additional measures proposed by Fulton Hogan. Some of these measures are only considered where noise or vibration levels exceed relevant management levels, and also include Out of Hours mitigation measures applied in accordance with the Out of Hours Work Approval procedure in Annexure C.

Table 8-1: Potential noise reductions for typical construction noise mitigation measures

Typical construction noise mitigation and management measures	Potential noise reduction (dBA) (where applicable)
Schedule construction works within the standard construction hours	No reduction during standard construction hours Eliminates out-of-hours noise impacts
Program night works to minimise the number of consecutive nights work impacting the same receivers.	Reduces overall impact and potential for ongoing sleep disturbance

Typical construction noise mitigation and management measures	Potential noise reduction (dBA) (where applicable)
Schedule noisy activities outside normal school hours when working adjacent to schools.	Eliminates impact on schools
Temporary acoustic fencing/barriers	Typically around 5 to 10 dB
Portable temporary screens	Up to around 15 dB
Construct operational noise walls	5-10 dB
Install operational property treatments	Variable
Avoid the coincidence of noisy plant working simultaneously close together	Up to 3 dB for halving the number of similar dominant plant items working together
Shut down equipment when not in use	Negligible reduction in comparison to worst-case predictions, however eliminates noise source during less noise intensive works
Maximise offset distance between noisy plant items and nearby noise sensitive receivers	Approximately 6 dB reduction per doubling of offset distance
Orient equipment with directional noise emissions away from sensitive receivers.	Dependent on equipment, can be up to 5 dB for noticeably directional sources such as exhausts
Carry out loading and unloading out away from sensitive receivers	Approximately 6 dB reduction per doubling of offset distance
Undertake regular compliance checks on noise emissions of plant and machinery to indicate whether emissions are higher than predicted or to identify defective silencing equipment.	No reduction of noise levels but ensures noise levels are maintained as expected
Undertake ongoing noise monitoring during construction at sensitive receivers during critical periods to identify and assist in managing high risk noise events.	No reduction of noise levels but ensures noise levels are maintained as expected
Limit heavy vehicle movements to daytime hours	No reduction during standard construction hours Eliminates out-of-hours noise impacts from heavy vehicle movements
Minimise reversing of equipment to prevent nuisance caused by reversing alarms	Eliminates or reduces tonal noise from reversing alarms

8.1 Construction Hours

8.1.1 Standard construction hours

In accordance with CoA D2 and RMS Specification D&C G36 Section 3.6, construction activities for the Project will be undertaken during the following standard construction hours:

- 7:00am to 6:00pm Mondays to Fridays, inclusive;
- 8:00am to 1:00pm Saturdays; and
- at no time on Sundays or public holidays.

8.1.2 Outside standard construction hours

In accordance with CoA D3, construction works outside of the standard construction hours identified in CoA D2 (Section 8.1.1) may be undertaken in the following circumstances:

- construction works that generates noise that is:

- $L_{Aeq(15\text{ min})}$ noise levels no more than 5 dBA above rating background level at any residence in accordance with the ICNG (DECC, 2009); and
- $L_{Aeq(15\text{ min})}$ noise levels no more than the noise management levels specified in Table 3 of the ICNG (DECC, 2009) at other sensitive receivers; and
- continuous or impulsive vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.2 of *Assessing Vibration: a technical guideline*; and
- intermittent vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.4 of *Assessing Vibration: a technical guideline*; or
- where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved; or
- for the delivery of materials required outside the standard construction 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
- out-of-hours work in accordance with CoA D4

In accordance with CoA D4 and RMS Specification D&C G36 Section 3.6, construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons, Out of Hours work may be permitted outside the standard construction hours with the approval of the Environmental Representative (ER), based on the Out of Hours assessment procedure provided in Annexure C of this CNVMP. The procedure describes:

- the process for obtaining the ER's approval for Out of Hours work;
- the details to be provided to the ER in any OOH application, including information on the nature and need and justification for activities to be conducted during the varied construction hours;
- requirements for consultation with the EPA, potentially affected receivers and Clarence Valley Council, and the evidence of the consultation to be provided to the ER.

Where works are proposed outside of standard hours, they will be undertaken in accordance with the Out of Hours Work Approval Procedure in Annexure C.

8.1.3 High noise impact activities and works

In accordance with CoA D5 and RMS Specification D&C G36 Section 3.6, except as expressly permitted by an EPL, activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) will only be undertaken:

- between the hours of 8:00am to 6:00pm Mondays to Friday;
- between the hours of 8:00am to 1:00pm Saturday; and
- in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

'Continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work which is the subject of CoA D5.

In accordance with CoA D6, high noise impact activities and work, considered to be those activities where noise sensitive land uses are expected to be "highly noise affected" as defined by the ICNG, will be limited to the mid-morning and mid-afternoon periods, where feasible and reasonable.

Table 8-2: Environmental management measures for noise and vibration impacts

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
General					
NV4	The appointed construction contractor will be required to prepare a detailed Construction Noise and Vibration Management Plan (CNVMP). This plan will include but not limited to the following: <ul style="list-style-type: none"> • Roles and responsibilities • Noise-sensitive receiver locations • Predicted impacts • Mitigation strategy • Monitoring methodology • Community engagement strategy. 	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Sections 4.6 and 4.7	Pre-construction	Contractor	This CNVMP Roles & responsibilities: CEMP Section 4.2 Section 5 Section 7.3 Section 8 Section 9.1 <i>Community Communication Strategy</i> (CoA C1) to be provided separately to the CEMP
NV5	Workers and contractors will be inducted and trained (such as through toolbox talks) in the use of equipment in ways that minimise noise.	EIS Section 8 Submissions Report Section 4	Pre-construction, Construction	Contractor	This CNVMP CEMP S5 Section 9.2
NV6	Site managers will periodically check the site and nearby residences for noise problems so that solutions can be quickly applied, where required.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.6	Pre-construction, Construction	Contractor	Section 9.3 <i>Community Communication Strategy</i> (CoA C1) to be provided separately to the CEMP
Working Hours					
NV7	Construction work will be undertaken in accordance with the approved construction hours as outlined in Section 6.4 of the EIS.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 3.6	Construction	Contractor	Section 8.1 Table 8-3 mitigation measure ID CNVMM1
NV8	Noise from construction work that might be carried out outside the recommended standard hours will follow Section 2.3 of the <i>Interim Construction Noise Guidelines</i> (DECC, 2009) where feasible and	EIS Section 8 Submissions Report Section 4	Construction	Contractor	Section 8.1.2 Table 8-3 mitigation measure ID CNVMM1

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
	reasonable.	Specification D&C G36 Section 3.6			Annexure C – Out of Hours Work Approval Procedure
Sensitive receivers					
NV9	The location of stationary plant (such as air-compressors and generators) will be located as far away as feasible and reasonable from sensitive receivers.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.6	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM14, CNVMM16
Noise screening - construction					
NV10	Natural screening by topography and vegetation will be used wherever possible to reduce noise impacts.	EIS Section 8 Submissions Report Section 4	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM15
NV11	Site sheds, other temporary structures or screens will be used to limit noise exposure where feasible and reasonable.	EIS Section 8 Submissions Report Section 4	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM15
Construction equipment					
NV12	Low noise construction equipment and/or methods will be preferred, where feasible and reasonable.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.6	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM3-CNVMM12
NV13	Compliance with the TfNSW <i>Construction Noise Strategy</i> which summarises the maximum allowable noise levels for construction equipment to be applied to the project.	EIS Section 8 Submissions Report Section 4	Construction	Contractor	Section 6.3.4 Section 7.3.1.11 Annexure A – Indicative Plant and Equipment and Construction Scenario Sound Power Levels Annexure B - Predicted noise levels for construction activities

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
Programming equipment					
NV14	Construction programming should aim to reduce noise impacts and minimise noisy activities occurring concurrently as far as feasible and reasonable.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.6	Pre-construction, Construction	Contractor	Table 8-3 mitigation measure ID CNVMM3- CNVMM22
Community consultation					
NV15	The Draft Community Consultation Strategy prepared for the project outlines methods for consultation with the community during construction which are to be followed, including, but not limited to: <ul style="list-style-type: none"> • Advance notification of planned activities and expected disruption/effects • Construction noise complaints handling procedure • Effective monitoring of noise levels in and around potentially affected dwellings. 	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.6	Construction	Contractor	<i>Community Communication Strategy (CoA C1) to be provided separately to the CEMP</i>
Piling					
NV16	Alternative piling methodologies will be investigated to reduce potential impacts from these activities.	EIS Section 8 Submissions Report Section 4	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM9
Vibration					
NV17	Limit construction vibration impacts on sensitive receivers.	EIS Section 8 Submissions Report Section 4 Specification D&C G36 Section 4.7	Construction	Contractor	Table 8-3 mitigation measure ID CNVMM23- CNVMM29
Noise screening - operation					
NV18	Operational noise barriers will be installed as early as possible to provide ongoing screening from construction activities, where	EIS Section 8 Submissions Report	Construction	Contractor	The operational noise barrier on the new bridge

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
	feasible and reasonable.	Section 4 SWTC Appendix 4.21			cannot be installed until such time that the new bridge has been built; therefore, the operational noise barrier will be installed towards the end of the construction phase.
Noise architectural treatments					
NV19	Noise architectural treatments at affected properties will be developed and implemented in consultation with property owners.	EIS Section 8 Submissions Report Section 4	Pre-construction	RMS	At-house architectural treatments will be implemented before and during construction (by RMS)

Table 8-3: Additional mitigation measures for noise and vibration impacts

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
NOISE				
Noise: Standard				
CNVMM1	Undertake works during standard construction hours as follows: (a) 7:00 am to 6:00 pm Monday to Friday (b) 8:00 am to 1:00 pm Saturdays, and (c) at no time on Sundays or public holidays. Where works must occur outside of standard construction hours, assess Out of Hours Works in accordance with the <i>Out of Hours Work Approval Procedure</i> provided in Annexure C of the CNVMP.	✓	✓	Construction Manager
CNVMM2	Implement a hot line and complaints handling procedure for noise and other construction related complaints.	✓	✓	Community Relations Manager
CNVMM3	Ensure all construction vehicles and mobile plant regularly used on site (i.e. greater than one day) have non-tonal reversing alarms (or an equivalent mechanism) fitted.	✓	✓	Foreman Operators
CNVMM4	Plan and conduct works in a manner to minimise the reversing of vehicles with audible reversing alarms.	✓	✓	Construction Manager Foreman
CNVMM5	Ensure trucks travel via internal haul roads and major roads where practicable, to minimise use of local roads.		✓	Foreman
CNVMM6	Position site access points and roads as far as practicable away from residential receivers.		✓	Foreman
CNVMM7	Ensure truck tailgates are cleared and locked at the point of unloading.		✓	Foreman Operators
CNVMM8	Use two way radios at the minimum effective volume.		✓	Foreman Operators
CNVMM9	Use bored piles or vibrated piles, rather than impact or percussion piling methods, wherever feasible and reasonable.		✓	Project Manager
CNVMM10	Do not use vehicle warning devices, such as horns, as signalling devices.		✓	Foreman Operators

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
CNVMM11	Undertake regular maintenance of plant and equipment to ensure that noise emissions do not increase over time. (Specification D&C G36 Section 4.6)		✓	Subcontractors Foreman
CNVMM12	Switch off vehicles and machinery when not in use. (Specification D&C G36 Section 4.6)		✓	Foreman Operators
Noise: Where PNL exceeds NML for residential or non-residential receivers				
	Implement all feasible and reasonable mitigation measures from CNVMM1 to CNVMM12 inclusive.			As noted above
CNVMM13	Measures noise levels from noise intensive plant prior to use to check against the manufacturer's specifications and/or the sound power levels listed in Annexure A. Repeat this periodically to ensure that it meets the manufacturer's specifications and that noise levels do not significantly increase over time. A significant increase will be taken to be a level 3 dB(A) or more above the specification or typical sound power levels. (Specification D&C G36 Section 4.6)	✓	✓	Construction Manager
CNVMM14	Maximise the offset distance between stationary equipment and noisy items of plant and sensitive receivers for each task and activity. (Specification D&C G36 Section 4.6)		✓	Foreman Operators
CNVMM15	Locate plant and equipment to take advantage of barriers provided by existing site features and structures.		✓	Foreman Operators
CNVMM16	Orient plant and equipment known to emit noise strongly in one direction so that the noise is directed away from noise sensitive areas. (Specification D&C G36 Section 4.6)		✓	Foreman Operators
CNVMM17	Use traffic controllers to minimise occurrences of vehicles queuing, idling or reversing near noise sensitive receivers as much as is practical.		✓	Construction manager Foreman
CNVMM18	Avoid metal-to-metal contact on equipment where feasible.		✓	Foreman Operators
CNVMM19	Avoid dropping material from a height into unlined metal trays (e.g. line trays with soil or similar to reduce drumming noise).		✓	Foreman Operators
Noise: Where PNL exceeds 75 dB(A) L_{eq} for residential receivers				
	Implement all feasible and reasonable mitigation measures from CNVMM1 to CNVMM19 inclusive.			As noted above
CNVMM20	Undertake high noise impact activities only:		✓	Construction Manager

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
	<ul style="list-style-type: none"> between the hours of 8:00 am to 6:00 pm Mondays to Fridays; between the hours of 8:00 am to 1:00 pm Saturdays; and in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. <p>Where feasible, undertake the works during mid-morning and mid-afternoon periods.</p>			
CNVMM21	Consult with affected sensitive receivers to determine if there are times that work can be carried out that will least affect them. (Specification D&C G36 Section 4.6)		✓	Environmental Manager Community Relations Manager
CNVMM22	Install temporary hoarding where feasible to shield noise to affected sensitive receivers.		✓	Construction Manager Foreman
VIBRATION				
Vibration: Where works are occurring within safe working distances for human comfort				
CNVMM23	Undertake works during standard construction hours. Where works must occur outside of standard hours, assess Out of Hours Works in accordance with the <i>Out of Hours Work Approval Procedure</i> provided in Annexure C of the CNVMP.	✓	✓	Construction Manager
CNVMM24	Implement a hot line and complaints handling procedure for vibration and other construction related complaints.	✓	✓	Community Relations Manager
CNVMM25	Undertake attended vibration measurements <i>before</i> vibration intensive plant is used within the safe working distance for cosmetic damage. (Specification D&C G36 Section 4.7)		✓	Foreman Environmental Officer
CNVMM26	Where vibration intensive works are occurring for a continuous period of time within the safe working distance for cosmetic damage, install a permanent vibration monitoring system to warn operators (via flashing light, audible alarm, short message service (SMS) etc.) when vibration levels are approaching the cosmetic damage objective to ensure applicable criteria are not exceeded. (Specification D&C G36 Section 4.7)		✓	Environmental Officer Operators
CNVMM27	Restrict speeds of construction traffic to 20 km/h across the site, or 40 km/h for haul roads. Signpost the speed limit.		✓	Foreman
CNVMM28	Restrict construction traffic to designated roadways.		✓	Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
CNVMM29	Run plant that has high and low vibration operating settings on the lowest effective vibration setting, including static rolling where feasible. (Specification D&C G36 Section 4.7)		✓	Foreman Operators
Vibration: Where works are occurring within safe working distances for cosmetic damage to buildings				
	Implement all feasible and reasonable mitigation measures from CNVMM23 to CNVMM29 inclusive.			As noted above
CNVMM30	Undertake pre-construction dilapidation surveys of buildings and structures where construction works will occur within safe working distances for cosmetic damage, prior to that work being undertaken. (Specification D&C G36 Section 4.7)	✓	✓	Environmental Officer Project Engineer
CNVMM31	Undertake post-construction dilapidation surveys of buildings and structures where construction works has occurred within safe working distances for cosmetic damage. (Specification D&C G36 Section 4.7)		✓	Environmental Officer Project Engineer
CNVMM32	Undertake surveys of buildings and structures immediately following a monitored exceedance of the relevant vibration criteria. (Specification D&C G36 Section 4.7)		✓	Environmental Officer Project Engineer
OUT OF HOURS WORK				
Noise: Low to medium impact – exceedance of 20 dB(A) or less of NML and no exceedance of sleep disturbance criteria (if applicable)				
OOHMM1	Assess Out of Hours works in accordance with the <i>Out of Hours Work Approval Procedure</i> provided in Annexure C of the CNVMP, including: <ul style="list-style-type: none"> • justification for Out of Hours work; • noise and vibration assessment; • notification to and consultation with EPA; • implementation of reasonable and feasible mitigation measures for receivers where the night time NMLs are predicted to be exceeded; and • consultation with the affected community. 	✓	✓	Environmental Manager Community Relations Manager
OOHMM2	Inform the community at least 48 hours before any Out of Hours work is to be undertaken and provide the following information: <ul style="list-style-type: none"> • programmed times and locations of construction work; • construction noise and vibration impact predictions; and • construction noise and vibration mitigation measures being implemented on site. 	✓	✓	Community Relations Manager
OOHMM3	Implement a hot line and complaints handling procedure for noise and other construction related	✓	✓	Community Relations

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
	complaints.			Manager
OOHMM4	Turn machinery and vehicles off when not in use.		✓	Foreman Operators
OOHMM5	Do not use vehicle warning devices, such as horns, as signalling devices.		✓	Foreman Operators
OOHMM6	Maximise the offset distance between noisy items of plant and sensitive receivers for each task and activity.		✓	Foreman Operators
OOHMM7	Locate plant and equipment to take advantage of barriers provided by existing site features and structures.		✓	Foreman Operators
OOHMM8	Orient plant and equipment known to emit noise strongly in one direction so that the noise is directed away from noise sensitive areas.		✓	Foreman Operators
OOHMM9	Ensure all construction vehicles and mobile plant regularly used on site (i.e. greater than one day) have non-tonal reversing alarms (or an equivalent mechanism) fitted.		✓	Foreman Operators
OOHMM10	Plan and conduct works in a manner to minimise the reversing of vehicles with audible reversing alarms.		✓	Construction Manager Foreman
OOHMM11	Use traffic controllers to minimise occurrences of vehicles queuing, idling or reversing near noise sensitive receivers as much as is practical.		✓	Construction Manager Foreman
OOHMM12	Ensure that truck tailgates are cleared and locked at the point of unloading.		✓	Foreman Operators
OOHMM13	Use two way radios at the minimum effective volume.		✓	Foreman Operators
OOHMM14	Site access points and roads will be positioned as far as practicable away from residential receivers.		✓	Foreman Operators
OOHMM15	Avoid metal-to-metal contact on equipment where feasible.		✓	Foreman Operators
OOHMM16	Avoid dropping material from a height into unlined metal trays (e.g. line trays with soil or similar to reduce drumming noise).		✓	Foreman

ID	Mitigation Measure	Timing		Responsibility
		PC ¹	C ²	
				Operators
Noise: High impact – exceedance of 20 dB(A) or less of NML and/or exceedance of sleep disturbance criteria				
	Implement all feasible and reasonable mitigation measures from OOHMM1 to CNVMM16 inclusive.			
OOHMM17	Undertake regular noise monitoring during works to ensure that noise levels do not exceed predicted noise levels.		✓	Environmental Manager
OOHMM18	Consult with affected sensitive receivers to determine if there are times that noisy work can be carried out that will least affect them.	✓		Community Relations Manager Construction Manager
OOHMM19	Offer respite periods to affected sensitive receivers.	✓	✓	Community Relations Manager Construction Manager
OOHMM20	Install temporary hoarding where feasible to shield noise to affected sensitive receivers.		✓	Construction Manager
OOHMM21	Consider temporary relocation of receivers where the construction noise level exceeds the NML by more than 25 dB(A).	✓	✓	Community Relations Manager

¹ PC means pre-construction

² C means construction

9 Compliance management

9.1 Roles and responsibilities

The Fulton Hogan 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 Table 8-2 and Table 8-3.

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 Project-specific noise and vibration management including:

- existence and requirements of this CNVMP;
- relevant legislation;
- standard, extended and out of hours construction hours;
- the process for seeking approval for out of hours works, including consultation;
- location of noise sensitive areas and receivers;
- general noise and vibration management measures;
- complaints reporting;
- 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 Section 5 of the CEMP.

9.3 Inspections and monitoring

Weekly and other routine inspections by Environmental Officers, RMS, and ER will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Section 8.2 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 Environmental Officer during the construction phase of the Project. The Noise and Vibration Monitoring Plan for the Project is provided in Annexure D of this CNVMP.

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- monthly noise monitoring at sensitive receiver locations nominated in Annexure D to determine the effectiveness of mitigation measures against predicted impacts;
- where complaints are received, additional 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 7.3 of this CNVMP;
- noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise; and
- ongoing spot checks of noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with manufactures specifications.

Where actual noise levels are found to significantly exceed the predicted worst case levels (i.e. an exceedance of more than 2 dBA), 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 AS1259.2-1990 *Acoustics – Sound Level Meters, Part 2: Integrating – Averaging* and carry appropriate NATA (or manufacturer) calibration certificates.

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 50 m of buildings to ensure that safe vibration levels specified in Section 6.3 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out where the work is required 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.

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* (heritage structures) and British Standard *BS 7385: Part 2 – 1993* (other structures).
- For human exposure to vibration – the evaluation criteria presented in *Assessing Vibration: A Technical Guideline* (DECC 2006).

9.4 Non-conformances

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

9.5 Consultation and Complaints

Complaints will be recorded and addressed in accordance with the Community Communication Strategy (CCS). 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 CCS.

Fulton Hogan will consult with affected educational institutions in accordance with the CCS and take reasonable steps to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements are made.

9.6 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this CNVMP, CoA and other relevant approvals, licenses and guidelines. Audit requirements are detailed in Section 8.3 and Appendix A9 of the CEMP.

9.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.5 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 (e.g. 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; and
- detail of any corrective actions and confirmation of their successful implementation.

Monitoring results will be reported by the Contractor to the RMS in the compliance reporting.

10 Review and improvement

10.1 Continuous improvement

Continuous improvement of this CNVMP 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 actions 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; and
- make comparisons with objectives and targets.

10.2 Update and amendment

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this CNVMP. This will occur as needed.

Any revisions to this CNVMP will be in accordance with the process outlined in Section 1.6 of the CEMP and, where required, be provided to RMS, ER and other relevant stakeholders for review and comment and forwarded to the Secretary of DP&E for approval.

A copy of the updated CNVMP 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.

Annexure A

Indicative Plant and Equipment and Construction
Scenario Sound Power Levels

Sound Power Levels for Construction Equipment

The following table presents typical sound power levels for the major plant items for each phase. A range is provided due to the variance in sound power levels that occur.

The typical overall sound power level presented for each phase is for a 'typical site'. It represents a range of the equipment listed at various distances around the site with varying duty cycles. The levels have been refined from predictions and measurements undertaken at similar sites over many different projects. The typical levels are not a summation of all the equipment listed in this table.

Phase	Major plant	Typical sound power level, dBA	Typical sound pressure level at 10 m, dBA
Preliminary activities and site establishment	Trucks	102 - 110	74 - 82
	Generators	101 - 109	73 - 81
	Light vehicles	90 - 98	62 - 70
	Excavators	99 - 109	71 - 81
	Chainsaws	110 - 115	82 - 87
	Mulchers	112 - 120	84 - 92
	Water carts	102 - 110	74 - 82
	Drilling rigs	110 - 115	82 - 87
	Cranes	104 - 112	76 - 84
	TYPICAL OVERALL	110 - 115	82 - 87
Flood mitigation works	Excavators	99 - 109	71 - 81
	Dump trucks	102 - 110	74 - 82
	Vibratory rollers	97 - 107	69 - 79
	Graders	104 - 112	76 - 84
	Front end loaders	104 - 112	76 - 84
	Water carts	102 - 110	74 - 82
	Profilers	108 - 116	80 - 88
	Bulldozers	106 - 114	78 - 86
	TYPICAL OVERALL	108 - 112	80 - 84
Roadwork and road surfacing	Chainsaw	110 - 115	82 - 87
	Graders	104 - 112	76 - 84
	Backhoes	102 - 110	74 - 82
	Trucks	102 - 110	74 - 82

Phase	Major plant	Typical sound power level, dBA	Typical sound pressure level at 10 m, dBA
	Water carts	102 - 110	74 - 82
	Vibratory rollers	97 - 107	69 - 79
	Excavators	99 - 109	71 - 81
	Pavers	104 - 112	76 - 84
	TYPICAL OVERALL	108 - 113	80 - 85
Drainage	Trucks	102 - 110	74 - 82
	Bulldozers	106 - 114	78 - 86
	Excavators	99 - 109	71 - 81
	Concrete pumps	97 - 105	69 - 77
	Concrete trucks	105 - 113	77 - 85
	TYPICAL OVERALL	107 - 112	79 - 84
Bulk earthwork	Trucks	102 - 110	74 - 82
	Bulldozers	106 - 114	78 - 86
	Excavators	99 - 109	71 - 81
	TYPICAL OVERALL	105 - 110	77 - 82
Bridgework	Batching plant	110 - 116	82 - 88
	Bored piling rig	100 - 110	72 - 82
	Concrete pumps	97 - 105	69 - 77
	Concrete trucks	105 - 113	77 - 85
	Cranes	104 - 112	76 - 84
	Barges	108 - 115	80 - 87
	Excavators	99 - 109	71 - 81
	Trucks	102 - 110	74 - 82
	TYPICAL OVERALL	111 - 116	83 - 88
Finishing work	Trucks	102 - 110	74 - 82
	Generators	101 - 109	73 - 81
	Light vehicles	90 - 98	62 - 70
	Cranes	104 - 112	76 - 84
	TYPICAL OVERALL	103 - 108	75 - 80
Ancillary sites and	Front end loader	104 - 112	76 - 84

Phase	Major plant	Typical sound power level, dBA	Typical sound pressure level at 10 m, dBA
facilities	Excavator	99 – 109	71 - 81
	Truck	102 - 110	74 - 82
	Compressor	105 - 110	77 - 82
	Crane	104 - 112	76 - 84
	Vibratory roller	97 – 107	69 - 79
	Generator	101 - 109	73 - 81
	TYPICAL OVERALL	108 - 114	80 - 86

Annexure B

Predicted noise levels for construction activities

NCA	Noise Limits (dBA)				Predicted noise level for construction stage (dBA)																	
					Site establishment		Flood mitigation		Roadwork and road surfacing		Drainage		Bulk earthwork		Bridge work		Piling		Finishing work		Ancillary sites	
	Time Period	Noise Affected Level	Highly Noise Affected Level	Sleep Disturbance (L _{Amax})	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}
1	Day (standard hours)	55	75	-	62	67	-	-	60	65	60	69	57	69	63	69	61	66	62	67	59	63
	Day (outside hours)	50	55	-																		
	Evening	44	49	-																		
	Night	37	42	65																		
2	Day (standard hours)	69	75	-	60	66	-	-	58	64	59	68	56	68	62	68	60	65	60	66	56	60
	Day (outside hours)	64	69	-																		
	Evening	51	56	-																		
	Night	41	46	65																		
3	Day (standard hours)	63	75	-	71	76	-	-	69	74	69	78	66	78	72	78	70	75	71	76	69	73
	Day (outside hours)	58	63	-																		
	Evening	46	51	-																		
	Night	36	41	65																		
4	Day (standard)	58	75	-	81	86	-	-	79	84	79	88	78	88	74	80	72	77	81	86	56	60

Annexure C

Out of Hours Work Approval Procedure

CoA D46(a)(vi): an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in CoA D4 by the ER.

CoA D3: Construction works outside the standard construction hours may be undertaken in the following circumstances:

- a) construction works that generate noise and vibration that is:
 - (i) $L_{Aeq(15\ min)}$ noise levels no more than 5 dB(A) above rating background level at any residence in accordance with the ICNG (DECC, 2009); and
 - (ii) $L_{Aeq(15\ minute)}$ noise levels no more than the noise management levels specified in Table 3 of the ICNG (DECC, 2009) at other sensitive receivers; and
 - (iii) continuous or impulsive vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.2 of Assessing Vibration: a technical guideline; and
 - (iv) intermittent vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.4 of Assessing Vibration: a technical guideline; or
- b) where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved; or
- c) for the delivery of materials required outside the standard construction hours by the NSW Police Force or other authorities for safety reasons; or
- d) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or
- e) out-of-hours work in accordance with CoA D4.

CoA D4: Construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted outside the standard construction hours with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved CEMP or CNVMP for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:

- a) process for obtaining the Environmental Representative's approval for Out of Hours work;
- b) details of the nature and need for activities to be conducted during the varied construction hours;
- c) justifies the varied construction hours in accordance with the Interim Construction Noise Guideline (DECC, 2009);
- d) provides evidence that consultation with potentially affected receivers and notification of Clarence Valley Council has been undertaken, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and
- e) provides evidence of consultation with the EPA on the proposed variation in standard construction hours.

Out of Hours Work Approval Procedure

Overview

This procedure has been developed to assist with compliance of environmental legislation, project obligations and to effectively manage potential environmental impacts associated with noise during construction of the Project. It is prepared in accordance with the CoA D46 (a)(vi), Environmental Impact Statement (EIS) management measures and the Construction Noise and Vibration Management Plan (CNVMP).

Objectives

This procedure outlines the project requirements for construction working hours and documents a process to be implemented when work outside of standard hours is required. The key objective of the procedure is to ensure that impacts to the local community are avoided and minimised and the requirements of the CoA are met.

Specific objectives include:

- Minimising potential adverse noise impacts to the community
- Identifying sensitive receivers and ensuring appropriate noise control measures are implemented during construction activities, and
- Ensuring appropriate measures are implemented to comply with the relevant CoA, EMM, legislation, RMS Specification G36 and other requirements as described in the CNVMP.

Project Approval Requirements

In accordance with CoA D2, standard construction hours are:

- 7am to 6pm Mondays to Fridays inclusive;
- 8am to 1pm Saturdays; and
- At no time Sundays or public holidays.

In accordance with CoA D5 construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken:

- between the hours of 8:00 am to 6:00 pm Monday to Friday;
- between the hours of 8:00 am to 1:00 pm Saturday; and
- in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.

Condition D6 requires that where feasible and reasonable, high noise impact activities and work must be limited to the mid-morning and mid-afternoon periods. For the purposes of this Procedure, mid-morning is from 9:00 am to 11:00 am, and mid-afternoon is from 1:00 pm to 4:00 pm.

In accordance with CoA D3 construction works outside the standard construction hours may be undertaken in the following circumstances:

- f) construction works that generate noise and vibration that is:
 - (v) $L_{Aeq(15 \text{ minute})}$ noise levels no more than 5 dB(A) above rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009); and
 - (vi) $L_{Aeq(15 \text{ minute})}$ noise levels 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 receivers; and

- (vii) continuous or impulsive vibration values, measured at the most affected residence, that are no more than those for human exposure to vibration, specified for residences in Table 2.2 of *Assessing Vibration: a technical guideline*; and
- (viii) intermittent vibration values, measured at the most affected residence that are no more than those for human exposure to vibration, specified for residences in Table 2.4 of *Assessing Vibration: a technical guideline*; or
- g) where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved ; or
- h) for the delivery of materials required outside the standard construction hours by the NSW Police Force or other authorities for safety reasons; or
- i) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or
- j) out-of-hours work in accordance with condition D4.

In accordance with CoA D4 construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:

- a) process for obtaining the Environmental Representative's approval for Out of Hours work;
- b) details of the nature and need for activities to be conducted during the varied construction hours;
- c) justifies the varied construction hours in accordance with the *Interim Construction Noise Guideline* (DECC, 2009);
- d) provides evidence that consultation with potentially affected receivers, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and
- e) provides evidence of consultation with the EPA and Council on the proposed work outside the standard construction hours.

Predicted Out of Hours Works

Predicted out of hours works include:

- Works where the TfNSW Transport Management Centre (TMC) (or other road authority) refuse to issue a road occupancy licence for the works or activities during standard construction hours due to requirements to maintain network capacity, for works such as vegetation clearing, traffic control, wide loads movement, signage, line marking and associated works for traffic switches
- Works associated with the replacement of the Pound Street viaduct which will need to be undertaken during the rail shutdown period
- Asphaltting
- Concrete paving and associated saw cutting of concrete pavement
- Precast concrete works (either starting early or finishing late to avoid excessive heat in summer thus assisting with worker safety and to ensure a quality product)
- Concrete pours for bridge work, girder and pile construction to achieve the required strength and quality product.
- Minor works (e.g. supervised pumping operations, use of generator for site surveillance/ security operations), and

- Utility/service relocations where the asset owner refuses to issue a permit for the works during standard construction hours.
- Ad hoc out of hours works required due to technical or other justifiable reasons.

Out of Hours Works Approval Process

To enable the works listed above to occur outside of standard construction hours the following process will be implemented:

- A Project Engineer will consult with the Environmental Manager (EM) and Community Relations Manager 6 weeks in advance of proposed OOHW. The engineer is to submit an *OOHW Approval Request Form* (refer to Attachment 1) which will allow the EM to undertake an assessment to determine the predicted noise level.
- The EM will assess the OOHW request using a predictive noise model and determine if the proposed works comply with the criteria listed in CoA D3.
- If the EM determines, based on initial noise assessment conducted using a predictive noise model, that the works will generate $L_{Aeq(15 \text{ minutes})}$ noise levels that will be less than $RBL + 5 \text{ dB(A)}$ and meet the requirements of CoA D3, the works will be approved by the EM. Specific noise management measures, in accordance with this CNVMP will be included in the OOHW approval and noise monitoring undertaken during the OOHW to confirm compliance.
- If the proposed OOHW do not comply with CoA D3, an assessment will be undertaken as required by CoA D4 and approval will be sought from the ER and RMS Representative.

Noise and Vibration Assessment

Where the proposed OOHW do not comply with CoA D3, approval is required from the ER and the RMS Representative. A noise and vibration assessment for the works will be undertaken and include the following:

- details of the nature and scope of each activity and work, including details of times, vehicles, plant and equipment to be used to undertake that activity or work;
- detailed analysis to justify the scheduling and duration of each activity and work outside the standard construction hours, including taking into account:
- the predicted impact on noise sensitive receivers of any activities and works undertaken outside the hours; and
 - the preference that high noise impact works be undertaken during the day;
 - detailed analysis to justify use of the selected construction and work methods, plant and equipment compared to alternatives taking into consideration noise and vibration impacts;
- a table showing details of the noise and vibration mitigation measures for each activity and work, including respite periods, proposed to be adopted to minimise noise and vibration impacts on surrounding noise sensitive receivers in each locality;
- a table showing for each activity and work in each noise catchment:
 - the address of each of the most affected noise sensitive receivers including those predicted to exceed the CoA D3 threshold;
 - the background noise level for each of the noise sensitive receivers listed in the table;
 - noise management levels as described in Section 4 of the ICNG (DECC, 2009);
 - the predicted $L_{Aeq (15 \text{ min})}$ noise level, incorporating any 5 dB correction for particularly annoying activities as listed on page 16 of the ICNG (DECC, 2009); and
 - an assessment of sleep disturbance as set out in Section 4.3 of the ICNG (DECC, 2009), where works are planned to extend over more than two consecutive nights.

- details of the specific noise mitigation measures to be adopted in respect of any activity or work predicted to generate noise levels at any noise sensitive receiver exceeding the noise affected $L_{Aeq(15minute)}$ level of background plus 5 dB outside the standard hours;
- a diagram showing the location of noise and vibration monitoring locations in relation to each of the most affected noise sensitive receivers for each activity and work in each noise catchment;

The EM will document the assessment taking into account the risk factors listed in the *Construction Noise Strategy (TfNSW, 2011)*, as shown in the table below, and submit it to the ER and RMS Representative for approval.

Low risk factors:	Medium risk factors:	High risk factors:
<ul style="list-style-type: none"> • no sleep disturbance • 1800 – 2200 weekdays • 1300 – 2200 Saturdays • 0800 – 1800 Sunday and Public Holiday nights 	<ul style="list-style-type: none"> • Sleep disturbance risk • 2200 – 0700 weekday nights • 2200 – 0800 Saturday nights • 1800 – 0700 Sunday and Public Holiday nights 	<ul style="list-style-type: none"> • Prolonged work (i.e. >1 week) • Sleep disturbance possible • Impulsive noise and vibration likely (e.g. vibratory rolling or rock breaking)

Applications for approval of OOHW with medium or high risk factors must be supported by a construction noise impact statement.

Noise monitoring

The EM will ensure that the following noise monitoring is undertaken for all OOHW:

- Undertake attended noise monitoring at representative stages of the activity or work to confirm whether the noise predictions in its noise assessment were accurate.
- If a complaint is received about the activity or works on the telephone complaints line then additional monitoring and review will be undertaken to assess the source of the complaint if this is considered an appropriate response.

If noise monitoring and review indicates that the activity, work or combination of simultaneous activities or works has caused or is causing noise levels higher than the predicted levels at any noise sensitive receiver then, the construction process will be reviewed in consultation with RMS and ER and additional noise mitigation measures will be implemented, where reasonable and feasible.

Community consultation and notification

The Community Relations Manager will notify the community in accordance with the Community Communication Strategy. This notification will:

- Be made by targeted letterbox drop, door knock, phone call or email to potentially affected noise sensitive receivers
- Be made not less than 5 days and not more than 14 days before commencement of any out of hours works or activities and include:
 - a diagram that clearly identifies the location of the proposed OOHW in relation to nearby cross streets and local landmarks or geographical features;
 - details of the timing, nature, scope and duration of the proposed works and activities;
 - detail of why the proposed works and activities are being undertaken outside of standard construction hours;
 - details of the predicted noise and vibration impacts of the works on identified sensitive receivers;
 - details of all proposed mitigation measures, including respite periods and proposed scheduling;

- details of the types of plant and equipment that will be used to undertake the work;
- details of how complaints may be made and additional information obtained about the work;
- contact details in community languages relevant to the locality; and include notification of any upcoming project community meetings / forums.

Complaints

Any complaints received as a result of the OOHW are to be managed in accordance with the Community Communication Strategy. On receipt of any complaints, changes will be made to the works to address the source of the complaint if reasonable and feasible (e.g. relocation of plant and equipment away from complainant). If changes are not able to be feasibly made, noise monitoring will be undertaken to confirm compliance with the predicted noise levels.

If the noise monitoring indicates that the noise levels are compliant with the predicted levels, the works will continue. If the noise monitoring determines that noise levels are greater than predicted, the construction process will be reviewed in consultation with RMS and ER and additional noise mitigation measures will be implemented, where reasonable and feasible.

Record keeping

All OOHWs applications are recorded electronically and documented with a unique identification number as per the *OOHW Approval Request Form* (refer to Attachment 1). Each application is entered into the OOHW database and tracked accordingly.

All noise monitoring results will be recorded using “Noise Monitoring Field Sheet” and data entered into the noise monitoring database.

Attachment 1. OOHW Approval Request Form

INTRODUCTION

Out of Hours Request No.	
Application Date:	
Name of person requesting the work:	
Nature and need for OOHW to be conducted during the varied construction hours:	
Why out of standard hours work is proposed/required:	
Any alternatives to OOHW:	
Justification of the proposed varied construction hours in accordance with the <i>Interim Construction Noise Guideline</i> :	

ITEM	DESCRIPTION	INFORMATION / COMMENTS
1	Description of the Proposed Work:	
2	Plant and equipment to be used: (list all plant and noise generating equipment to be used during the work activities) e.g. hand tools, generators, crane etc.	
	Details on any concurrent construction activities that will be undertaken adjacent/ in close proximity to the Proposed Work	
3	Names of Foreman supervising the work:	
4	Subcontractor Details (if applicable)	
5	Location of Work:	
6	Proposed Dates/duration:	
7	Start time:	

ITEM	DESCRIPTION	INFORMATION / COMMENTS
8	Finish time:	
9	NOISE: Will the work generate noise audible at the nearest residence? Attach a map of the work area	
	What are the predicted noise levels?	
	Describe the proposed activities generating noise	
	What measures will be taken to reduce noise impacts?	
	Proposed noise & vibration monitoring?	
10	VIBRATION: Will any vibration-intensive activities be occurring within the safe working distances for human comfort in the CNVMP?	
11	TRAFFIC: Will the work require traffic control?	
	Describe the location and nature of disruption to traffic proposed	
	Who is planning the traffic control?	
	Who will be responsible for the traffic control during the work?	
12	What lighting will be provided for night out of hours work?	
13	How will any lighting be managed to minimise the potential for light to impact on adjacent residents or drivers on adjacent roads.	
14	Does the work team comprise a minimum of two persons?	
15	Who in the work team holds current senior first aid qualifications?	
16	Where is the first aid kit to be located?	
17	What means of communications is to be used to summon assistance in an emergency?	
18	Has a check of the functionality of the proposed emergency means been made?	
19	Who from the project team will be supervising the work?	

ASSESSMENT

Acoustic assessment prepared to determine if works

Less than RBL + 5 dB(A)?

ASSESSMENT

are above RBL + 5 dB(A) at closest receiver	<input type="checkbox"/> Above RBL + 5 dB(A)?
If works occur for more than two consecutive nights (10 pm – 7 am), is sleep disturbance possible?	<input type="checkbox"/> Not applicable <input type="checkbox"/> Sleep disturbance criterion not exceeded <input type="checkbox"/> Sleep disturbance criterion exceeded
Noise Report required?	<input type="checkbox"/> Yes <input type="checkbox"/> No (as less than RBL + 5 dB(A) and no risk of sleep disturbance)

APPROVALS

1	ENVIRONMENTAL	NAME: SIGNATURE:..... DATE:.....
2	COMMUNITY	NAME: SIGNATURE:..... DATE:.....
3	TRAFFIC	NAME: SIGNATURE:..... DATE:.....
4	SAFETY	NAME: SIGNATURE:..... DATE:.....
5	PROJECT MANAGER	NAME: SIGNATURE:..... DATE:.....
6	EVIDENCE OF CONSULTATION WITH POTENTIALLY AFFECTED RECEIVERS	<input type="checkbox"/> Attached <input type="checkbox"/> N/A (noise levels comply with CoA D3)

APPROVALS

7	EVIDENCE OF CONSULTATION WITH EPA AND COUNCIL	<input type="checkbox"/> Attached <input type="checkbox"/> N/A (noise levels comply with CoA D3)
8	ER APPROVAL REQUIRED	<input type="checkbox"/> N/A (noise levels comply with CoA D3) DATE SUBMITTED:..... DATE APPROVED:.....
9	RMS REPRESENTATIVE APPROVAL REQUIRED <i>Any approval by the RMS Representative to work outside of standard working hours is conditional on FH liaising with community as per Specification D&C G36 Clause 3.7 and complying with the requirements of Clause 4.6, as detailed in this CNVMP.</i>	<input type="checkbox"/> N/A (noise levels comply with CoA D3) DATE SUBMITTED:..... DATE APPROVED:.....

Annexure D
Noise and Vibration Monitoring Plan

Standard noise monitoring locations have been selected for monthly noise monitoring as part of the Project and are shown on the map provided as Figure D1. These locations are:

- (1) 16 Clarence Street, Grafton – near Pound Street intersection.
- (2) 5 Kent Street, Grafton – near existing bridge.
- (3) 10 Pound Street, Grafton – near Bromley Street intersection.
- (4) 3 Riverside Drive, South Grafton.
- (5) Lot 390 Butters Lane, South Grafton.
- (6) 28 Through Street, South Grafton.

Note that these locations are subject to ease of access and, if applicable, acceptance from a resident that monthly monitoring can occur on or at the boundary of their property. If a resident does not wish monitoring to occur, then an equivalent nearby alternative location will be selected.

The following Table documents the Noise and Vibration Monitoring plan.

Monitoring details	Record	Frequency	Responsibility	Test procedures
NOISE MONITORING				
Noise monitoring at standard monitoring locations identified in Figure D1.	Noise Monitoring Record	Monthly	Environmental Officer	<p>Where noise monitoring is to occur at a sensitive receiver location, the monitoring will be undertaken at the nearest relevant sensitive receiver. If monitoring cannot be undertaken at the receiver, a suitable representative location will be selected.</p> <p>The testing method includes:</p> <ul style="list-style-type: none"> • Sound level meter configured for “Fast” time weighting and “A” frequency weighting. • The test environment will be free from reflecting objects where possible. Where the noise monitoring is conducted within 3.5 metres of large walls or a building facade, then a reflection correction of up to -2.5 dBA will be applied to remove the effect of increased noise due to sound reflections from such structures. • The tests will not be carried out during rain or when the wind speed at the test site exceeds 5 m/s.
Where complaint is received and monitoring is considered an appropriate response to determine if noise levels exceed predicted ‘worst case’ construction noise levels documented in this CNVMP.	Noise Monitoring Record	As required	Environmental Officer	<ul style="list-style-type: none"> • Conditions such as wind velocity, wind direction, temperature, relative humidity and cloud cover will be recorded. These may be obtained from the nearest Bureau of Meteorology monitoring station or on-site weather station/observations. • The monitoring period should be sufficient such that the measured noise levels are representative of the noise over a 15-minute period. • At a minimum L_{eq}, L_{max}, L_{10} and L_{90} levels will be measured and reported. <p>The observations of the person undertaking the measurements will be reported including audibility of construction noise, other noise in the environment and any discernible construction activities contributing to the noise at the receiver.</p>
Spot checks of noise intensive plant where it is required to check the noise emission from the plant against manufacturer’s specifications.	Noise Monitoring Record	Monthly for construction activities with predicted noise levels greater than 65 dBA at receiver locations	Environmental Officer	<p>The test procedure for construction plant will follow the stationary test procedures according to Australian Standard <i>AS 2012.1 Acoustics – Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors – Stationary test condition</i>.</p> <p>The testing method includes:</p> <ul style="list-style-type: none"> • Sound level meter configured for “Fast” time weighting and “A” frequency weighting. • The test environment will be free from reflecting objects.

Monitoring details	Record	Frequency	Responsibility	Test procedures
Where required for the purposes of refining construction methods or techniques to reduce noise levels.	Noise Monitoring Record	As required	Environmental Officer	<ul style="list-style-type: none"> The tests will not be carried out during rain or when the wind speed at the test site exceeds 5 m/s. In accordance with AS 2012.1, a minimum of 3 measurement points will be defined at locations on the hemispherical surface around the plant with the radius determined by the basic length (L) of the machine. The A-weighted L_{eq} background noise at the measurement locations will be at least 6 dB and preferably 10 dB below the level with the plant operating. Both L_{eq} and L_{10} levels will be measured and reported.
VIBRATION MONITORING				
At the commencement of vibratory compaction work within 50 m of residential buildings.	Vibration Monitoring Record	As required	Environmental Officer	<p>Attended vibration monitoring will be undertaken when checking the safe working distances from construction plant (e.g. compaction plant) or in response to a complaint.</p> <p>The testing method includes:</p> <ul style="list-style-type: none"> Transducer to be affixed to ground or building in general accordance with AS 2775-2004. Monitoring to be conducted for at least three distances from the plant, including a representative distance for the nearest sensitive structures and/or receivers. The testing will be conducted at each location to obtain a suitable representation of the range of vibration levels that would occur from the tested plant. The plant will be tested in the settings in which it is expected to operate. For vibratory rollers this may include both "High" and "Low" settings. <p>Peak (PPV) vibration levels and the dominant frequency of the vibration will be recorded for assessment against the structural and cosmetic damage criteria. In situations in which human comfort is also of concern then the rms vibration level should also be recorded.</p>
Where complaint is received and monitoring is considered an appropriate response.	Vibration Monitoring Record	As required	Environmental Officer	
Where an activity may occur within safe working distances for cosmetic damage for no more than one day continuously.	Vibration Monitoring Record	As required	Environmental Officer	
Where required for the purposes of refining construction methods to reduce vibration levels.	Vibration Monitoring Record	As required	Environmental Officer	

Monitoring details	Record	Frequency	Responsibility	Test procedures
Where an activity may occur within safe working distances for cosmetic damage for a period of more than one day continuously.	Vibration Monitoring Record	As required	Environmental Officer	<p>Continuous vibration monitoring will be undertaken in situations where there is a risk that vibration from a particular construction activity may exceed the cosmetic damage criteria at a sensitive structure. This will be where activities may occur within the safe working distances for cosmetic damage identified in Section 8.3.1.</p> <p>The testing method includes:</p> <ul style="list-style-type: none"> • Transducer to be affixed to ground or building in general accordance with AS 2775-2004. • Vibration logger to continuously measure vibration levels while the relevant works are occurring within the safe working distance for cosmetic damage. • Measurement to be conducted as close as possible to the sensitive structure. • A warning system will be implemented with the monitoring system including one or both of the following: <ul style="list-style-type: none"> - Audible and/or visual warning alarm - SMS and/or email alerts to site staff.
Dilapidation surveys of buildings and structures where construction works occurs within the safe working distance for cosmetic damage	Dilapidation Report	Prior to that work being undertaken and post-construction	Construction Manager	<p>At a minimum, dilapidation surveys and reports will comprise:</p> <ul style="list-style-type: none"> • A visual inspection of the structure, including all internal and external walls, ground level floors and external pavements, all connections of other structures above ground level and their connection at ground level and any exposed foundations. • Full written report outlining the condition of the internal and external components of each property. • A series of photographs of each identified defect/crack. • A sketched floor plan showing the exact location of each defect and measurements of crack width/defect size. • Identification of any condition changes relative to pre-construction and the likely cause of the change (post-construction only).

GRAFTON BRIDGE
Additional crossing of the Clarence River
at Grafton, NSW
Construction noise and vibration

Fulton Hogan Design:
Standard noise monitoring locations

Client: Fulton Hogan
Drawn by: TRE
Checked by: CJ / MV
Dated: 7 June 2016
Page size: A3
Data sources: FH / RMS

Legend

- Fulton Hogan Design
- NCA
- Noise Monitoring Location

