APPENDIX B3

Construction noise and vibration management plan

Woolgoolga to Ballina

Pacific Highway Upgrade (sections 3 to 11)

OCTOBER 2015

Document control

File name	CEMP Appendix B3_NVMP_Rev3.doc
Report name	W2B Construction Noise and Vibration Management Plan
Revision number	3

Revision history

Revision	Date	Description	Approval
0	24/07/2015	PB review	
1	7/8/15	RMS review	
2	18/9/15	Agency review	
3	23/10/15	Final for approval	

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Glossary/Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	NSW Department of Environment and Climate Change (now EPA)
DP	Delivery Partner
DP&E	NSW Department of Planning and Environment
EIS	Woolgoolga to Ballina Pacific Highway Upgrade Environmental Impact Statement (December, 2012)
EMS	Environmental management system
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPL	NSW Environment Protection Licence under the Protection of the Environment Operations Act 1997.
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	NSW Environment Protection Authority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
ER	Environmental Representative
ERG	Environmental Review Group
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.

High-noise impact activities and work	Jack hammering, rock breaking or hammering, pile driving, dynamic compaction, vibratory rolling, cutting of pavement, concrete or steel or other work occurring on the surface that generates noise with impulsive, intermittent, tonal or low frequency characteristics.
$L_{Aeq\ (15min)}$	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.
$L_{A\ (max)}$	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LGA	Local government area
Low-noise impact activities and work	Deliveries, site access, equipment pre-start, refuelling, office works, foot-based and manual activities using hand tools, work in ancillary activities, finishing works and clean-up and activities that generate noise that is no more than 5 dB(A) above rating background level at any residence.
MCoA	NSW Minister for Planning Condition of Approval
Minister, the	NSW Minister for Planning
NCA	Noise Catchment Area – A noise catchment area comprises the grouping together of sensitive receivers including residential dwellings into a single geographic area. Across the noise catchment area, there is likely to be a similar noise environment audible by residents and passers-by.
OEH	NSW Office of Environment and Heritage
PC	Pacific Complete
PoEO Act	NSW Protection of the Environment Operations Act 1997
project, the	Pacific Highway Upgrade – Woolgoolga to Halfway Creek, Section 3 to 11
SPIR	Woolgoolga to Ballina Pacific Highway Upgrade Submissions Preferred Infrastructure Report (November, 2013)
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 therefore an RBL value for each period (day, evening and night)
RMS	NSW Roads and Maritime Services
Secretary	Secretary of the Department of Planning and Environment
Sensitive receiver	Residence, educational institution (eg school, university, TAFE college), health care facility (eg nursing home, hospital), religious facility (eg church) and children's day care facility.
SWL	Sound Power Level
Sparsely populated areas	Areas where sensitive receivers are located greater than 200 metres from the SSI boundary.
SPL	Sound Pressure Level

1 Introduction

1.1 Context

This Construction Noise and Vibration Management Plan (CNVMP) forms part of the Construction Environmental Management Plan (CEMP) for the planned construction of sections 3 to 11 of the Woolgoolga to Ballina Pacific Highway Upgrade. Sections 1 and 2 of the upgrade have been included in separate CEMPs and their subplans.

This CNVMP has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), the mitigation and management measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS) and the Submissions/Preferred Infrastructure Report (SPIR), and all applicable legislation.

The CNVMP describes applicable and relevant:

- Noise and vibration legislation and regulation
- Minister's conditions of approval (MCoA) issued by the NSW Minister for Planning
- Mitigation and management commitments contained in the response to submissions and preferred infrastructure report (SPIR).

1.2 Background

Chapter 15 of the environmental impact statement (EIS) (Roads and Maritime, 2012) assessed the project's likely potential noise and vibration impacts. An associated noise working paper (technical assessments) was also produced to support the EIS.

The working paper and EIS confirmed the likely potential for direct and indirect noise and vibration impacts to occur during the project's construction. However, both concluded that providing that identified mitigation measures are implemented any residual impacts can be suitably managed.

1.3 Environmental management systems overview

The CEMP describes the overall system for environmental management of the project being delivered by Pacific Complete (PC) in partnership with Roads and Maritime Services (Roads and Maritime).

The CNVMP has been developed in response to MCoA D26(a) and provides practical management measures and actions that will be put in place to avoid or minimise noise and vibration impacts pre-construction, during construction and post-construction.

The CNVMP environmental control measures will be incorporated into location or activity-specific environmental work method statements (EWMS). EWMS will be developed and signed off by environment and management representatives prior to associated works and construction personnel will be required to undertake works in accordance with the identified requirements and associated mitigation measures.

Used together, the CEMP and EWMS form management guides that clearly identify the required environmental management actions that will be referenced by all personnel and contractors on the project.

This plan will be reviewed as part of the CEMP (refer to Section 9 and Section 10 of the CEMP).

2 Purpose and objectives

2.1 Purpose

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

The management of noise and vibration impacts in this CNVMP is based on the assessment undertaken as part of the EIS, and subsequent construction noise and vibration investigations. The assessment has considered the following guidelines and standards:

- Environmental Criteria for Road Traffic Noise (ECRTN) (EPA 1999)
- NSW Industrial Noise Policy (EPA 2000)
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001)
- Interim Construction Noise Guideline (ICNG) (DECC 2009)
- Assessing Vibration: A Technical Guideline (DEC 2006)
- British Standard 7385: Part 2 'Evaluation and measurement of vibration in buildings'
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC)
- Australian Standard AS2187.2-2006: 'Explosives – Storage, Transport and Use'.

2.2 Objectives

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

- Identifying sensitive receivers and ensure appropriate environmental controls and procedures are implemented during construction activities.
- Minimising potential adverse noise and vibration impacts to the environment and community.
- Managing impacts if they occur through a systematic analysis of mitigation strategies.
- Ensure appropriate measures are implemented to address the relevant CoA outlined in Table 3.1 and the mitigation measures detailed in the EIS.
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 and Section 3.4 of this CNVMP.

2.3 Targets

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

- Full compliance with the relevant legislative requirements and MCoA.
- Implement all feasible and reasonable noise mitigation measures with the aim of achieving the construction Noise Management Levels detailed in the *Interim Construction Noise Guideline* (DECC, 2009).
- That blasting activities are only undertaken at designated times and remain within established/agreed criteria.
- Complaints from the community and stakeholders are minimised.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to noise and vibration management includes:

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

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

3.1.2 Guidelines

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

- RMS QA Specification G36: Environmental Protection (Management System) (Roads and Maritime, 2014)
- NSW *Road Noise Policy* (RNP) (DECCW 2011)
- NSW *Industrial Noise Policy* (EPA 2000)
- RTA *Environmental Noise Management Manual* (ENMM) (RTA 2001a)
- NSW *Interim Construction Noise Guideline* (ICNG) (DECC 2009)
- NSW *Assessing Vibration: A Technical Guideline* (DEC 2006)
- British Standard *BS7385: Part 2 Evaluation and Measurement of Vibration in Buildings*
- German *DIN 4150: Part 3 – 1999 Effects of Vibration on Structure* (DIN 1999)
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990)* Australian and New Zealand Environment and Conservation Council (ANZECC)
- Australian Standard *AS2187.2-2006: Explosives – Storage, Transport and Use*.

3.2 Minister's Conditions of Approval

The MCoA relevant to this CNVMP are listed Table 3-1. A cross reference is also included to indicate where the condition is addressed in this CNVMP or other project management documents.

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

MCoA No.	Condition Requirements	Document Reference
Construction Noise		
B14	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECCW, 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. *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 NML.*	Section 1 Section 7
B15	Construction activities associated with the SSI shall be undertaken during the following standard construction hours: (a) 7.00am to 6.00pm Monday to Friday, inclusive; and (b) 8.00am to 5.00pm Saturday; and (c) at no time on Sunday or public holidays.	Section 1 Section 7 Appendix C
B16	Construction works outside of the standard construction hours identified in condition B15 may be undertaken in the following circumstances: (a) construction works that generate noise that is: (i) 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 (ii) no more than the noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) at other sensitive receivers; or (b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or (e) low noise impact activities and work as follows: (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; or (f) works approved through an EPL; or (g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI.	Appendix C

MCoA No.	Condition Requirements	Document Reference
B17	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 construction hours specified in condition B15 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* (DECCW, 2009); (d) provides evidence that consultation with potentially affected receivers and notification of the relevant 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.	Appendix C
B18	Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken: (a) between the hours of 8.00am to 5.00pm Monday to Friday; (b) between the hours of 8.00am to 1.00pm Saturday; and (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. 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. The works subject to this condition may be undertaken in sparsely populated areas within the construction hours specified in condition B15.	Section 7
B19	The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods, except in sparsely populated areas.	Section 7

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td colspan="2">Construction Vibration</td><td></td></tr>
<tr><td>B20</td><td>The SSI shall be constructed with the aim of achieving the following construction vibration goals:
(a) for structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures;
(b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard BS 7385-1:1990 – Evaluation and measurement of vibration in buildings (and referenced in Australian Standard 2187.2 – 2006 Explosives – Storage and use – Use of explosives). Guide for measurement of vibration and evaluation of their effects on buildings; and
(c) for human exposure, the acceptable vibration values set out in Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).</td><td>Section 6.5</td></tr>
<tr><td>B21</td><td>Blasting associated with the SSI shall only be undertaken during the following hours:
(a) 9.00am to 5.00pm, Monday to Friday, inclusive;
(b) 9.00am to 1.00pm on Saturday; and
(c) at no time on Sunday or public holidays.
Blasting outside the above hours and in accordance with the standard construction hours where:
(i) no sensitive receivers in sparsely populated areas would be impacted by blasting; or
(ii) an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours.
This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.</td><td>Section 6.5
Section 7
Appendix B</td></tr>
<tr><td>B22</td><td>The Applicant shall ensure that Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.
Table 1 - Airblast overpressure limits for human comfort
<table>
<tr><th>Receiver</th><th>Type of blasting operations</th><th>Airblast Overpressure Limit</th></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>115 dBL for 95% of blasts per year</td></tr>
<tr><td>120 dBL maximum limit</td></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>120 dBL for 95% of blasts per year</td></tr>
<tr><td>125 dBL maximum limit</td></tr>
</table></td><td>Section 6.5
Section 7
Appendix B</td></tr>
</table>

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td></td><td>
<table>
<tr><td>Occupied non-sensitive sites, such as factories and commercial premises</td><td>All blasting</td><td>125 dBL maximum limit.
For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer’s specifications or levels that can be shown to adversely affect the equipment operation</td></tr>
</table>
Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J5.4(A) – AS 2187.2 – 2006
</td><td></td></tr>
<tr><td>B23</td><td>
The Applicant shall ensure that Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.
Table 2 – Ground vibration limits for human comfort
<table>
<tr><th>Receiver</th><th>Type of blasting operations</th><th>Peak component particle velocity (mm/s)</th></tr>
<tr><td>Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>5 mm/s for 95% of blasts per year</td></tr>
<tr><td>10 mm/s maximum limit</td></tr>
<tr><td>Sensitive site</td><td>Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>10 mm/s maximum limit</td></tr>
<tr><td>Occupied non-sensitive sites, such as factories and commercial premises</td><td>All blasting</td><td>25 mm/s maximum limit.
For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer’s specifications or levels that can be shown to adversely affect the equipment operation</td></tr>
</table>
Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J4.5(A) – AS 2187.2 – 2006.
</td><td>Section 6.5
Section 7
Appendix B</td></tr>
</table>

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td></td><td>
Table 3 – Ground vibration limits for control of damage to structures
<table>
<tr><th>Receiver</th><th>Type of blasting operations</th><th colspan="2">Peak component particle velocity (mm/s)</th></tr>
<tr><td>Other structures or architectural elements that include masonry, plaster and plasterboard in their construction [1]</td><td></td><td>15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.</td><td>20 mm/s 15 Hz and above</td></tr>
<tr><td>Reinforced or framed structures. Industrial and heavy commercial buildings [2]</td><td>All blasting</td><td>50 mm/s at 4 Hz and above</td><td></td></tr>
<tr><td>Unreinforced or light framed structure. Residential or light commercial type building [2]</td><td>All blasting</td><td>15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz</td><td>20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above</td></tr>
<tr><td>Unoccupied structures of reinforced concrete or steel construction</td><td>All blasting</td><td colspan="2">100 mm/s maximum, where agreed with the structure owner.</td></tr>
<tr><td>Infrastructure service structures, such as pipelines, power lines, cables and reservoirs.</td><td>All blasting</td><td colspan="2">Limits to be determined by structural design methodology in consultation with the infrastructure service provider.</td></tr>
</table>
Source:
1 - Table J4.5(B) – AS 2187.2 – 2006.
2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).
</td><td></td></tr>
<tr><td>B24</td><td>The blasting criteria specified in conditions B22 and/or B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria. In obtaining the agreement the Applicant shall make available to the landowner:
(a) details of the proposed blasting program and justification for the proposed increase to blasting criteria including alternatives considered (where relevant);
(b) the environmental impacts of the increased blast limits on the surrounding environment and most affected residences or other</td><td>Section 6.5
Section 7
Appendix B</td></tr>
</table>

MCoA No.	Condition Requirements	Document Reference
	sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; and (c) the blast management and mitigation measures, and monitoring procedures to be implemented to monitor blasting impacts. The Applicant shall provide a copy of the written agreement to the Director General and the EPA, including details of the consultation undertaken (with clear identification of proposed blast limits and potential property impacts) prior to commencing blasting at the increased limits. Unless otherwise agreed by the Secretary, the following exclusions apply to the application of this condition: (a) Any agreements reached may be terminated by the landowner at any time should concerns about the increased blasting limits be unresolved. Should an agreement be terminated by a landowner, the Applicant shall not exceed the criteria specified in conditions B22 and/or B23 for future blasting at that receiver. (b) The blasting limit agreed to under any agreement for an occupied residential building can at no time exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL.	
B25	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
B26	Prior to the use of the dynamic compaction construction method, the Applicant shall undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.	Section 7
B27	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.	TBC
Land Use Survey		
D10	Prior to the commencement of construction, the Applicant shall undertake a land use survey to identify areas that are sensitive to construction vibration and construction ground-borne noise impacts. The results of the survey shall be incorporated into the Construction Noise and Vibration Plan.	Section 4.1
Construction Environmental Management Plan		
D26 (a)	As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement: (a) a **Construction Noise and Vibration 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 *Interim Construction Noise Guidelines* (DECC, 2009) and shall include, but not necessarily be limited to:	This plan

MCoA No.	Condition Requirements	Document Reference
	(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	Section 4.1
	(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 6.3
	(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);	Section 7
	(iv) procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and	Section 7 Appendix B
	(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 8
	(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 B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners;	Appendix C
	(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;	Section 7
	(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 exceedences of relevant noise and vibration goals are detected; and	Section 8
	(ix) mechanisms for the monitoring, review and amendment of this plan.	Section 8

4 Existing environment

4.1 Sensitive receivers

The project extends from the Coffs Harbour local government area (LGA) in the south to Ballina LGA in the north and comprises regional urban communities such as Grafton and Maclean as well as smaller rural communities including Corindi, Tucabia, Ulmarra, Harwood, New Italy, Woodburn, Broadwater and Wardell. There are large portions of the study area that are comprised of national park, state forest and nature reserves, along with rural and agricultural land uses.

The noise and vibration assessment identified and considered potential noise impacts for each individual dwelling along the 155 km alignment and within 600 metres either side of the new or existing road centre line (the study area). A total of 1,222 residences are located within the study area. A breakdown of residences within each project section is as follows:

- Section 1: 416 residential receivers and 23 commercial/ non-residential receivers
- Section 2: 24 residential receivers and four commercial/ non-residential receivers
- Section 3: 60 residential receivers (of which seven are to be acquired) and two commercial/non-residential receivers
- Section 4: 266 residential receivers (of which 12 are to be acquired) and five commercial/ non-residential receivers
- Section 5: 241 residential receivers (of which seven are to be acquired) and two commercial/non-residential receivers
- Section 6: Seven residential receivers
- Section 7: 26 residential receivers and five commercial/non-residential receivers
- Section 8: 39 residential receivers (of which one is to be acquired) and 10 commercial/ non-residential receivers
- Section 9: 23 residential receivers (of which two are to be acquired) and one commercial/ non-residential receiver
- Section 10: 95 residential receivers (of which 12 are to be acquired) and three commercial/non-residential receivers
- Section 11: 25 residential receivers (of which three are to be acquired) and 13 commercial/non-residential receivers.

Section 3 to 11 of the Woolgoolga to Ballina project extends approximately 125 km from Glenugie to Ballina and passes through a variety of different land usage areas. The route passes primarily through rural and agricultural land, however many areas of clustered sensitive receivers are also located sporadically along the length of the alignment.

Table 4-1 summarises the various sections of the project and the chainage of each section.

Table 4-1 Sections and distances

Section	Start		End	
	Location	Chainage (km)	Location	Chainage (km)
Section 3	Glenugie	33.8	Tyndale	68.8
Section 4	Tyndale	68.8	Maclean	82.0
Section 5	Maclean	82.0	Illuka Road	96.4
Section 6	Illuka Road	96.4	Devil's Pulpit	105.4
	Devil's Pulpit	105.4	Devil's Pulpit	111.1
Section 7	Devil's Pulpit	111.1	Trustums Hill	126.4
Section 8	Trustums Hill	126.4	Broadwater NP	137.6
Section 9	Broadwater NP	137.6	Richmond River	145.1
Section 10	Richmond River	145.1	Coolgardie Road	158.6
Section 11	Coolgardie Road	158.6	Ballina Bypass	164.0

Whilst the EIS noise and vibration assessment identified and considered potential noise impacts within Noise Catchment Areas (NCAs) along the entire length of the Woolgoolga to Ballina alignment, this CNVMP focusses only on potential construction noise and vibration impacts associated with Section 3 to 11 of the Woolgoolga to Ballina project. Sensitive receivers identified within Sections 3 to 11 are summarised in Table 4-2. The location of sensitive receivers is detailed in the SITEMAP GIS system for the project.

Table 4-2 Sensitive receivers

Section	Sensitive Receiver Category	Quantity
Section 3	Commercial	14
	Residential	102
Section 4	Commercial	14
	Community	21
	Education	14
	Medical	1
	Recreation	5
	Residential	501
Section 5	Commercial	22
	Community	4
	Education	2
	Recreation	1
	Residential	196
Section 6	Residential	7
Section 7	Residential	3
Section 8	Commercial	2
	Community	1

Section	Sensitive Receiver Category	Quantity
	Residential	29
Section 9	Commercial	46
	Community	10
	Education	2
	Recreation	2
	Residential	241
Section 10	Commercial	17
	Community	6
	Recreation	3
	Residential	200
Section 11	Commercial	36
	Community	2
	Education	1
	Residential	164

4.2 Ambient noise

Noise monitoring was conducted as part of the EIS for the Woolgoolga to Ballina project in 2011 and 2012. The monitoring was undertaken to determine background noise levels to aid with establishing construction noise criteria for areas of sensitive receivers along the alignment. Locations were selected to be representative of receivers that would experience potential noise impacts from the existing highway and/or the project (see for monitoring locations).

A summary of the noise monitoring results is provided in Table 4-3.

Table 4-3 Ambient noise monitoring results for Section 3 to 11

ID	Section	NCA	Address	RBL dB(A)		
				Day (7.00–18.00)	Eve (18.00–22.00)	Night (22.00–7.00)
12	03	NCA-A	6639 Pacific Highway, Glenugie, NSW 2460	39	39	34
15	03	NCA-B	961 Wooli Road, Pillar Valley, NSW 2462	29	33	30
16	03	NCA-B	73 Edward Ogilvie Drive, Clarenza, NSW, 2460	43	40	32
18	03	NCA-B	24–26 Candole Street, Tucabia, NSW 2462	32	32	29
19	03	NCA-B	9 School Lane, Swan Creek, NSW 2462	44	42	35
20	03	NCA-B	625 Tucabia-Tyndale Road, Tucabia, NSW 2462	34	39	42
21	03	NCA-B	1874 Pacific Highway, Ulmarra, NSW 2462	39	42	34
23	03	NCA-C	2321 Pacific Highway, Cowper, NSW 2460	41	40	38

ID	Section	NCA	Address	RBL dB(A)		
				Day (7.00–18.00)	Eve (18.00–22.00)	Night (22.00–7.00)
24	04	NCA-C	2991 Pacific Highway, Tyndale, NSW 2460	57	53	57[1]
25	04	NCA-C	3358 Pacific Highway, Tyndale, NSW 2460	44	42	37
26	04	NCA-C	86 O'maras Lane, Gulmarrad, NSW 2463	41	38	33
29	04	NCA-D	4064 Pacific Highway, Gulmarrad, NSW 2463	43	44	39
32	04	NCA-D	Jubilee Street, Townsend, NSW 2463	44	43	36
33	04	NCA-D	13 Scullin Street, Townsend, NSW 2463	43	44	39
35	05	NCA-E	4A Petticoat Lane, Harwood, NSW 2465	48	47	40
36	05	NCA-E	40 Morpeth Street, Harwood, NSW 2465	45	44	39
38	05	NCA-F	5055 Pacific Highway, Chatsworth, NSW 2469	45	40	35
40	05	NCA-F	395 Chatsworth Road, Chatsworth, NSW 2469	37	39	35
41	05	NCA-F	53 Old Pacific Highway, Woombah, NSW 2469	43	44	41
44	06	NCA-G	6530 Pacific Highway, Jackybulbin, NSW 2463	46	46	42
45	08	NCA-G	7175 Pacific Highway, Tabbimoble, NSW 2472	42	42	34
46	08	NCA-G	8120 Pacific Highway, Tabbimoble, NSW 2472	45	43	37
48	08	NCA-G	65 Whites Road, New Italy, NSW 2472	45	47	48
50	08	NCA-G	60 The Gap Road, Trustums Hill, NSW 2472	40	41	44
51	08	NCA-G	60 The Gap Road, Trustums Hill, NSW 2472	37	43	45
52	09	NCA-G	20 The Gap Road, Trustums Hill, NSW 2472	44	43	42
54	09	NCA-H	82 Trustrums Hill Road, Woodburn, NSW 2472	44	43	35
55	09	NCA-H	165 Woodburn Evans, Woodburn, NSW 2472	45	57	50[1]
56	09	NCA-H	63 River Street, Woodburn, NSW 2472	45	47	46
57	09	NCA-H	9810 Pacific Highway, Broadwater, NSW 2472	48	51	45
58	10	NCA-I	2-4 Pacific Highway, Broadwater, NSW 2472	45	43	36
59	10	NCA-I	85 Broadwater Evans Head Road, Broadwater NSW 2472	42	36	37
64	11	NCA-J	11184 Pacific Hwy, East Wardell, NSW 2477	43	42	40
66	11	NCA-J	1175 Wardell Road, Wardell, NSW 2477	33	38	46
67	11	NCA-K	848 Pimlico Road, Wardell, NSW 2477	43	43	43

ID	Section	NCA	Address	RBL dB(A)		
				Day (7.00–18.00)	Eve (18.00–22.00)	Night (22.00–7.00)
68	11	NCA-K	109 Meridian Drive, Coolgardie, NSW 2478	41	42	38

Note 1: These monitoring locations have particularly high night-time noise levels. Reference to the noise logging data shows that the noise environment in these locations is likely influenced by erroneous sources of noise such as mechanical plant or nearby insect noise. These locations have therefore been discounted when determining NMLs for the various NCAs.

The measured background noise levels vary along the alignment. Noise levels are typically seen to be lower where monitoring locations are situated in rural settings away from population and sources of noise.

5 Noise and vibration criteria for NSW

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

- NSW *Interim Construction Noise Guideline* (ICNG)
- NSW *Assessing Vibration: a technical guideline*
- *The ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

Relevant elements of these documents are summarised and discussed in this Section.

5.1 Construction noise and assessment objectives

The DECC *Interim Construction Noise Guideline* (ICNG, July 2009) provides guidelines for the assessment and management of construction noise. The RNP refers to the use of the ICNG for the assessment of construction noise impacts.

The ICNG focuses on applying a range of work practices and management strategies to minimise construction noise impacts rather than focusing on achieving numeric noise levels which is not always practical on large infrastructure projects.

The main objectives of the ICNG are to:

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

5.2 Quantitative noise assessment criteria

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

Residential premises

Table 5-1 sets out NMLs for noise at residences and how they are to be applied.

In Table 5-1 the rating background level (RBL) is used when determining the management level. 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* (EPA, 2000).

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

Table 5-1 Noise at residents using quantitative assessment

Time of day	Management Level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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 (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: – times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences – if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other land uses

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). Table 5-2 presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. Consultation should be undertaken with noise sensitive land use occupants likely to be affected by noise from the works to schedule the project's work hours to achieve a reasonable noise outcome.

Internal noise levels are assessed at the centre of the occupied room. External noise levels are assessed at the most affected point within 50 metres of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences. Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened).

The management levels in Table 5-2 are 5 dB above the corresponding road traffic noise criteria in the Road Noise Policy (RNP) (and the 'maximum' levels in the NSW *Industrial Noise Policy* (EPA 2000) for commercial and industrial uses) to account for the variable and short-term nature of construction noise.

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

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

Notes:

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

5.3 Sleep disturbance criteria

An accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance – this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep.

In addition the differing grades of sleep state make a definitive definition difficult, and even where sleep disturbance is not noted by the subject, factors such as heart rate, mood and performance can still be negatively affected (WHO, 1995).

An assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\ minute)}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period. Factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 10.00pm and 7.00am); and
- Whether there are times of day when there is a clear change in the existing noise environment (such as during early morning shoulder periods).

Currently the information relating to sleep disturbance impacts indicates that:

- Maximum noise levels below 50–55 dB(A) are unlikely to cause an awakening from a sleep state.
- One or two noise events per night with maximum internal noise levels of 65–70 dB(A) are not likely to affect health and wellbeing significantly.

As such, an assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\ minute)}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period.

The sleep disturbance screening criterion for construction noise impacts will be determined by an $L_{A1(1\ minute)}$ noise level not exceeding the $L_{A90(15\ minute)}$ by more than 15 dB(A).

5.4 Construction traffic noise criteria

Road construction will last for a substantial amount of time and it is therefore necessary to consider potential impacts of construction generated road traffic.

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW *Road Noise Policy* states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

5.5 Noise Catchment Areas

The EIS noise and vibration assessment defined Noise Catchment Areas (NCAs) for the length of the alignment and used these NCAs to assess the potential impacts from the construction of the project. Due to the project locality and with an aim of providing a clear and adaptable assessment methodology, new NCAs have been defined for the project as part of the CNVMP. The new NCAs characterise the changing land uses adjacent to the project and provide a simplified approach.

The NCAs for the project are presented in Table 5-3 which describes the location of each of the catchments. Figures attached to this plan, show the NCAs along the length of the project.

Table 5-3 Noise catchment areas

NCA	Section	Description	Sensitive Receiver Category				
			Commercial	Community	Education	Recreational	Residential
NCA-A	3	Primarily bushland; interchange with existing highway; scattered rural dwellings.	4	0	0	0	14
NCA-B	3	Primarily farmland and bushland; scattered rural dwellings and township of Tucabia.	0	0	0	0	49
NCA-C	3, 4	Primarily farmland and bushland; adjacent to existing highway; scattered rural dwellings and townships of Tyndale and Gulmarrad.	16	0	0	0	131
NCA-D	4, 5	Townships of Maclean and Townsend; adjacent to existing highway.	8	22	14	5	415
NCA-E	5	Primarily farmland surrounding the Clarence River; adjacent to existing highway; scattered rural dwellings and township of Harwood.	13	2	1	0	109
NCA-F	5	Primarily farmland surrounding the Clarence River; adjacent to existing highway; scattered rural dwellings and township of Woombah.	9	2	1	1	82
NCA-G	6, 7, 8	Primarily bushland; adjacent to existing highway; scattered rural dwellings.	3	1	0	0	56
NCA-H	8	Primarily farmland and nearby township of Woodburn; adjacent existing highway.	41	10	2	2	216
NCA-I	8, 9, 10	Primarily farmland and bushland; adjacent existing highway; scattered rural dwellings and township of Broadwater.	21	6	1	3	225
NCA-J	10, 11	Primarily farmland and bushland; scattered rural dwellings and township of Wardell.	7	0	0	0	61
NCA-K	11	Primarily farmland and bushland; interchange with existing highway; scattered rural dwellings.	29	2	0	0	86

5.6 Adopted project noise management levels

Based on the measured noise levels described in Section 1, the project-specific construction NMLs for each NCA are presented in Table 5-1. Given that works outside of standard construction hours are likely for the project, NMLs for out of hours works are also included.

Monitoring locations were selected to be representative of receivers that would experience a similar noise impacts and have similar background levels.

Table 5-4 Project-specific construction noise management levels

NCA	Section	Noise Monitor ID	Noise Level (dBA)							
			Standard–Daytime (7am–6pm)		OOHWs–Evening (6pm–10pm)		OOHWs–Night-time (10pm–7am)		Sleep disturbance	
			RBL	NML	RBL	NML	RBL	NML	RBL	NML
NCA-A	3	12	39	49	39	44	34	39	34	49
NCA-B	3	18	32	42	32	37	29	34	29	44
NCA-C	3, 4	26	41	51	38	43	33	38	33	48
NCA-D	4, 5	29	43	53	44	49	39	44	39	54
NCA-E	5	36	45	55	44	49	39	44	39	54
NCA-F	5	40	37	47	39	44	35	40	35	50
NCA-G	6, 7, 8	45	42	52	42	47	34	39	34	49
NCA-H	8	54	44	54	43	48	35	40	35	50
NCA-I	8, 9, 10	58	45	55	43	48	36	41	36	51
NCA-J	10, 11	68	41	51	42	47	38	43	38	53
NCA-K	11	68	41	51	42	47	38	43	38	53

5.7 Vibration criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

The first of these vibration effects relating specifically to the human comfort aspects of the project are taken from the DEC (2006) *Assessing Vibration – A Technical Guideline*. This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (see Table 5-5).
- Impulsive vibration – up to three instances of sudden impact eg dropping heavy items, per monitoring period (see Table 5-6).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (see Table 5-7).

Table 5-5 Continuous vibration acceleration criteria (m/s2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 5-6 Impulsive vibration acceleration criteria (m/s2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 5-7 Intermittent vibration impacts criteria (m/s1.75) 1-80Hz

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

The other two effects relate to impacts on the building itself and are assessed against international standards as follows:

- British Standard *BS7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration* (BSI 1993)
- German *DIN 4150: Part 3 – 1999 Effects of Vibration on Structure* (DIN 1999).

The German standard provides the most stringent criteria and has been used in this NVMP. The DIN guideline values for peak particle velocity (mm/s) measured at the foundation of the building are summarised in Table 5-8. The criteria are frequency dependent and specific to particular categories of structure.

Table 5-8 Structural damage criteria

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

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

5.8 Blast criteria

Guidelines documented in the ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration has been used to establish goals for assessing blast air-blast overpressure and ground vibration.

Air-blast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 5-9 when measured at the most affected residence or other sensitive receiver.

Table 5-9 Air-blast overpressure limits for human comfort (Specified in CoA B22)

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people. Source – Table J5.4(A) – AS 2187.2 – 2006

Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

Table 5-10 Ground vibration limits for human comfort (Specified in CoA B23)

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation.

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people. Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 5-11 Ground vibration limits for control of damage to structures (Specified in CoA B23)

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction 1		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings 2	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building 2	All blasting	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
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:

1 - Table J4.5(B) – AS 2187.2 – 2006.

2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

For assessment of air-blast overpressure the DECC/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure.

The blasting criteria specified in CoA B22 and CoA B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria, in accordance with CoA B24.

The Blast Management Procedure for the project is included in this document in Appendix B.

6 Environmental aspects and impacts

6.1 Environmental aspects

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

- Site establishment
- Clearing and grubbing
- Demolition
- Earthworks and drainage
- Drilling and blasting
- Quarrying – crushing and screening and rock hammering
- Concrete & asphalt batch plants
- Bridgeworks (piling)
- Paving and concrete saw cutting
- Road furnishing
- Establishment and operation of ancillary facilities.

6.2 Impacts

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

- The type of equipment and number of simultaneously operating plant items
- Topography and the presence of any other physical barriers
- Proximity to sensitive receivers
- Hours/duration of construction works
- The prevailing background noise level
- Ground conditions.

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

6.3 Construction activities

A range of plant and equipment will be required to undertake activities associated with the project. A summary of anticipated construction scenarios and predicted noise levels are provided in Table 6-2. This information will be used to determine potential impacts on the receiving community. An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community.

Table 6-1 Proposed construction activities

Component	Typical activity
Enabling works	• Progressive installation of environmental controls including temporary or permanent fencing, enabling noise mitigation measures. • Conduct pre-clearing vegetation fauna surveys (to allow for utility adjustments). • Clearing of vegetation and processing of materials (to allow for utility adjustments).
Relocation or protection of services	• Preclearance checks. • Gas. • Water. • Telecommunications infrastructure.
Site establishment	• Installation of boundary fencing. • Establishment of construction facilities. • Establishment of stockpile sites and ancillary facilities • Installation of environmental controls • Pre-clearing vegetation fauna surveys • Temporary traffic management arrangements • Construction of access roads • Progressive installation of environmental controls including temporary or permanent fencing, construction and operational noise mitigation measures • Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required) • Clearing of vegetation and processing of materials • Removal of harvestable timber. • Temporary upgrade work for existing local roads and intersections • Operation of ancillary facilities.
Bulk earthworks	• Implementation and construction of local roadworks and any local road diversions including any construction of side roads to maintain existing traffic movement (where required) • Stripping topsoil and stockpiling it for reuse in landscaping • Embankment foundation or soft soils treatments, such as the installation of wick drains and drainage blankets • Excavation of cuttings, including the processing, stockpiling or haulage of material; blasting activities and stabilisation of batters • Construction of embankments, including foundation drainage. • Demolition of buildings and structures.
Drainage and structures	• Installation of cross-drainage, including culverts and inlet and outlet work including any channel diversions and scour protection work • Construction of any retaining walls • Installation of fauna connectivity structures • Construction of subsurface drainage • Installation of longitudinal and vertical drainage in cuttings and embankments.
Bridge construction	• Additional geotechnical works • Establishment of bridge work compounds • Installation of rock caissons or cofferdams or temporary access roads/ platforms across waterways

Component	Typical activity
	• Installation of bridge foundations (driven or bored piles, pile caps and footings) • Construction of bridge abutments and piers • Construction of bridge superstructure including deck and pavement work • Construction of scour protection along the waterway or waterfront land.
Rest areas	• Establishment of rest area work compounds • Construction of base and select layers of materials • Construction of pavement layers • Installation of structures (wash rooms, seating, information boards, line markings) • Reuse of topsoil • Planting of native plants and seeding disturbed areas with native and cover crops species
Pavement work	• Construction of base and select layers of materials • Construction of pavement layers • Construction of pavement drainage, including kerb and gutter (where required) • Construction of concrete barriers, wire rope fencing and guardrails.
Road furniture	• Installation of signage • Line marking • Installation of safety barriers
Landscaping and restoration	• Reuse of topsoil • Planting of native plants and seeding disturbed areas with native and cover crops species (note this will take place throughout construction as elements of the work are complete where ongoing disturbance is not anticipated).
Open to traffic	• Electrical and signage testing • Commissioning and final check • Decommissioning of construction facilities • Remove construction environmental controls • Handover the road to the operations and maintenance team • Road open to traffic.

Table 6.2 provides a summary of noise producing construction scenarios listed in Table 6.2, and associated plant and equipment required for the works. Due to the nature of construction activities, this plant and equipment may be used in isolation or simultaneously at any time during each phase of work. The overall sound power levels refer to the full equipment list for each phase. Appendix A provides a detailed list of equipment and corresponding individual sound power levels.

Construction activities presented in Table 6.2 have been grouped into construction Scenarios 01 to 12 according to the overall sound power level (Lw) of the activity. These scenarios 01 to 12 are used within SiteMap to show corresponding noise predictions.

Table 6-2 Construction scenarios and associated plant and equipment

Scenario		Construction scenario	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
ID	Reference			
01	08_BAS	Construction of water quality basins	1 x Excavator 20t 1 x Bogie 1 x Water pump	106
	20_SGN	Signage installation	1 x Excavator 6t 1 x Truck 10t 2 x Hand tools 1 x Rattle gun (hand-held)	106
02	17_LMK	Line marking	1 x Line marking plant 1 x Road sweeper	107
	18_WLI	Wall installation	1 x Mobile crane 50t 1 x Franna crane 1 x Flatbed truck	107
03	11_ENV	Installation of environmental controls	1 x Backhoe 7.5t 1 x Grader 2 x Hand tools	108
04	16_SPS	Spray sealing activities	1 x Bitumen spray truck 1 x Bogie 1 x Multi tyred roller* 1 x Light vehicle	109
05	01_GEO	Geotechnical works	1 x Piling rig small (bored) 1 x Backhoe 7.5t 1 x Excavator 20t 1 x Generator	110
	02_DCL	Discrete clearing	2 x Excavator 20t 1 x Chipper 2 x Dump truck	110
	07_SER	Services and drainage installation	1 x Suction truck 1 x Excavator 20t 1 x Bogie 2 x Hand tools	110
	14_CSC	Soft concrete saw cutting	1 x Saw cutting machine* 1 x Daymaker	110
06	03_BCL	Broad clearing	2 x Excavator 20t 2 x Chipper 2 x Dump truck	111
	09_HAU	Plant and materials haulage	1 x Low loader 1 x Water cart 2 x Dumper	111

Scenario		Construction scenario	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
ID	Reference			
07	10_VMW	Verge and median works	1 x Bogie 1 x Grader 1 x Bobcat 1 x Roller (non-vibratory)* 1 x Water cart	112
	19_BDG	Bridge installations – bored piling	1 x Piling rig large (bored) 2 x Mobile crane 100t 2 x Flatbed truck 1 x Generator 4 x Hand tools	112
08	05_DRL	Earthworks – Drill and blasting	1 x Drilling rig 1 x Backhoe 7.5t 1 x Truck	113
	12_KCB	Kerb and barrier works	1 x Kerb slipform machine or 1 x Barrier slipform machine 2 x Concrete truck/agitator	113
	15_SCP	Shoulder concrete paving	1 x Shoulder paving machine 1 x water tanker 1 x Concrete truck/agitator 1 x Light vehicle	113
	21_MCP	Main compound	2 x Truck 1 x Franna crane 1 x Front end loader 1 x Generator 5 x Light vehicle	113
09	13_CCP	Carriageway concrete paving	1 x Paving machine Skidsteer 2 x Concrete truck/agitator Light vehicle	114
10	06_FIL	Earthworks – Fill and compact	2 x Compactor 1 x Grader 1 x Water cart 1 x Roller (non-vibratory)* 1 x Smooth drum roller* 3 x Articulated truck	116
11	04_CUT	Earthworks - Cut	2 x Excavator 30t 1 x Excavator 12t (breaker)* 1 x Water cart 2 x Dump truck 1 x Dozer 3 x Articulated truck	124

Scenario		Construction scenario	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
ID	Reference			
12	22_CCP	Crushing compound	1 x Excavator (30T) 1 x Generator 1 x Excavator 12t (breaker)* 2 x Front end loader 1 x Mobile jaw crusher (50T)* 2 x Dump truck 1 x Water cart 1 x Mobile screen	125

* Indicates 5dB(A) penalty applied for tonal, annoying or impulsive sound sources in accordance with ICNG.

Typical construction equipment noise levels have been obtained from 'Appendix A' of A*S 2436 – 2010 Guide to noise and vibration control on construction, demolition and maintenance site*; *BS 5228-2009 Code of practice for noise and vibration control on construction and open sites*, UK Department for Environment, Food and Rural Affairs databases (DEFRA), and the project EIS.

The levels include a correction to allow for typical on site usage during a normal 15 minute period. The default usage factors are based on the US Federal Highway Administration's Roadway Construction Noise Model or similar values.

Potential construction noise impacts were modelled for each receiver using the CONCAWE algorithm in the SoundPLAN noise modelling software.

6.4 Construction noise assessment

Comprehensive construction noise predictions at individual receiver locations are contained within the EIS noise and vibration working paper and are considered to represent the anticipated impacts.

Further construction noise and vibration assessment has been undertaken as part of this CNVMP using the construction activities described in Section 6.3 to assist in construction planning and noise and vibration impact management.

This information will be used to determine potential noise and vibration impacts on the community. An adaptive management approach will be applied to the implementation of mitigation measures to ensure noise and vibration impacts on the community are minimised as far as practicable.

Potential noise impacts associated with the proposed works are described in the following sections.

6.4.1 Section 3 – Glenugie to Tyndale

Section 3 extends along 35 km of project alignment and incorporates NCA-A, NCA-B, and part of NCA-C, and includes commercial and residential receivers.

NCA-A

Worst-case construction noise impacts in NCA-A at residential receivers closest to mainline roadworks (refer Table 6.2) are anticipated to exceed NMLs by between 5 dB and 25 dB during the night-time period. NML exceedances in NCA-A are 10 dB lower for daytime works compared to night-time works. Worst-case night-time NML exceedances are reduced to less than 5 dB at residential receivers approximately 420 m from the works.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-A is predicted to exceed NMLs by up to 10 dB and 20 dB for the daytime and night-time periods respectively.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are predicted to exceed NMLs by up to 25 dB during the night-time period. Cumulative noise impacts are not predicted to significantly increase the worst-case construction noise levels as mainline road works control NML exceedances.

The closest residential receivers to the mainline works are located approximately 240 m from the closest works. No residential receivers in NCA-A are predicted to be highly noise affected (as defined by the ICNG) due to mainline works, ancillary sites, or cumulative noise impacts.

Table 6-3 NCA – A Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	3	-	-	-	-	-	-	-	-	-	-	2	3
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	49	3	-	-	-	-	-	1	2	2	2	3	11	11
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	44	4	1	2	2	2	2	3	4	4	6	9	11	11
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	44	4	1	2	2	2	2	3	4	4	6	9	11	11
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	39	8	3	4	4	6	8	9	10	11	11	11	11	11
Highly Noise Affected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	-	-

* Construction compound

OOHW Day (RBL+5)

NCA-B

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-B are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 450 m from the works for mainline works Scenario 12 (refer Table 6.2) with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-B is predicted to exceed NMLs by up to 18 dB during the daytime and greater than 25 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 150 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts as mainline road works control NML exceedances.

The closest residential receivers to the mainline works are predicted to be highly noise affected due to mainline works activities. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-4 NCA – B Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	42	38	12	15	19	23	27	31	37	39	42	49	49	49
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	37	43	31	37	39	42	47	49	49	49	49	49	49	49
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	37	43	31	37	39	42	47	49	49	49	49	49	49	49
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	34	47	42	47	49	49	49	49	49	49	49	49	49	49
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	1	1

* Construction compound

NCA-C

Section 3 includes approximately 3.6 km of alignment in NCA-C and includes commercial and residential receivers. Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 3 component of NCA-C are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 330 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-C is predicted to exceed NMLs by up to 8 dB during the daytime and up to 22 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 220 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts at most receivers as mainline road works control NML exceedances.

The closest residential receivers to the mainline works are predicted to be highly noise affected due to mainline works activities. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-5 NCA – C Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	51	19	9	10	12	14	16	17	18	19	22	25	39	40
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	46	31	17	18	19	22	24	25	25	26	29	33	40	40
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	43	34	22	24	25	25	26	29	32	33	38	39	40	40
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	38	39	29	32	33	38	39	39	40	40	40	40	40	40
Highly Noise Effected														
Residential	75	-	1	1	1	2	2	2	3	3	3	3	4	4

* Construction compound

6.4.2 Section 4 – Tyndale to Maclean

Section 4 extends along 13 km of project alignment and incorporates NCA-C and part of NCA-D, and includes commercial, residential, and other sensitive receivers.

NCA-C

Section 4 includes approximately 10.5 km of alignment in NCA-C and includes commercial and residential receivers. Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 4 component of NCA-C are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 300 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-C is predicted to exceed NMLs by up to 5 dB during the daytime and up to 17 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 250 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts at most receivers as mainline road works control NML exceedances.

The closest residential receivers to the mainline works are located within 80 m of the project alignment and are predicted to be highly noise affected due to mainline works activities. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-6 NCA – C Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	1	-	1	1	1	1	1	1	1	1	1	1	1
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	51	13	8	9	9	10	10	11	11	11	13	16	58	69
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	46	59	11	11	11	13	16	16	16	20	25	37	91	91
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	43	71	13	16	16	16	20	25	29	37	44	58	91	91

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	38	86	25	29	37	44	50	58	69	87	89	91	91	91
Highly Noise Effected														
Residential	75	1	1	1	1	1	1	2	2	3	3	3	5	5

* Construction compound

NCA-D

Section 4 includes approximately 3.2 km of alignment in NCA-D and includes the Townsend and Maclean townships. Residential receivers in Townsend are located immediately adjacent the project alignment.

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-D are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 160 m from the works for mainline works Scenario 12 (refer Table 6.2) with lesser impacts for other scenarios. Worst-case night-time NML exceedances reduce to 10 dB at approximately 730 m on the eastern side of the works (Townsend) and at approximately 350 m on the western side of the alignment (Maclean) where the topography provides shielding from the works.

Worst-case mainline construction noise predictions for the educational facilities located approximately 550 m west of the project alignment (Mclean high school and North Coast TAFE) are predicted to receive minor exceedances of the NMLs of around 1 dB. These exceedances would only intermittently during earthworks and crushing activities.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-D is predicted to exceed NMLs by up to 13 dB during the daytime and 23 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 85 m from the nearest ancillary site. These noise impacts are restricted to two residential receivers located immediately adjacent the southernmost ancillary compound in NCA-D.

The ancillary site located at the end of Ti Tree Lane is not anticipated to exceed the daytime NMLs. Minor exceedances of the night-time NML of up to 4 dB are predicted.

Worst-case ancillary site noise predictions for the Mclean high school and North Coast TAFE educational facilities are not predicted to exceed the NMLs for these receivers.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are only apparent at receivers adjacent the southern ancillary compound where cumulative noise levels increase NML exceedances by around 2 dB.

The closest residential receivers to the mainline works are predicted to be highly noise affected due to mainline works activities. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-7 NCA – D Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	1	1	1	1	1	1	1	1	12	13
Recreational	65	-	-	-	-	-	-	-	1	1	1	1	1	1
Residential	53	4	31	33	36	42	45	48	53	62	72	90	290	327
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	1	1	1	1	1	1	1	1	12	13
Recreational	65	-	-	-	-	-	-	-	1	1	1	1	1	1
Residential	48	42	48	53	62	72	81	90	99	107	126	166	394	396
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	1	1	1	1	1	1	1	1	12	13
Recreational	65	-	-	-	-	-	-	-	1	1	1	1	1	1
Residential	49	24	45	48	53	62	72	81	90	99	107	143	383	394
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	1	1	1	1	1	1	1	1	12	13
Recreational	65	-	-	-	-	-	-	-	1	1	1	1	1	1
Residential	44	206	81	90	99	107	126	143	166	197	233	327	398	399
Highly Noise Effected														
Residential	75	-	6	6	7	7	7	7	8	9	11	12	21	23

* Construction compound

6.4.3 Section 5 – Maclean to Iluka Road

Section 5 extends along 14 km of project alignment and incorporates NCA-D, NCA-E and NCA-F, and includes commercial, residential, and other sensitive receivers.

NCA-D

Section 5 includes approximately 1.8 km of alignment in NCA-D and includes residential receivers.

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 5 area of NCA-D are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 160 m from the works for mainline works Scenario 12 (refer Table 6.2) with lesser impacts for other scenarios. Worst-case night-time NML exceedances reduce to 10 dB at approximately 720 m from the works on both sides of the alignment.

Worst-case ancillary compound noise at the potentially most affected residential receivers in the Section 5 area of NCA-D is predicted to exceed NMLs by up to 6 dB during the daytime and 15 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 160 m from the nearest ancillary site.

Cumulative noise impacts are not predicted to significantly increase the worst-case construction noise levels as mainline road works control NML exceedances.

The closest residential receiver to the mainline works is predicted to be highly noise affected due to mainline works activities. This receiver is located approximately 50 m from mainline works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-8 NCA – D Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	53	2	2	2	2	2	3	3	3	4	4	4	5	5
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	48	4	3	3	4	4	4	4	4	4	4	5	5	5
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	49	3	3	3	3	4	4	4	4	4	4	5	5	5
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	44	5	4	4	4	4	4	5	5	5	5	5	5	5
Highly Noise Effected														
Residential	75	-	1	1	1	1	1	1	1	1	1	1	1	1

* Construction compound

NCA-E

NCA-E includes the township of Harwood. Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-E are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 160 m from the works for mainline works Scenario 12 (refer Table 6-2

Table 6-2) with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-E is predicted to exceed NMLs by up to 4 dB during the daytime and up to 14 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 200 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts as mainline road works control NML exceedances.

The closest residential receivers to the mainline works are predicted to be highly noise affected due to mainline works activities with the nearest receivers located as close as 50 m from the works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-9 NCA – E Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	2	2	3	3	3	3	3	3	3	3
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	55	25	19	24	31	37	46	53	63	68	77	85	105	108
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	2	2	3	3	3	3	3	3	3	3
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	50	93	53	63	68	77	85	85	86	89	91	94	109	109
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	2	2	3	3	3	3	3	3	3	3
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	49	99	63	68	77	85	85	86	89	91	93	99	109	109
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	1	2	2	3	3	3	3	3	3	3	3
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	44	109	86	89	91	93	94	99	102	105	108	109	109	109
Highly Noise Effected														
Residential	75	-	3	3	4	4	4	4	4	4	4	5	11	15

* Construction compound

NCA-F

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-F are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 230 m from the works for mainline works Scenario 12 (refer Table 6-2) with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-F is predicted to exceed NMLs by up to 2 dB during the daytime and up to 9 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 510 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts as mainline road works control NML exceedances.

The closest residential receivers to the roadworks are predicted to be highly noise affected due to mainline works activities with the nearest receivers located as close as 50 m from the works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-10 NCA – F Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	1	1	2	2	2	2	2	2	2	3	3	3
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	1
Residential	47	4	26	30	38	45	46	48	49	53	54	61	82	82
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	1
Residential	42	12	48	49	53	54	59	61	64	73	77	82	82	82
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	1
Residential	44	8	45	46	48	49	53	54	59	61	64	77	82	82
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	1
Residential	40	14	53	54	59	61	64	73	77	82	82	82	82	82
Highly Noise Effected														
Residential	75	-	2	2	2	3	3	4	4	4	5	6	12	13

* Construction compound

6.4.4 Sections 6 – Iluka Road to Devil's Pulpit

NCA-G

NCA-G spans across Sections 6 through 8 and includes approximately 33.8 km of alignment, and includes commercial and residential receivers.

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 6 component of NCA-G are anticipated to exceed NMLs by up to 23 dB during the daytime and more than 25 dB during the night-time. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 250 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in Section 6 is predicted to exceed NMLs by up to 10 dB during the daytime and up to 23 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 90 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are predicted to increase the worst-case noise impacts by up to 2 dB at the receiver closest to the ancillary compound. Cumulative noise impacts are not predicted for the other receivers in Section 6.

The closest residential receiver to the mainline works and ancillary compound is predicted to be highly noise affected due to mainline works activities.

Table 6-11 NCA – G Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	52	1	1	1	1	1	2	2	2	3	3	4	7	7
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	4	2	2	3	3	3	4	6	6	7	7	7	7
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	4	2	2	3	3	3	4	6	6	7	7	7	7
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	39	5	7	7	7	7	7	7	7	7	7	7	7	7

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	-	-

* Construction compound

6.4.5 Section 7 – Devil's Pulpit to Trustums Hill

NCA-G

Section 7 is situated within NCA-G and includes residential receivers. Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 7 component of NCA-G are anticipated to exceed NMLs by up to 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 250 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in Section 6 is predicted to exceed NMLs by up to 11 dB during the daytime and up to 24 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 85 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are predicted to increase the worst-case noise impacts by up to 2 dB at the receiver closest to the ancillary compound. Cumulative noise impacts are not predicted for the other receivers in Section 6.

The closest residential receiver to the mainline works and ancillary compound is predicted to be highly noise affected due to mainline works activities.

Table 6-12 NCA – G Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	52	1	1	1	1	1	1	1	1	1	1	1	3	3
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	1	1	1	1	1	1	1	1	1	1	3	3	3
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	1	1	1	1	1	1	1	1	1	1	3	3	3

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	39	3	1	1	3	3	3	3	3	3	3	3	3	3
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	-	1

* Construction compound

6.4.6 Section 8 – Trustums Hill to Broadwater NP

NCA-G

Section 8 is situated within NCA-G and includes residential and commercial receivers. Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 8 component of NCA-G are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 250 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in Section 7 is predicted to exceed NMLs by up to 9 dB during the daytime and up to 22 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 160 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts at residential receivers as mainline road works control NML exceedances.

The closest residential receiver to the mainline works and ancillary compound is predicted to be highly noise affected due to mainline works activities.

Table 6-13 NCA – G Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	1	1	1	1	1	1	1	1	1	1	2	2
Community	55	-	1	1	1	1	1	1	1	1	1	1	1	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	52	4	16	16	17	18	19	20	23	24	24	27	29	29
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	1	1	1	1	1	1	1	1	1	1	1	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	7	20	23	24	24	25	27	28	28	29	29	29	29

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	1	1	1	1	1	1	1	1	1	1	1	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	7	20	23	24	24	25	27	28	28	29	29	29	29
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	1	1	1	1	1	1	1	1	1	1	1	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	39	15	29	29	29	29	29	29	29	29	29	29	29	29
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	4	4	4	13	13

* Construction compound

6.4.7 Section 9 – Broadwater NP to Richmond River

Section 9 extends along 7.5 km of project alignment and incorporates NCA-G, NCA-H and NCA-I, and includes commercial, residential, and other sensitive receivers.

NCA-G

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 9 component of NCA-G are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 250 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

The closest residential receivers to the mainline works are predicted to be highly noise affected due to mainline works activities.

Table 6-14 NCA – G Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	52	-	8	8	9	11	13	13	14	14	15	15	17	17
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	-	13	14	14	15	15	15	15	17	17	17	17	17
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	-	13	14	14	15	15	15	15	17	17	17	17	17
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	39	-	17	17	17	17	17	17	17	17	17	17	17	17
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	4	5

* Construction compound

NCA-H

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-H are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 230 m from the works for mainline works Scenario 12 (refer Table 6-2) with lesser impacts for other scenarios.

Worst-case mainline construction noise predictions for the educational facilities located approximately 1.3 km northwest of the project alignment in the township of Woodburn are predicted to receive minor exceedances of the NMLs of up to 2 dB. These exceedances would only intermittently during earthworks and crushing activities.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-H is predicted to exceed NMLs by up to 12 dB during the daytime and up to 25 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 50 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts at residential receivers as mainline road works control NML exceedances.

The closest residential receivers to the roadworks are predicted to be highly noise affected due to mainline works and ancillary site activities. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-15 NCA – H Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	1	1
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	54	4	6	7	8	8	8	9	9	9	9	12	24	26
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	49	20	9	9	9	9	9	12	15	19	20	21	49	86
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	48	30	9	9	9	9	12	15	19	20	21	23	86	134
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	40	216	21	21	23	23	24	26	27	28	34	86	216	216
Highly Noise Effected														
Residential	75	-	-	-	-	-	-	-	-	-	-	-	4	5

* Construction compound

NCA-I

Section 9 includes approximately 4.7 km of alignment in NCA-I and includes residential and commercial receivers.

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 9 area of NCA-I are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 220 m from the works for mainline works Scenario 12 (refer Table 6-2) with lesser impacts for other scenarios. Worst-case night-time NML exceedances reduce to 10 dB at approximately 950 m from the works on both sides of the alignment.

Worst-case ancillary compound noise at the potentially most affected residential receivers in in the Section 9 area of NCA-I is predicted to exceed NMLs by up to 9 dB during the daytime and 23 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 70 m from the nearest ancillary site.

Cumulative noise impacts are not predicted to significantly increase the worst-case construction noise levels as mainline road works control NML exceedances.

The closest residential receiver to the mainline works is predicted to be highly noise affected due to mainline works activities. This receiver is located approximately 30 m from mainline works (acquired as part of the project). Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-16 NCA – I Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	1
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	55	2	2	2	2	2	2	2	2	2	2	4	5	5
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	50	4	2	2	2	2	3	4	4	4	4	5	8	8
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	48	4	2	2	3	4	4	4	4	5	5	5	8	8
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	41	6	5	5	5	5	5	5	6	7	8	8	8	8
Highly Noise Effected														
Residential	75	-	1	1	1	1	1	1	1	1	1	2	2	2

* Construction compound

6.4.8 Section 10 – Richmond River to Coolgardie Road

Section 10 extends along 13.5 km of project alignment and incorporates part of NCA-I, and includes commercial, residential, and other sensitive receivers.

NCA-I

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in the Section 10 area of NCA-I are anticipated to exceed NMLs by 23 dB during the daytime and more than 25 dB night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 220 m from the works for mainline works Scenario 12 (refer Table 6-2) with lesser impacts for other scenarios. Worst-case night-time NML exceedances reduce to 10 dB at approximately 950 m from the works on both sides of the alignment.

Worst-case ancillary compound noise at the potentially most affected residential receivers in in the Section 10 area of NCA-I is predicted to exceed NMLs by up to 6 dB during the daytime and 20 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 90 m from the nearest ancillary site.

Cumulative noise impacts are not predicted to significantly increase the worst-case construction noise levels as mainline road works control NML exceedances.

The closest residential receiver to the mainline works is predicted to be highly noise affected due to mainline works activities. This receiver is located approximately 90 m from mainline and interchange works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-17 NCA – I Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	2	2
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	55	6	3	4	5	5	5	5	6	6	6	7	50	77
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	2	2
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	50	35	5	6	6	6	7	7	8	10	13	27	195	200
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	2	2
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	48	95	6	6	7	7	8	10	13	19	27	38	200	200
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	2	2
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	41	193	19	27	31	38	50	77	110	159	188	200	200	200
Highly Noise Effected														
Residential	75	-	1	1	1	1	1	2	2	2	2	2	2	2

* Construction compound

6.4.9 Section 11 – Coolgardie Road to Ballina Bypass

Section 11 extends along 5.4 km of project alignment and incorporates NCA-J and NCA-K, and includes commercial and residential receivers.

NCA-J

Worst-case construction noise impacts at residential receivers closest to mainline roadworks in NCA-J are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 160 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-J is predicted to exceed NMLs by up to 4 dB during the daytime and up to 12 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 330 m from the nearest ancillary site.

Cumulative noise impacts are not predicted to significantly increase the worst-case construction noise levels as mainline road works control NML exceedances.

The closest residential receivers to the roadworks are predicted to be highly noise affected due to mainline and interchange works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-18 NCA – J Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	1	1	1	1	1	1	1
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	51	10	22	24	24	25	26	26	28	30	30	38	61	61
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	46	30	26	28	30	30	33	38	41	44	45	54	61	61
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	22	26	26	28	30	30	33	38	41	44	47	61	61
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	-
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	43	40	30	33	38	41	44	45	47	54	54	61	61	61

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Highly Noise Effected														
Residential	75	-	4	5	7	7	7	7	7	8	8	9	19	20

* Construction compound

NCA-K

Worst-case construction noise impacts at residential receivers closest to mainline and interchange roadworks in NCA-K are anticipated to exceed NMLs by more than 25 dB during the daytime and night-time periods. Worst-case night-time NML exceedances of up to 25 dB are predicted to extend to residential receivers up to approximately 160 m from the works for mainline works Scenario 12 with lesser impacts for other scenarios.

Worst-case ancillary compound noise at the potentially most affected residential receivers in NCA-K is predicted to exceed NMLs by up to 15 dB during the daytime and up to 23 dB during the night-time. Residential receivers most affected by ancillary compound noise impacts are located as close as 75 m from the nearest ancillary site.

Worst-case cumulative noise impacts from the simultaneous operation of the ancillary compounds and the loudest mainline works scenarios are not predicted to significantly increase the worst-case noise impacts at residential receivers as mainline road works control NML exceedances.

The closest residential receivers to the roadworks are predicted to be highly noise affected due to mainline and interchange works. Construction noise from ancillary sites alone is not predicted to result in the nearest receivers being highly noise affected.

Table 6-19 NCA – K Noise Management Level Exceedance Summary

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Day (RBL+10)														
Commercial	75	-	-	-	-	-	-	-	-	1	1	1	2	2
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	51	49	14	16	18	18	18	20	22	25	31	37	80	83
OOHW Day (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	46	84	20	22	25	31	34	37	45	46	52	63	84	84
Evening (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	47	82	18	20	22	25	31	34	37	45	46	58	84	84

	NML (dBA)	Number of Sensitive Receivers exceeding Project NML's												
		Mainline Construction Scenarios												
		C*	1	2	3	4	5	6	7	8	9	10	11	12
Night (RBL+5)														
Commercial	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Community	55	-	-	-	-	-	-	-	-	-	-	-	-	1
Recreational	65	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	43	84	31	34	37	45	46	52	58	63	77	80	84	84
Highly Noise Effected														
Residential	75	-	4	4	4	4	5	5	5	5	5	6	9	11

* Construction compound

6.5 Construction vibration and blasting assessment

6.5.1 Vibration assessment

Table6-20 lists vibration intensive plant likely to be used during construction while Table 6-21 and Table 6-22 provide predicted ground vibration levels at various distances from the plant. The vibration levels are indicative only and will vary depending on the particular item of plant and geotechnical conditions.

Table 6-20 Typical plant vibration levels

Item	*Peak particle velocity at 10 m (mm/s)*
Impact Pilling	12[1]
Loader Breaking Kerbs	6–8
15 Tonne Compactor	7–8
7 Tonne Compactor	5–7
Roller	5–6
Rock Breaker	2–4.5
Dozer	2.5–4
Backhoe	1
Jackhammer	0.5

Note:[1] Vibration generated by impact piling has the potential to generate significant vibrations levels. Piling is expected to be associated with the construction of the bridges. As far as possible bored piling would be used in lieu of standard pile-driving to minimise vibration impacts from piling activities. This assessment assumes the use of impact piling based on 12 mm/s at 10 m and is therefore considered conservative.

Based on the above levels, the maximum potential vibration impacts of these activities at various distances are shown in Table 6-21 and Table 6-22.

Key:

expected to comply with vibration criteria
expected to exceed the recommended vibration criteria
expected to exceed the maximum vibration criteria

Table 6-21 Typical plant vibration levels (ground vibration)

Building damage					
Plant description	**Vibration level (mm/s)[1]**				
	5 metres	**10 metres**	**25 metres**	**50 metres**	**100m**
Criterion	5 (typical)/3 (heritage)				
Vibratory roller (3–8 tonne)[2]	7	3	0.7	0.3	0.1
Vibratory roller (8–13 tonne)[2]	19	9	2	1	0.4
Vibratory roller (13–18 tonne)[2]	22	10	3	1	0.4
Vibratory roller (>18 tonne)[2]	28	13	4	1	0.5
Hydraulic hammer	6	2	0.5	0.2	0.1
Impact Pile driver[3]	30	12	3.6	1.5	0.6
Vibratory pile driver[4]	28	11	3	1	0.4
Drilling of blasting holes	6	2	0.5	0.2	0.1
Pile boring	6	2	0.5	0.2	0.1
Jackhammer (hand held)	2	0.8	0.2	<0.1	-

Table 6-22 Typical plant vibration levels (human comfort)

Human comfort					
Plant description	**eVDV (mm/s$^{1.75}$)[5]**				
	5 metres	**10 metres**	**25 metres**	**50 metres**	**100m**
Criterion	0.2 daytime/0.1 night time				
Vibratory roller (3-8 tonne)[2]	5.9	2.3	0.6	0.2	0.1
Vibratory roller (8-13 tonne)[2]	16.2	7.3	2.2	0.8	0.3
Vibratory roller (13-18 tonne)[2]	18.2	8.2	2.5	0.9	0.3
Vibratory roller (>18 tonne)[2]	23.7	10.7	3.2	1.2	0.4
Hydraulic hammer	5	1.8	0.5	0.2	0.1
Impact Pile driver[3]	65	26	8	3.2	1.3
Vibratory pile driver[4]	23	9	2.5	0.9	0.4
Drilling of blasting holes	5	1.8	0.5	0.2	0.1
Pile boring	5	1.8	0.5	0.2	0.1
Jackhammer (hand held)	1.9	0.7	0.2	<0.1	-

1 - Calculated in accordance with *BS5228 – Code of practice for noise and vibration control on construction and open sites (95% confidence) / FTA Guidance Manual for Transit Noise and Vibration Impact Assessment*
2 - Mid amplitude setting
3 – Assumes soft ground
4 – Steady state operation (startup/shutdown may be higher)
5 – Calculated in accordance with Appendix B2 'Assessing vibration a technical guideline' and assumes 6hrs per day of intermittent vibration

Results presented in Table 6-21 indicate structural damage vibration impacts are unlikely at any properties located further than 50 m from vibration inducing works.

Where vibratory rolling or impact/vibratory piling activities are required to be undertaken within 50 m of a heritage item, mitigation measures will be implemented by the contractor in accordance with Section 7.

Where heavy vibratory rolling or piling (either impact or vibratory) are undertaken within the distances outlined in Table 6-22 of a residential property, potential exceedances of human comfort levels may be experienced and as such mitigation measures will be required to be implemented in accordance with Section 7.

When detailed information regarding the proposed construction requirements and methodology becomes available and prior to the contractor starting works, a vibration assessment for the CNVMP will be completed by the contractor. This will include the location of vibration intensive plant as well as the offset distance to structures.

6.5.2 Blasting assessment

Blasting may be required to remove rock outcrops. Blast holes will be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. Impacts associated with blasting normally relate to air-blast overpressure and ground vibration.

Potential vibration and air-blast overpressure impacts generated through blasting will be managed primarily through a site and blast-specific assessment in conjunction with preliminary small scale testing conducted at each proposed blast site prior to the commencement of full scale blasting. Further assessment of potential blasting impacts is discussed in this Blast Management Procedure contained in Appendix B of this CNVMP.

7 Environmental control measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the EIS, Submissions/Preferred Infrastructure Report, Conditions of Approval and RMS documents. Specific measures and requirements to address impacts from noise and vibration are outlined in Table 7-1, these measures and requirements will be adopted and implemented by Pacific Complete and/or the Project Contractor as applicable.

Table 7-1 Noise and vibration management and mitigation measures

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
CONSTRUCTION NOISE				
NV15	The contractor will provide training to all project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolbox talks and targeted awareness training.	Contractor	Pre-construction	Good practice
NV16	Work compounds, parking areas, equipment and material stockpile sites will be positioned away from noise-sensitive receiver.	Contractor	Pre-construction	Good practice
NV17	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.	Contractor	Pre-construction	Good practice
NV1	Where 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.	Contractor	Construction	MCoA B25
NV2	Haulage routes will be located as far away as possible from residential receivers, where this is reasonable and feasible.	Contractor	Construction	Submissions/ PIR (CNV3)
NV3	Equipment will be maintained in efficient working order.	Contractor	Construction	Submissions/ PIR (CNV4)
NV4	Quieter construction methods will be used, where there are sensitive receivers potentially affected and where this is considered reasonable and feasible. These may include grinding, rock splitting or terrain levelling instead of hydraulic rock breaking.	Contractor	Construction	Submissions/ PIR (CNV5)

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
NV5	Where acceptable from a work health and safety perspective, quieter alternatives to reversing alarms (such as spotters, closed circuit television monitors and 'smart' reversing alarms) will be used, particularly during night-time activities.	Contractor	Construction	Submissions/ PIR (CNV6)
NV6	Machinery will not be turned on prior to the work hours outlined in this EIS. This will include daily maintenance activities and/or 'warming up' of engines.	Contractor	Construction	Submissions/ PIR (CNV8)
NV7	Truck movements will be restricted to identified haulage routes and the routes outlined in the Construction Traffic Management Plan.	Contractor	Construction	Submissions/ PIR (CNV9)
NV8	The use of temporary noise shielding will be considered at locations where substantial exceedances of noise criteria are predicted.	Contractor	Construction	Submissions/ PIR (CNV11)
NV9	Static noise sources, such as generators, pumps and lighting towers, will be located as far as possible from sensitive receivers.	Contractor	Construction	Submissions/ PIR (CNV12)
NV10	Regular noise monitoring will be undertaken during proposed construction hours at a representative receiver location, between: • 6am to 7pm, Monday to Friday • 8am to 5pm, Saturday.	Contractor	Construction	Submissions/ PIR (CNV13)
NV11	Noise and vibration monitoring will be undertaken in accordance with Section 8.3.1. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where significant exceedances of relevant noise and vibration goals are detected.	Contractor	Construction	Good practice
NV12	Initial noise monitoring of plant and equipment will be undertaken to ensure the noise performance levels predicted in this NVMP are being met.	Contractor	Construction	Good practice
NV13	The selection of plant and equipment will be based on noise emission levels. This equipment will be operated and maintained so that noise emissions are minimised.	Contractor	Construction	Submissions/ PIR (CNV13)
NV14	Crushing operations will only be undertaken: (a) between the hours of 8.00am to 5.00pm Monday to Friday; (b) between the hours of 8.00am to 1.00pm Saturday; and in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.	Contractor	Construction	Good practice

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
NV18	Loading and unloading will be carried out as far as practical away from sensitive receivers.	Contractor	Construction	Good practice
NV19	Truck movements will be kept to a minimum, ie trucks will be sufficiently utilised for each trip.	Contractor	Construction	Good practice
NV20	Trucks will not queue outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers outside of standard construction hours unless required by road safety considerations.	Contractor	Construction	Good practice
NV21	Noisy plant working simultaneously close together will be avoided to the greatest extent practical adjacent to noise affected sensitive receivers.	Contractor	Construction	Good practice
NV22	Whenever practical, at the end of shifts, excavation and/or ripping plant will be taken from their work areas and left overnight away from the immediate vicinity of sensitive receivers. Warming up of the plant will then be conducted away from such receivers.	Contractor	Construction	Good practice
NV23	Truck drivers will limit compression braking as far as practicable.	Contractor	Construction	Good practice
NV24	Where possible, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce the transmission of noise between work sites and receiver locations.	Contractor	Construction	Good practice
NV25	Unless required for technical reasons, the contractor shall undertake high noise generating work (such as use of concrete saws or hydraulic hammers) during the day, or early in the evening if required to be undertaken at night ; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents.	Contractor	Construction	Good practice
CONSTRUCTION VIBRATION				
NV26	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any structure or service, a building condition survey will be conducted and preliminary vibration monitoring undertaken by a qualified contractor.	Contractor	Pre-construction	Submissions/ PIR (CNV15)
NV27	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any heritage structure or potentially structurally unsound service, a building condition survey will be conducted and preliminary vibration monitoring undertaken by a qualified contractor. A follow-up survey will be conducted in response to any vibration complaints.	Contractor	Pre-construction	Submissions/ PIR (CNV16)

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
NV28	Prior to the use of the dynamic compaction construction method, the contractor will undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.	Contractor	Pre-construction	MCoA B26
NV29	Appropriately sized equipment will be selected to minimise vibration emissions, where required	Contractor	Construction	Submissions/ PIR (CNV17)
NV30	Building Condition Inspections for each public utility, structure and building will be carried out where: (i) Blasting operations are within 500 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2 mm/s, whichever is the greater. (ii) Pile driving activities are within 250 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2 mm/s, whichever is the greater. Other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2 mm/s.	Contractor	Construction	Good practice
NV31	The Building Condition Inspection report will include as a minimum: (i) Floor plan of the subject building. (ii) Record site details - age, construction, site slope and provision for drainage, presence of trees. (iii) Type of defects and their positions and extents on the floor plan. (iv) Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks. (v) How doors sit in the jambs – out of line may indicate foundation settlement. External signs of reactive clay foundation soil, eg lifting of slabs, uneven kerbing.	Contractor	Construction	Good practice

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
WORKING HOURS, COMMUNITY CONSULTANTION AND ENGAGMENT				
NV38	Affected receivers will be notified prior to the commencement of out of hours work. Notification includes contact details of project personnel in charge of the out of hours works.	Communications Manage	Pre-construction	Submissions/ PIR (CNV1)
NV42	Identified receivers will be notified by letter of the proposed hours and asked for comment and feedback. This will include justification for the proposed extended working hours along with the benefits the community can expect. Where the community or individual residents wish to receiver further clarification on the proposed hours, individual interviews or public meetings will be organised to address any further issues. Discussions will be sufficiently detailed to provide a general summary of the expected impacts but also how this relates to individual receivers. At this stage, more detail will be available regarding the proposed construction activities to be undertaken in the extended hours. Property owners will be provided with the complaints management procedures to be in place for extended working hours. Feedback will be collected to help determine the final adopted working hours for the project, with community consultation continuing throughout the project.	Communications Manager	Pre-construction	Submissions/ PIR (CNV31)
NV32	Construction works associated with the Project, other than blasting, will only be undertaken during the following standard construction hours: • 7.00am to 6.00pm Mondays to Fridays, inclusive; and • 8.00am to 5.00pm Saturdays; and • at no time on Sundays or public holidays. Unless otherwise assessed and approved, or justified in the CEMP or this Plan.	Contractor	Construction	MCoA B15
NV33	Works outside of the construction hours identified in CoA B15 will only be undertaken in the following circumstances: a) works that generate noise that is: (i) 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 (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and	Contractor	Construction	MCoA B16

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
	Climate Change, 2009) at other sensitive receivers; or b) for delivery of materials required outside these hours by the Police or other authorities for safety reasons; or c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or e) low noise impact activities and work as follows: (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; f) works approved through an EPL or works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI.			
NV34	Any proposal to undertake works outside of the standard working hours identified in CoA B15 will be subject to CoA B17 and the processes and assessment requirement contained in the out of hours works procedure (see Appendix C).	Contractor	Construction	MCoA B17
NV35	Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken: (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm Saturday; and (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. *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.* *The works subject to this condition may be undertaken in sparsely populated areas*	Contractor	Construction	MCoA B18

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
	within the construction hours specified in condition CoA B15.			
NV36	The contractor shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods, except in sparsely populated areas.	Contractor	Construction	MCoA B19
NV37	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.	Contractor	Construction	MCoA B27
NV39	Construction will be timetabled to minimise noise impacts where feasible and reasonable. This may include time and duration restrictions and respite periods. These measures will be considered after consultation with affected receivers	Contractor	Construction	Submissions/ PIR (CNV2)
NV40	All noise complaints received will be dealt with promptly. Construction methods may need to be altered to reduce noise impacts at the affected locations.	Environmental Officer, Noise Specialist	Construction	Submissions/ PIR (CNV7)
NV41	Where it has been identified as necessary (eg in response to community complaints), noise monitoring will be undertaken to check that the noise mitigation measures are effective	Contractor	Construction	Submissions/ PIR (CNV10)
BLASTING INCUDLING BLAST RELATED COMMUNITY CONSULTATION				
NV43	A blast management plan will be prepared prior to the start of blasting activities.	Blast Contractor/ Contractor	Pre-construction	Submissions/ PIR (CNV18)
NV44	Where sensitive receivers are located close to the blast site, a series of trials will be undertaken at a reduced scale to determine site-specific blast response characteristics, to define allowable blast sizes to occur within the criteria.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV19)
NV45	Controlled blasting activities will only be undertaken between the hours of: a) 9.00am to 5.00pm, Monday to Friday b) 9.00am to 1.00pm, Saturday; and c) at no time on Sunday or public holidays Blasting outside the above hours and in accordance with the standard construction hours where:	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV20) MCoA B21

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
	• no sensitive receivers would be impacted by blasting, or • an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. *This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.*			
NV46	A minimum of 24 hours' notice will be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV21)
NV47	Monitoring of overpressure and vibration levels will be undertaken for each blast at the potentially most affected receivers.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV22)
NV48	A building condition survey will be undertaken for all buildings located within 200 metres of the proposed blasting area prior to the start of blasting. The proponent will be responsible for rectifying any damage occurring from the blasting, with the cost to be borne by the proponent.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV23)
NV49	Should blasting be required within 200 metres of the water reservoirs at the Lang Hill borrow source, a dilapidation or preconstruction condition survey will be undertaken before blasting work commences in consultation with Richmond Valley Council and Rous Water.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV24)
NV50	The maximum instantaneous charge (MIC) will be reduced to the lowest possible level by the use of delays, reduced diameter holes, and/or deck loading.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV25)
NV51	Adequate stemming will be provided and exposed detonating cord be eliminated (by covering with at least 300 millimetres of quarry dust or road base).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV26)
NV52	Secondary blasting will be eliminated. (A rock breaker or drop hammer will be used instead of popping). Effort will be made to eliminate the need for toe shots (eg by better control of drill patterns).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV27)
NV53	Weather conditions at the time of the blast will be assessed. Blasting will be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion will be avoided where possible or, (if not possible) blasting will occur between 11.00am and 1.00pm.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV28)

	Measure/Requirement	Responsibility	Timing/ frequency	Reference
NV54	Strict control will be exercised over the spacing and orientation of all blast drill holes. Holes will be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV29)
NV55	Controlled blasting times will be determined in consideration of site-specific conditions and in consultation with affected residents and take place, where possible, when impacts are likely to be the least intrusive (eg all blasts be fired at a set time acceptable to residents and preferably when the background noise is highest).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV30)

8 Compliance management

Pacific Complete will manage the environmental performance and compliance of the work by undertaking independent inspections and audits, and reviewing reports submitted by the Project Contractors. Pacific Complete will report to the Department of Planning and relevant government bodies as required, to provide evidence of the works compliance with legislative requirements, conditions of approval and standards and guidelines.

8.1 Roles and responsibilities

The organisational structure and overall roles and responsibilities for Pacific Complete and Project Contractors are outlined in Section 4.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 8 of this CNVMP.

8.2 Training

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

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Normal construction hours.
- The process for seeking approval for out of hours works, including consultation.
- Location of noise sensitive areas.
- Complaints reporting.
- General noise and vibration management measures.
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.
- Minimisation of noise impacts at ancillary sites during Out of Hours Work, particularly at the beginning, end and during meal breaks (eg arrival and exit of vehicles and personnel).

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

8.3 Inspections and monitoring

Weekly and other routine inspections by Pacific Complete environmental staff, the Environment Manager, and the Environmental Representative will occur throughout construction. Details on the nature and frequency of these inspections are documented in Section 8 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the project. Monitoring will be undertaken by a suitably qualified Acoustic Consultant or other trained environmental staff during the construction phase of the project.

8.3.1 Noise monitoring

The following noise monitoring will be undertaken by the contractor:

- Periodic noise monitoring at nominated sensitive receiver locations to determine the effectiveness of mitigation measures.
- Where complaints are received, additional noise monitoring will be undertaken at sensitive receivers to determine if the actual construction noise levels are appropriate.
- Noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise.
- 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 exceed the anticipated worst-case levels, the source of excessive noise will be identified, and additional feasible and reasonable measures will be implemented by the contractor 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 Australian Standard AS IEC 61672.1—2004 – *Electroacoustics—Sound level meters, Part 1: Specifications* and carry current NATA (or manufacturer) calibration certificates.

8.3.2 Vibration monitoring

The following vibration monitoring will be undertaken by the contractor:

- For the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work within 50 metres of buildings to ensure that safe vibration levels specified in Section 6.5 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out within the established buffer zones, or where there is considered to be a risk that levels may exceed the relevant structural damage goals.
- During blasting operations, both to determine compliance and in response to complaints.
- Vibration monitoring will 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.

Table 8-1 Vibration monitoring requirements

Item	Requirement
1	The measurements will include peak particle velocity (PPV) and x, y, z component velocities.
2	The measurements will include frequency response spectrum.
3	Vibration monitoring shall be undertaken by personnel suitably qualified and experienced in undertaking vibration measurements.

Item	Requirement
4	Vibration monitoring at structures will be conducted at the nearest location to the works that is adjacent to the foundations of the relevant sensitive structure. If monitoring is not able to be undertaken adjacent to the structure, a suitable position at a representative location from the works will be selected.
5	Vibration monitors will include tri-axial vibration sensors measuring over a frequency range from 1 to 500 Hz, in accordance with DIN 4150. The sensors will be mounted in general accordance with Australian Standard ***AS 2775-2004 Mechanical vibration and shock*** – Mechanical mounting of accelerometers.
6	Vibration monitoring results will be compared to both the human exposure, structural damage criteria outlined in DIN 4150 and the ANZECC blasting criteria. Where the criteria are found to be exceeded based on measurement results, construction activities shall be altered as necessary to achieve compliance with the criteria.

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 will be undertaken and an interim building condition survey prepared.

Vibration monitoring will be carried out with the aim of achieving the following construction vibration goals (CoA B20):

a) For human exposure, the acceptable vibration values set out in *Assessing Vibration: A Technical Guideline* (DEC, 2006).

b) For damage to other buildings and/or structures, the vibration limits set out in the British Standard *BS 7385-1:1990 – Evaluation and measurement of vibration in buildings* (and referenced in Australian Standard *AS2187.2 – 2006 Explosives – Storage and use – Use of explosives*). Guide for measurement of vibration and evaluation of their effects on buildings.

c) For structural damage to heritage structures, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures*;

8.4 Non-conformances

If this NVMP has not been followed or implemented appropriately, as found during an inspection of the site, the contractor will raise a non-conformance. Non-conformances in general will be dealt with and documented in accordance with Section 8.7 of the CEMP.

8.5 Complaints

The contractor will record any complaints in accordance with the Communications and Stakeholder Engagement Strategy. 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 the required timeframe and action taken recorded in accordance with the Strategy.

8.6 Auditing

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

An audit schedule will be developed for the project by the PC Environment Manager and will include internal and third party external audits which will include this CHMP.

Audit requirements are detailed in Section 8.3 of the CEMP.

8.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.3 of the CEMP.

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

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

9 Review and improvement

9.1 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 action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

9.2 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.

Once approved under MCoA D21, the Ancillary Sites Management Plan will form Appendix B9 of the CEMP. Any revisions to the CNVMP or Ancillary Sites Management Plan will be in accordance with the process outlined in Section 1.6 of the CEMP

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

Appendix A
Plant and equipment sound power levels

Equipment	Maximum $L_{Aeq(15min)}$ SWL (dBA)	Maximum L_{Amax} SWL (dBA)
Air Blower (Leaf Blower)	100	108
Air Leg – SIG	110	118
Asphalt Milling Machine	111	119
Auger (hand)	103	111
Auger Drill Rig	111	116
Back Hoe (7.5 tonne JCB)	102	111
Ballast Regulator	118	126
Ballast Tamper	118	126
Bitumen Spray Truck	100	108
Bobcat	104	110
Bogies	97	107
Bolting Jumbo	124	132
Bump Truck	98	106
Car Parking	73	81
Chainsaw	108	116
Chipper	120	128
Circular Saw (Battery Operated)	104	112
Circular Saw	106	114
Compactor	108	110
Compressor	95	97
Compressor & Breaker (250 CFM)	95	97
Compressor for Air Scrubber	72	80
Concrete Pump	106	109
Concrete Saw (Soff-Cutt)	103	111
Concrete Saw	115	123
Concrete Scabbler	106	114
Concrete Truck/Agitator	106	112
Concrete Vibrator	102	105
Core Drill	98	102
CPT Truck	110	118
Crane (small)	98	108
Crane Truck	100	106
Daymakers (4 Aspects)	77	80
Diamond Saw	115	123
Diesel Bowser	98	106
Dingo (mini loader with auger attachment)	103	111
Dozer	110	118
Dozer (Hyundai)	89	118

Equipment	Maximum $L_{Aeq(15min)}$ SWL (dBA)	Maximum L_{Amax} SWL (dBA)
Dump Truck (approx. 5 tonne)	100	108
Dumper (5 tonne)	95	103
Elevated Working Platform	97	102
Erkat ER 2000 Twin Header	109	117
Excavator (Breaker – Small)	117	120
Excavator (.5 tonne)	84	92
Excavator (0 tonne)	94	100
Excavator (2 tonne)	94	100
Excavator (5 tonne)	96	102
Excavator (20 tonne)	99	105
Excavator (25 tonne)	102	108
Excavator (3 tonne)	84	90
Excavator (30 tonne)	104	110
Excavator (40 tonne)	109	115
Excavator (7.5 tonne)	92	98
Excavator (Breaker) with Acoustic Hoarding	116	124
Excavator (Breaker)	121	124
Excavator (Diamond Rock Saw)	106	109
Excavator (Ripper)	105	110
Excavator (Shears)	99	107
Flatbed Truck	100	106
Forklift	101	106
Franna Crane	99	107
Front End Loader (FEL) 962	112	119
Front End Loader (L20)	104	111
Generator	101	104
Generator (silent)	53	61
Generator (small)	95	103
Grader	108	113
Grinder 4"	98	102
Grout Mixer & Pump	97	105
Hammer Drill (Concrete Drill for Cross-Stiching)	100	108
Hammer Drill	108	116
Hand Drill	97	100
Hand Tools	94	100
Hand Tools (5mins)	94	100
Hand Tools (electric)	96	102
Hydraulic Jack	95	103

Equipment	Maximum $L_{Aeq(15min)}$ SWL (dBA)	Maximum L_{Amax} SWL (dBA)
Hydraulic Post Driver (Impact)	118	126
Hydrema (from Dump Truck)	100	108
Hydro-Demolition	120	128
Hydromulching Equipment	97	105
Impact Wrench (pneumatic)	99	107
Jack Pick (Hand Held, Hilti TE56)	92	100
Jackhammer	108	113
Jumbo Drill Rig	124	132
Kanga Hammer (electric jackhammer)	105	113
Line Marking Plant	98	106
Line Marking Removal Plant	109	117
Low Bed/Float	100	105
Low Loader	106	114
Material Transport Vehicle	103	111
Milling Head ER2000	109	117
Mobile Crane (00 tonne)	101	107
Mobile Crane (25 tonne)	99	105
Mobile Crane (300 tonne)	104	110
Mobile Crane (50 tonne)	100	106
Mobile Crane (all terrain) (20 tonne)	104	112
Mobile Jaw Crusher (50 tonne)	120	128
Multi Tyred Roller	103	111
Paving Machine	104	112
Petrol Drill	98	106
Petrol Spike Puller (hp)	100	108
Piling Rig (Bored)	108	118
Piling Rig (Bored) with Acoustic Hoarding	103	118
Piling Rig (Impact)	128	133
Piling Rig (Vibratory)	116	121
Plate compactor	108	114
Plate Striking	100	115
Rattle Gun (Hand held)	99	105
Road Header	113	121
Road Profiler	107	113
Road Sweeper	98	101
Rock Anchor Drill	108	116
Rockbreaker (Silenced SOONAN SB40)	116	119
Roller (non-vibratory)	100	108

Equipment	Maximum $L_{Aeq(15min)}$ SWL (dBA)	Maximum L_{Amax} SWL (dBA)
Saw Cutting Machine	106	114
Scissor Lift	92	102
Semi Trailer	106	112
Shotcrete Rig (based on concrete pump)	106	114
Skidsteer Loaders (approx/2 tonne)	97	107
Slip Form Machine	102	110
Smooth Drum Roller	109	117
Standard Penetration Test	110	120
Suction Truck	100	109
Super Sucker	100	109
Support Vehicle	98	106
Tamper (Cobra)	109	117
Tamping Head (For Excavator)	114	122
Telehandler	92	100
Tipper Truck	97	107
Tower Crane	100	108
Trench Roller	104	110
Truck (0 tonne)	98	103
Truck (2-5 tonne)	103	108
Truck (25t)	98	113
Truck (HIAB)	98	108
Tub Grinder	116	124
Ute	98	106
Vacuum (Industrial)	100	108
Vehicle (Light commercial eg 4WD)	101	109
Ventilation Scrubber	98	106
Vibratory Roller (0–2 tonne)	109	117
Vibratory Roller (Light)	105	113
Wacker Rammer	108	114
Water Gurney	110	113
Water Pump	97	105
Water Tanker (8000 litre)	98	103
Weed Eater	100	108
Welding Equipment	97	100
Stump Grinder	116	116
Soil Stabilizer	105	110

Appendix B
Blast management procedure

APPENDIX B

Blast Management Procedure

OCTOBER 2015

Document control

File name	AppB_Blast_Management_Procedure_Rev3.doc
Report name	W2B Blast Management Plan
Revision number	2

Revision history

Revision	Date	Description	Approval
0	22/715	Draft for comment	
1	7/8/15	RMS review	
2	21/9/15	Agency review	
3		Final for approval	

Distribution of controlled copies

Copy no.	Issued to	Version
1		
2		
3		
4		
5		

Contents

Tables

Glossary/Abbreviations

Item	Description
AS	Australian Standard
BS	British Standard
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise And Vibration Management Plan
MCoA	NSW Minister for Planning Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	Department of Environment and Climate Change (now EPA)
DIN	Deutsches Institute fur Normung
DP	Delivery Partner
EA	Environmental Assessment
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
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	Environmental Planning and Assessment Act 1979
ER	Environmental Representative
ERG	Environmental Review Group
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

Item	Description
$L_{Aeq\ (15min)}$	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.
$L_{A\ (max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NATA	National Association of Testing Authorities
OOHW	Out of hours work
PC	Pacific Complete
Project, the	Pacific Highway Upgrade – Woolgoolga to Halfway Creek, Section 3 to 11
RBL	The Rating Background Level for each period is the medium value of the RBL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
RMS	Root Mean Square
Roads and Maritime	Roads and Maritime Services
SWP	Sound Power Level
SPL	Sound Pressure Level
VDV	Vibration Dose Value
W2HC	Woolgoolga to Halfway Creek

1 Introduction

1.1 Context

This Blast Management Procedure (BMP) forms part of the Construction Noise and Vibration Management Sub Plan (CNVMP) which forms part of the Construction Environmental Management Plan (CEMP) for the planned construction of sections 3 to 11 of the Woolgoolga to Ballina Pacific Highway Upgrade. Sections 1 and 2 of the upgrade have been included in separate CEMPs and their subplans.

This BMP has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), the Environmental Management Measures, the mitigation and management measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS) and the Submissions/Preferred Infrastructure Report (SPIR), and all applicable legislation.

1.2 Scope

This document specifies the blast management procedure and includes methods for undertaking airblast and vibration monitoring during blasting activities and for maintaining flyrock, airblast and ground borne vibration impacts at a minimum.

2 Environmental requirements

2.1 Guidelines

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

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System).
- British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings.
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: Explosives – Storage, Transport and Use.

2.2 Minister's Conditions of Approval

The MCoA relevant to this BMP are listed in Table 2-1.

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Table 2-1 Minister's Conditions of Approval relevant to blasting

MCoA no.	Condition Requirements	Document Reference
B14	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECCW, 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 and Management Plan	Construction Noise and Vibration Management Plan
B20	The SSI shall be constructed with the aim of achieving the following construction vibration goals: (a) For structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: *Structural Vibration – Part 3 Effects of Vibration on Structures* (b) For damage to other buildings and/or structures, the vibration limits set out in the British Standards *BS7385-1:1990 - Evaluation and measurement of 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 (c) For human exposure, the acceptable vibration values set out in *Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).	Section 2.3
B21	Blasting associated with the SSI shall only be undertaken during the following hours: (a) 9.00am to 5.00pm, Monday to Friday, inclusive; (b) 9.00am to 1.00pm on Saturday; and (c) at no time on Sunday or public holidays. Blasting outside the above hours and in accordance with the standard construction hours where: (i) no sensitive receivers in sparsely populated areas would be impacted by blasting; or (ii) an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.	Chapter 3

<table>
<tr><th>MCoA no.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>B22</td><td>The Applicant shall ensure that Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.
Table 1 - Airblast overpressure limits for human comfort
<table>
<tr><th>Receiver</th><th>Type of blasting operations</th><th>Airblast Overpressure Limit</th></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>115 dBL for 95% of blasts per year</td></tr>
<tr><td>120 dBL maximum limit</td></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>120 dBL for 95% of blasts per year</td></tr>
<tr><td>125 dBL maximum limit</td></tr>
<tr><td>Occupied non-sensitive sites, such as factories and commercial premises</td><td>All blasting</td><td>125 dBL maximum limit.
For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer’s specifications or levels that can be shown to adversely affect the equipment operation</td></tr>
</table>
Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.
Source – Table J5.4(A) – AS 2187.2 – 2006</td><td>Section 5.5.1</td></tr>
<tr><td>B23</td><td>The Applicant shall ensure that Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.
Table 2 – Ground vibration limits for human comfort
<table>
<tr><th>Receiver</th><th>Type of blasting operations</th><th>Peak component particle velocity (mm/s)</th></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>5 mm/s for 95% of blasts per year</td></tr>
<tr><td>10 mm/s maximum limit</td></tr>
<tr><td>Sensitive site</td><td>Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>10 mm/s maximum limit</td></tr>
</table></td><td>Section 5.5.2</td></tr>
</table>

MCoA no.	Condition Requirements			Document Reference
	Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation	

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 3 – Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction [1]		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings [2]	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building [2]	All blasting	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
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, power lines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

MCoA no.	Condition Requirements	Document Reference
	Source: *1 - Table J4.5(B) – AS 2187.2 – 2006.* *2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).1*	
B24	The blasting criteria identified in conditions B22 and/or B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria. In obtaining the agreement the Applicant shall make available to the landowner: (a) Details of the proposed blasting programme and justification for the proposed increase to blasting criteria including alternatives considered (where relevant); (b) The environmental impacts of the increased blast limits on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; (c) The blast management and mitigation measures, and the procedures to be implemented to monitor blasting impacts. The Applicant shall provide a copy of the written agreement to the Secretary and the EPA, including details on the consultation undertaken (with clear identification of proposed blast limits and potential property impacts) prior to commencing blasting at the increased limits. Unless otherwise agreed by the Secretary, the following exclusions apply to the application of this condition: (a) Any agreements reached may be terminated by the landowner at any time should concerns about the increased blasting limits be unresolved. Should an agreement be terminated by a landowner, the Applicant shall not exceed the criteria specified in Conditions B22 and/or B23 for future blasting at that receiver. (b) The blasting limit agreed to under any agreement for an occupied residential building can at no time exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL.	Chapter 5
D26 (a)	As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement: (a) 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 *Interim Construction Noise Guidelines* (DECC, 2009) and shall include, but not necessarily be limited to: (i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval; (ii) details of construction activities and an indicative schedule for construction works; including the identification of key	Construction Noise and Vibration Plan This Plan

MCoA no.	Condition Requirements	Document Reference
	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; (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); (iv) procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and (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; (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 B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners; (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; (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 exceedences of relevant noise and vibration goals are detected; and (ix) mechanisms for the monitoring, review and amendment of this plan.	

2.3 Environment protection licence

An Environment Protection Licence (EPL) will be issued for the project with conditions relating to blasting including blasting hours. It is anticipated that compliance will generally be consistent with the EPL issued for Sections 1 and 2 of the project. The EPL conditions will be incorporated into contractors documentation.

2.4 Heritage structure ground vibration guidelines

No known heritage buildings are located within the vicinity of the proposed blasting locations. If any are subsequently identified, the following ground vibration guidelines will apply.

The ANZECC guidelines do not contain criteria relevant to these property types and, as such, the adoption of relevant ground vibration criteria would be considered appropriate. German Standard DIN 4150-3 *Structural Vibration Part 3: Effects of Vibration on Structures* contains vibration guidelines for buildings of 'great intrinsic value (eg listed buildings under a preservation order)'. The vibration criteria in Table 2-2 should be applied at these locations.

Table 2-2 DIN 4150: Structural damage limits for building vibration

Group	Group – Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plan of Floor of Uppermost Storey
		Less than 10Hz	10–50 Hz	50–100 Hz	All Frequencies
1.	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20–40	40–50	40
2.	Dwellings and buildings of similar design and/or use.	5	5–15	15–20	15
3.	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order).	3	3–8	8–10	8

Note: For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

2.5 Roads and Maritime G36 Annexure E

G36 Annexure E requirements for building condition surveys to be undertaken where structures are located at various distances to certain types of vibration works are shown in Table 2-3.

Table 2-3 G35 Annexure E requirements for building condition surveys and distances from vibration sources

Activity	Distance
Blasting Operations	*500 metres*
Pile Driving	*200 metres*
Excavation by hammering or ripping	*200 metres*
Vibrating Compaction > 7 tonne plant	*200 metres*
Vibrating Compaction < 7 tonne plant	*200 metres*
Demolition of Structures	*200 metres*

3 Details of blasting

3.1 Blasting times

Blasting operations will be confined to the following times:

- 9.00am to 5.00pm, Mondays to Fridays, inclusive;
- 9.00am to 1.00pm on Saturdays; and
- at no time on Sundays or public holidays.

Blasting outside the above hours and in accordance with the standard construction hours is permitted where:

- No sensitive receivers in sparsely populated areas would be impacted by blasting; or
- An agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours.

This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.

3.2 Justification for blasting

Several 'cut' areas have been identified where the removal of soil and rock material may be required. Soil at these sites will be excavated using dozers, scrapers or excavators, whilst soft rock material will generally be removed using ripping and/or hammering techniques.

Geotechnical surveys may however identify the presence of hard rock in the lower levels of some cut locations. Where this rock is identified as being too hard to be removed using typical extraction techniques, blasting may be required. However, blasting will only be undertaken where no other reasonable or feasible extraction methods are able to be employed.

3.3 Blasting overview

All blasts will be planned foremost with consideration of the protection of people and property in the vicinity of the proposed blast, including trial blasts. This will be achieved through the preparation of a site specific and detailed blast management plan prior to each blast which will be prepared by the blast contractor and will address potential risks and control measures. This plan will be prepared in accordance with Section 4 of AS 2187.2-2006 *Australian Standard Explosives – Storage and Use, Part 2: Use of Explosives*.

3.3.1 Flyrock risk

Flyrock is often a result of under-burden, over-charging or insufficient blasthole stemming, and is the projection of large rock pieces from the face of the blast or from the blasthole collar. Flyrock from a face is most likely to be projected perpendicular to the face and least likely to be projected parallel to the face. The clearance distance design for blasts is relative to the maximum throw of flyrock. Safety factors are introduced for plant and personnel as follows:

- The clearance distance for plant and equipment is double the maximum throw
- The clearance distance for personnel is four times the maximum throw

With further evaluation of site specific conditions, additional measures can also be considered to reduce clearance distances required.

3.3.2 Ground vibration

Vibration is generated at the moment of the blast and is transmitted through the ground. The effects of vibration can be divided into three main categories:

- Where occupants or users of the building are disturbed or inconvenienced
- Those in which the building contents may be affected
- Circumstances in which the integrity of the building or the structure itself may be prejudiced

Vibration is measured by monitoring the movement of the ground through the three orthogonal axis, and producing a figure to represent the vector sum of this movement. The vibration levels at which human discomfort is perceived are well below the levels at which building damage may be caused. The main on site influences on ground vibration during a blast are as follows:

- Maximum Instantaneous Charge (MIC)
- Detonator delay interval
- Direction of initiation
- Charge confinement
- Blast hole deviation
- Geological conditions
- Water saturation of ground

In general terms, ground vibration increases with increased charge mass and reduces with distance.

3.3.3 Airblast overpressure

Airblast or overpressure is an air pressure wave that is generated by explosive movement of rock and gases at the triggering of a blast and is transmitted through the air. During a blasting event, the major influences on airblast levels include:

- Detonator delay interval
- Blasthole burden
- Blasthole spacing
- The amount and type of stemming used
- Direction of initiation of the blast
- The charge depth
- Charge confinement
- Blasthole deviation
- Geological conditions
- Meteorological conditions

3.4 Proposed blast locations

The EIS identified locations where controlled rock blasting may be required, refer to Table 3.1. These locations are indicative only and are subject to change. When detailed information regarding the location and methodology becomes available and prior to the contractor starting works, a site specific blast assessment and management plan following the procedures documented within this BMP will be prepared.

Table 3-1 Indicative locations where controlled rock blasting may be required (subject to geotechnical advice)

Station	Location
Project section 1 – Woolgoolga to Halfway Creek	
2.3 to 2.5	Kangaroo Trail Road
7.6 to 8.3	Dirty Creek Range
9.1 to 9.3	Interchange at Range Road
9.7 to 9.9	Range Road East
11.3 to 11.4	South of Falconers Lane
Project section 2 – Halfway Creek to Glenugie upgrade	
26.8 to 27.2	South of Franklins Road, Glenugie
27.5 to 28.1	Franklins Road, Glenugie
28.4 to 28.8	Glenugie
Project section 3 – Glenugie upgrade to Tyndale	
48.1 to 48.6	South of Mitchell Road
51.6 to 52.3	South of Firth Heinz Road
53.8 to 54.6	South of twin bridges over unnamed creek
57.4 to 58.2	North of Champion Creek
59.4 to 60.0	South of Pine Brush State Forest
63.0 to 63.9	Pine Brush State Forest
64.7 to 65.3	North of Pine Brush State Forest
65.8 to 66.0	North of Pine Brush State Forest
66.5 to 67.0	South of Sheehys Lane (including Jacko's Quarry)
67.5 to 67.9	Interchange at Tyndale
68.1 to 68.8	Interchange at Tyndale
Project section 4 – Tyndale to Maclean	
69.1 to 69.4	Interchange at Tyndale
75.9 to 76.4	Green Hill
76.5 to 77.1	South of McIntyres Lane
81.3 to 81.6	Maclean Bypass
Project section 5 – Maclean to Iluka Road, Mororo	
82.4 to 83.1	Maclean Lookout

Station	Location
Project section 8 – Trustums Hill to Broadwater National Park	
128.1 to 128.8	Interchange at Woodburn
134.7 to 135.1	Lang Hill borrow site
Project section 9 – Broadwater National Park to Richmond River	
142.1 to 142.2	Broadwater Evans Head Road
144.8 to 144.9	South of Richmond River
Project section 10 – Richmond River to Coolgardie Road	
146.1 to 146.3	North of Richmond River
147.3 to 148.0	South of Old Bagotville Road
148.3 to 148.4	South of Old Bagotville Road
152.2 to 152.5	South of Wardell Road (Hillside Lane)

3.5 Blast assessment

Specific blasting and geotechnical details will need to be assessed on a site and blast design specific basis. It is important that the actual buffer zone distances, associated specifically with this project, be identified and appropriate measures taken to limit airblast and vibration to acceptable levels at critical locations. Blast charge weights and blast configurations must therefore be selected to ensure that objectives outlined in section 2 are not exceeded.

The distance limits relating to vibration and airblast are determined using formula as outlined in Australian Standard 2187.2-1993, applicable to free-face blasting in 'average field conditions', and Orica Explosives Blasting Guideline (2006) respectively which state:

Vibration Formula: $$V = 1140\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

and

Airblast Formula: $$A = 164.2 - 24\left(Log_{10}R - 0.33Log_{10}Q\right)$$

Where:

V = ground vibration as peak particle velocity in mm/s
R = distance between charge and point of measurement in metres
Q = effective charge mass per delay or maximum instantaneous charge in kilograms
A = peak airblast level in dBLinear

The distance limits per nominated MIC may vary significantly depending on the geological conditions, local shielding and meteorological factors at the site.

It is important that blasting be monitored at the initial stages and at critical locations to confirm predicted airblast and vibration levels and to in turn modify the blast design and buffer zones accordingly around the site.

4 Environmental control measures

4.1 Introduction

Blast performance should be regularly reviewed and possible improvements implemented to ensure a good relationship is maintained with persons who may be affected by the blast and the regulatory authorities. Appropriate action for the management of airblast and ground borne vibration impacts is summarised in **Table 4-1**Table 4-1.

Table 4-1 Blast management actions

Action	Responsibility	Timing/ frequency
Reduce the maximum instantaneous charge (MIC) to the lowest possible level by use of detonator delays, reduced blasthole diameter, and/or deck loading.	Blast manager	Ongoing
Ensure stemming is adequate and eliminate the use of detonating cord.	Blast manager	Ongoing
Eliminate secondary blasting. (Instead of popping, use rock breaker or drop hammer). Also make extra efforts to eliminate the need for toe shots, (eg better control of drill patterns).	Blast manager	As required
Assess weather conditions at the time of the blast. Avoid heavy cloud cover and avoid firing if a strong wind is blowing towards residences. In particular, avoid days of severe temperature inversion but if not possible blast between 11am and 1pm. Consider not loading a shot with explosives if the weather forecast is unfavourable.	Blast manager Environmental Construction Manager	As required
Exercise strict control over the spacing and orientation of all blastholes. Ensure that the blastholes are spaced in such a manner that the explosive force is just sufficient to break the rock to the required size.	Blast manager	Ongoing
Establish times of blasting to suit the situation, eg fire all blasts at a set time acceptable to neighbours and preferably when background noise is highest. It is preferable to fire at times when neighbours are out or active, rather than when they are seated for meals.	Blast manager Environmental Construction Manager	Pre-blast

A range of environmental requirements and control measures are identified in the various environmental documents, including the EA, Statement of Commitments, Conditions of Approval and Roads and Maritime documents. Specific measures and requirements to address impacts from noise and vibration are outlined in Table 4-2**Table 4-2**.

Table 4-2 Blast management and mitigation measures

	Measure/Requirement	Responsibility	Timing/frequency	Reference
NV43	A blast management plan will be prepared prior to the start of blasting activities.	Blast Contractor/ Contractor	Pre-construction	Submissions/ PIR (CNV18)
NV44	Where sensitive receivers are located close to the blast site, a series of trials will be undertaken at a reduced scale to determine site-specific blast response characteristics, to define allowable blast sizes to occur within the criteria.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV19)
NV45	Controlled blasting activities will only be undertaken between the hours of: a) 9am to 5pm, Monday to Friday b) 9am to 1pm, Saturday; and c) at no time on Sunday or public holidays. Blasting outside the above hours and in accordance with the standard construction hours where: • no sensitive receivers would be impacted by blasting, or • an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. *This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.*	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV20) MCoA B21
NV46	A minimum of 24 hours' notice will be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV21)
NV47	Monitoring of overpressure and vibration levels will be undertaken for each blast at the potentially most affected receivers.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV22)
NV48	A building condition survey will be undertaken for all buildings located within 200 metres of the proposed blasting area prior to the start of blasting. The proponent will be responsible for rectifying any damage occurring from the blasting, with the cost to be borne by the proponent.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV23)

	Measure/Requirement	Responsibility	Timing/frequency	Reference
NV49	Should blasting be required within 200 metres of the water reservoirs at the Lang Hill borrow source, a dilapidation or preconstruction condition survey will be undertaken before blasting work commences in consultation with Richmond Valley Council and Rous Water.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV24)
NV50	The maximum instantaneous charge (MIC) will be reduced to the lowest possible level by the use of delays, reduced diameter holes, and/or deck loading.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV25)
NV51	Adequate stemming will be provided and exposed detonating cord be eliminated (by covering with at least 300 millimetres of quarry dust or road base).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV26)
NV52	Secondary blasting will be eliminated. (A rock breaker or drop hammer will be used instead of popping). Effort will be made to eliminate the need for toe shots (eg by better control of drill patterns).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV27)
NV53	Weather conditions at the time of the blast will be assessed. Blasting will be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion will be avoided where possible or, (if not possible) blasting will occur between 11am and 1pm.	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV28)
NV54	Strict control will be exercised over the spacing and orientation of all blast drill holes. Holes will be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV29)
NV55	Controlled blasting times will be determined in consideration of site-specific conditions and in consultation with affected residents and take place, where possible, when impacts are likely to be the least intrusive (eg all blasts be fired at a set time acceptable to residents and preferably when the background noise is highest).	Blast Contractor/ Contractor	Construction	Submissions/ PIR (CNV30)
NV56	The building condition inspection survey report will include as a minimum: • Floor plan of the subject building. • Record site details – age, construction, site slope and provision for drainage, presence of trees. • Type of defects and their positions and extents on the floor plan • Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks. • How doors sit in the jambs - out of line may indicate foundation settlement. External signs of reactive clay foundation soil, eg lifting of slabs, uneven kerbing.	Blast Contractor/ Contractor	Construction	Good Practice

5 Compliance management

Pacific Complete will manage the environmental performance and compliance of the work by undertaking independent inspections and audits, and reviewing reports submitted by the Project Contractors. Pacific Complete will report to the Department of Planning and relevant government bodies as required, to provide evidence of the works compliance with legislative requirements, conditions of approval and standards and guidelines.

5.1 Blasting actions and response plan

Following receipt of blast monitoring (airblast and ground vibration) results, the Blasting Contractor will, within three business days, review that data against the trigger values identified in section 2. In the event that one or more trigger values are exceeded, the contractor will immediately review its operating procedures and adjust them to ensure the blasting levels comply with the trigger values identified in section 2.

5.2 Roles and responsibilities

The organisational structure and overall roles and responsibilities for Pacific Complete and Project Contractors are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 4 of this BMP.

The roles and responsibilities as outlined below are those that are specific to the BMP and are in addition to those statutory responsibilities that may be associated with the various roles.

Table 5-1 Noise and vibration management and mitigation

Role	Responsibilities
Drill and Blast Coordinator	To ensure correct notification is relayed to relevant person including blast location, predicted vibration, safe area for blast evacuation. To ensure pre-blast notifications have been conducted. To ensure that the traffic control protocol is in place. To ensure blast design is carried out to minimize risks to infrastructure and personnel. To review environmental conditions. To ensure all blast notification signs are updated prior to each shot.
Shot firer	To receive notification that the blast site is evacuated and secure. To receive notification that the site is prepared for the shot. To postpone the blast or give authorization (to be in the blast zone if shot is already fired but not cleared) if contacted for an emergency evacuation. To notify underground sentry that the shot has been cleared.
Undermanager	To receive information from the Blast Coordinator pertaining to the blasting activities To ensure all personnel in his/her district are aware of the time of a shot and are prepared to evacuate if necessary. To have personnel stationed near the phone during a blast. In the event of a planned evacuation to account for all personnel in their section and organise the evacuation.
Employees & Contractors	Work in accordance to the standards and requirements of the BMP and associated standards and procedures. Ensure that they are aware of the potential hazards associated with blast procedure.

Role	Responsibilities
Manager, Health Safety Environment & Community	Prepare appropriate training modules and ensure training is provided to employees and contractors who have a role under this BMP. Schedule refresher training. Maintain records of training provided under this BMP.

5.3 Training

Blasting Contractors will be informed of their responsibilities under this plan and provided with a copy of this document. All employees, contractors and utility staff associated with blast planning will undergo site induction training that includes construction blast management issues. The induction training will address elements related to airblast and vibration management including:

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Permitted blasting hours
- Location of noise sensitive areas
- Complaints reporting
- Monitoring requirements
- Blast management measures
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with blasting.

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

5.4 Notification

Residents and other sensitive receivers located within 500 m of a blast location will be notified at least 24 hours prior to each blast. Information provided will include:

- The location of the blast
- A schedule of blast times
- Details of an onsite contact person (name and telephone number) that can deal directly with any complaints or concerns.

Typically this contact will be by telephone or face to face, however where contact cannot be made, a letterbox drop will be done.

5.5 Specification for monitoring

For the purposes of checking compliance with the airblast and ground vibration conditions and for investigating complaints of airblast and vibration annoyance, monitoring must be undertaken. Monitoring will be undertaken by a suitably qualified representative. This representative may be the blast contractor, an Acoustic Consultant or an Environmental Officer experienced in undertaking blasting measurements.

Where access to a potential blast emissions affected property for monitoring purposes is not feasible, the measurement may be undertaken at the appropriate property boundary and the results extrapolated to reflect the impact at the receptor premises.

The proposed monitoring system for this project will include a portable near-field unit placed within close proximity to the blast area and up to three additional blast monitoring units located at critical assessment locations.

The blast monitoring locations are to include areas within the surrounding community recognised as potentially sensitive or susceptible to blast impacts mostly because of their close proximity to the blasting. The monitoring locations to be considered shall be representative of the worst-affected premises surrounding the blast sites.

5.5.1 Measurement of airblast

Blast monitoring equipment consists of a computer and display unit connected by cable to a geophone transducer which senses vibration, and to a microphone with low-frequency measurement characteristics which senses airblast. Vibration and airblast levels are monitored concurrently upon detection of a trigger, and the data is processed and stored in the computer memory. The operator may either retrieve the data at the conclusion of each monitoring period either in person or via a telephone modem if the logger is fitted with a mobile phone option.

Airblast from blasting shall be measured using noise measurement equipment with a lower limiting frequency of 2 Hz (- 3 dB response point of the measurement system) and a detector onset time of not greater than 100 µs as assessed in accordance with AS 1259.1 clauses 8.5 and 10.4.

Measurement of airblast will be taken at an appropriate location that is exposed to the direction of blasting and at least 4 m from any noise-affected building or structure or within the boundary of a noise sensitive place, at a position between 1.2 m and 1.5 m above the ground.

Blast monitoring instrumentation will be installed and maintained in accordance with relevant Australian Standards (eg AS 2187.2 - 1993) or as otherwise prescribed by the EPA. Monitoring units will be calibrated annually to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics).

In accordance with MCoA B22 airblast overpressure generated by blasting shall not exceed the criteria specified in Table 5.2 when measured at the most affected residence or other sensitive receiver.

Table 5-2 Airblast overpressure limits for human comfort

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J5.4(A) – AS 2187.2 – 2006

The blasting criteria identified in Table 5.2 may be increased where the written agreement of the relevant landowner has been given to increase the criteria in accordance with MCoA B24.

Construction contractors will be required to show compliance with the relevant requirements of the EPL issued for the project.

5.5.2 Measurement of ground vibration

For assessment of airblast the EPA/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure (towards the blast site).

Vibration instrumentation must be capable of measurement over the range 0.1 mm/s to 300 mm/s with accuracy within 5 per cent and have a frequency response flat to within 5 per cent over the frequency range of 4.5 Hz to 250 Hz.

The ground-borne vibration transducer (or array) must be attached to a mass of at least 30 kg to ensure good coupling with the ground where the blast site and the measurement site cannot be shown to be on the same underlying strata. The mass shall be buried so that its uppermost surface is at the same level as the ground surface.

In accordance with MCoA B23 ground vibration generated by blasting shall not exceed the criteria specified in Table 5.3 and Table 5.4 when measured at the most affected residence or other sensitive receiver.

Construction contractors will be required to show compliance with the relevant requirements of the EPL issued for the project.

Table 5-3 Airblast overpressure limits for human comfort

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 5-4 Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction [1]		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings [2]	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building [2]	All blasting	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
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, power lines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:

1 - Table J4.5(B) – AS 2187.2 – 2006.

2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).1

The blasting criteria identified in Table 5.3 and Table 5.4 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria in accordance with MCoA B24.

5.5.3 Recording

Blast monitoring records provide the data for determining any improvements in blast outcomes, including the management and control of ground vibration and airblast. As a minimum, blast monitoring records will include the following. A copy of these records will be included in the site blast records.

a) The size of the blast, ie number of blastholes and quantity of explosives in each blasthole (MIC)

b) The method of initiation and the timing sequence to be used in the blast

c) The date and time of the blast

d) The location of the measurement transducers (geophones, accelerometers, microphones)

e) Instrument trigger-levels

f) Measurement equipment and operator details

g) The location of the blast

h) The location of any structures and/or persons who may be affected by the blast

i) The measured ground vibration (PPV) and airblast values (dB(L) peak) including the peak particle velocity values for each of the triaxial components, a derived vector peak particle value

j) Weather conditions, especially temperature, wind speed and direction, cloud cover, relative humidity, and any other notable conditions such as rain

k) Any subjective information from the shotfirer and any persons who may be affected by the blast

l) Location, date and time of recording.

5.6 Non-conformances

Non-conformances in general will be dealt with and documented in accordance with Section 8.7 of the CEMP.

5.7 Complaints

Complaints (including damage complaints from vibration) will be recorded and dealt with in accordance with the *Communications and Stakeholder Engagement Strategy* and with relevant requirements in the EPL issued for the project. 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 Strategy.

5.8 Auditing

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

Audit requirements are detailed in Section 8.3 of the CEMP.

5.9 Reporting

Reporting requirements and responsibilities are documented in Section 8.3 of the CEMP.

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

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

6 Review and improvement

6.1 Continuous improvement

Continuous improvement of this BMP 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 preventive action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

6.2 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 BMP. This will occur as needed.

Only the PC Environment Manager, Environmental Representative or delegate, has the authority to change any of the environmental management documentation.

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

Appendix C

Out of hours works procedure

APPENDIX C

Out of Hours Works Procedure

NOVEMBER 2015

Contents

Tables

Figures

Glossary/Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA/dB(A)	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	Department of Environment and Climate Change (now EPA)
EA	Environmental Assessment
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
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	*Environmental Planning and Assessment Act 1979*
EM	Environmental Manager
ER	Environmental Representative
ERG	Environmental Review Group
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..
$L_{Aeq\ (15min)}$	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.
$L_{A\ (max)}$	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.

Low-noise impact activities and work	Deliveries, site access, equipment pre-start, refuelling, office works, foot-based and manual activities using hand tools, work in ancillary activities, finishing works and clean-up and activities that generate noise that is no more than 5 dB(A) above rating background level at any residence.
OEH	Office of Environment and Heritage
OOH	Out of hours
OOHW	Out of hours work
PC	Pacific Complete
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 therefore an RBL value for each period (day, evening and night)
Roads and Maritime	Roads and Maritime Services
SWP	Sound Power Level
SPL	Sound Pressure Level
Sparsely populated areas	Areas where sensitive receivers are located greater than 200 metres from the SSI boundary.

1 Introduction

1.1 Context

This Out of Hours Works (OOHW) Procedure forms part of the Construction Environmental Management Plan (CEMP) for the planned construction of sections 3 to 11 of the Woolgoolga to Ballina Pacific Highway Upgrade. It has been developed to provide a consistent approach to assess, approve and manage OOHW.

This OOHW procedure has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), mitigation and management measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS) and the Submissions/Preferred Infrastructure Report (SPIR), the EPL to be issued for the project and all applicable legislation. This procedure provides guidance for determining the noise levels and potential impacts on amenity for any activity proposed outside standard construction hours. This procedure also details the consultation requirements and approval process to be followed prior to undertaking those works.

1.2 Purpose

This OOHW procedure has been developed as part of the Project's Construction Noise and Vibration Management Plan (CNVMP) and should be read in conjunction with that document.

This OOHW procedure:

- Identifies the Ministers Conditions of Approval (MCoA), environmental mitigation measures applicable to OOHW for the Project.
- Details Project specific noise management levels.
- Provides information on the need and justification for carrying out work outside of standard construction hours.
- Identifies the risk assessment process used to categorise OOHW and mitigation measures to be considered for each category.
- Provides detail on the requirement to carry out a noise and vibration assessment.
- Provides guidance on the approval pathway for an OOHW application and community and agency consultation approach for OOHW.

This procedure does not apply to blasting as blasting is only permitted during working hours as specified in MCoA B21.

This document is supported by the following templates and fact sheets which will be developed at a later stage:

- Template OOHW application form
- Template OOHW assessment form
- Template OOHW notification letter
- Template OOHW consultation/agreement letter
- Roads and Maritime Fact Sheet – Out of Hours Works
- Roads and Maritime Fact Sheet – Paving.

2 Legislative context

The process for carrying out works outside of standard construction hours is outlined in the CoA. The following requirements are applicable to OOHW and have been addressed in this procedure.

2.1 Minister's Conditions of Approval

2.1.1 Standard construction hours

The majority of construction activities will take place within approved standard construction hours as defined in MCoA B15. Standard construction hours are:

- 7am to 6pm, Monday to Friday
- 8am to 5pm Saturday
- No work on Sunday or public holidays.

2.1.2 Out of hours works

The Project MCoAs provide for OOHW as listed in Table 2-1.

Table 2-1 Conditions of Approval relevant to noise and vibration

MCoA No.	Condition requirements	Document Reference
Construction Noise		
B16	Construction works outside of the standard construction hours identified in condition B15 may be undertaken in the following circumstances: (a) construction works that generate noise that is: (i) 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 (ii) no more than the noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) at other sensitive receivers*;* or (b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or (e) low noise impact activities and work as follows: (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; or (f) works approved through an EPL; or (g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI.	This Procedure

MCoA No.	Condition requirements	Document Reference
B17	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 construction hours specified in condition B15 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* (DECCW, 2009); (d) provides evidence that consultation with potentially affected receivers and notification of the relevant 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.	This Procedure

2.2 Relevant legislation and guidelines

This OOHW procedure has been developed with consideration of relevant legislation, guidelines, specifications and policy documents outlined in [Section 3.1 of the CNVMP].

Specifically, the Interim Construction Noise Guidelines (ICNG) (DECC, 2009) outlines five categories of works that may be undertaken outside the recommended standard hours. These are:

1. The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads.
2. Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.
3. Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours.
4. Public infrastructure works that shorten the length of the project and are supported by the affected community.
5. Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

2.3 Environment Protection Licence

An environmental protection licence (EPL) applies to the project. In accordance with Section 115ZH Clause (1)(e) of the *Environmental Planning and Assessment Act 1979*, any licence issued under the *Protection of the Environment Operations Act 1997* must be consistent with the planning approval. The EPL will detail requirements for the project construction, reporting, and monitoring, however it is required to align with the project conditions of approval. Where relevant, specific references to the EPL are included throughout this Procedure.

2.4 Adopted project noise management levels

Based on measured noise levels, the project-specific construction noise objectives for each representative monitoring location have been determined and are presented in Table 2-2. This includes noise management levels (NML) for work outside standard construction hours. For works proposed to extend over more than two consecutive nights, the NML for sleep disturbance should be calculated.

Noise sensitive receivers and noise catchment areas (NCAs) are detailed in Section 4.1 and Section 5.5 of the CNVMP. Refer to SiteMap for the location of noise sensitive receivers for the project.

Table 2-2 Project-specific construction noise management levels

NCA	Section	Noise Monitor ID	Noise Level (dBA)							
			Standard–Daytime (7am–6pm)		OOHWs–Evening (6pm–10pm)		OOHWs–Night-time (10pm–7am)		Sleep disturbance	
			RBL	NML	RBL	NML	RBL	NML	RBL	NML
NCA-A	3	12	39	49	39	44	34	39	34	49
NCA-B	3	18	32	42	32	37	29	34	29	44
NCA-C	3, 4	26	41	51	38	43	33	38	33	48
NCA-D	4, 5	29	43	53	44	49	39	44	39	54
NCA-E	5	36	45	55	44	49	39	44	39	54
NCA-F	5	40	37	47	39	44	35	40	35	50
NCA-G	6, 7, 8	45	42	52	42	47	34	39	34	49
NCA-H	8	54	44	54	43	48	35	40	35	50
NCA-I	8, 9, 10	58	45	55	43	48	36	41	36	51
NCA-J	10, 11	68	41	51	42	47	38	43	38	53
NCA-K	11	68	41	51	42	47	38	43	38	53

Project specific Noise Catchment Areas (NCAs) are identified in Section 5.5 of the CNVMP.

3 Justification for out of hours work

As detailed in section 2.2 above, the ICNG details five categories of works that may be undertaken outside recommended standard hours. Consistent with these categories, the Project will require that certain activities take place outside of standard construction hours during the evening and night-time periods. Out of hours work may be required due to technical considerations (such as the need to meet particular quality specifications – refer to section 3.1,3.2 and 3.3), to facilitate an accelerated construction program (refer to section 3.4), or to maintain the safety of road users or construction workers (refer to section 3.5).

3.1 Concrete paving

Quality specifications for concrete paving detail the weather conditions such as temperature and rainfall during the placement of the concrete. For jointed concrete base pavement, the specifications prohibit the placement of concrete during rain or when the ambient air temperatures are below five degrees or above 32 degrees. Higher temperatures can be restrictive to concrete paving in NSW. As hot weather affects the quality of the concrete pavement, paving in the early evening and into the night is preferred as it takes advantage of cool night-time temperatures.

Due to the climatic consideration experienced in the region during summer, where daytime temperatures often exceed the maximum temperature threshold of 32 degrees, concrete paving may need to occur during the evening and night-time periods.

3.2 Concrete saw cutting

To manage cracking associated with the drying and shrinkage of concrete pavement, saw cutters are used to cut the pavement. The timing of concrete cutting is governed by the hydration rate of the concrete and may require cutting within four and 24 hours after paving, with a cutting 'window' as short as 30 minutes. As the timing is critical to the quality of the pavement and acceptance of the finished product, concrete saw-cutting may be needed at any time including outside standard construction hours. Concrete saw cutting is a construction activity that is transient in nature, and each saw cut would be of a short duration.

Concrete saw cutting may need to occur in the evening and night-time periods.

3.3 Concrete batch plant

The Project includes operation of a concrete batch plant. In addition to normal daytime operation for concrete supply, the concrete batch plant will need to operate in conjunction with out of hours concrete pours. There may also be a need to cast bridges or other infrastructure in situ, which would require the plant to operate continuously for up to 24 hours.

To keep up with the materials demand during these peak periods of concrete production, the batch plant may require material deliveries outside normal working hours.

3.4 Other construction activities

Other construction activities that may require scheduled out of hours work include, but are not limited to:

- Large concrete bridge deck pours. To ensure the quality of concrete, in situ bridge deck pours may occur early in the morning during summer months.
- General concrete pours. Other concrete pour activities in addition to paving and bridge pours may be required along the project.
- Steel fixing (positioning and securing of steel reinforcing bars and steel mesh used in reinforced concrete). Steel fixing may occur early in the morning during summer months, before ambient temperatures 'heat up' the steel bars and mesh, to ensure the safety of construction workers.
- The lifting and setting of bridge spans or girders. To ensure the safety of the travelling public, work may occur outside of peak traffic periods.
- Demolition of existing bridges. To ensure the safety of the travelling public work may occur outside of peak traffic periods.
- Traffic management, traffic switches or road tie-in work to tie in the new road works to the existing highway. To reduce inconvenience to road users and to provide safety to construction workers work may occur outside of peak traffic periods.
- Earthworks. General earthworks are required for the Project, and in some scenarios can be undertaken out of hours where there is sufficient distance eg 300m to sensitive noise receivers.
- Sediment basin management. When rainfall has occurred sediment basins on the Project require maintenance to ensure they meet relevant Licence provisions and water quality parameters.
- Operation of ancillary facilities to support out of hours work.

Other construction activities may be required or proposed to be undertaken outside of standard working hours. These activities will be also be assessed in accordance with the process outlined in this OOWH Procedure.

3.5 Extended work hours

The contractor, where reasonable and feasible should conduct the majority of construction activities within the approved standard construction hours, as defined in MCoA B15 and reproduced below:

- 7.00am to 6.00pm Monday to Friday, inclusive
- 8.00am to 5.00pm Saturday
- At no time on Sunday or public holidays.

However, MCoA B16 and B17 allow for certain construction activities to occur outside the construction hours specified in MCoA B15 with prior approval. Requests for OOHW approval must be for technical or other justifiable reasons and will be considered on a case by case basis.

The EIS details circumstances where works may be required to be undertaken outside of the approved standard construction hours. Additionally, the ICNG outlines five situations where works may be undertaken outside the recommended standard hours. These are:

6. The delivery of oversized plant or structures that police or other authorities determine requires special arrangements to transport along public roads.
7. Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.

8. Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours.
9. Public infrastructure works that shorten the length of the project and are supported by the affected community.
10. Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Consistent with points three through five above, the Project will require that certain activities take place outside of standard construction hours during the evening and night-time periods.

Out of hours work may be required due to technical considerations (such as the need to meet particular concrete quality specifications), to facilitate an accelerated construction program (and minimise disruption to the community, local business, motorists, pedestrians and cyclists as work would be completed earlier), or to maintain the safety of road users or construction workers, particularly where safety considerations require lane closures to undertake the work.

4 Out of Hours Works approval process

This section outlines the process for OOHW identification, assessment, consultation and approval. The steps involved in the process are outlined in Figure 4-1 and detailed further below.

4.1 Step 1 – Identify need for OOHW

Contractors engaged by Pacific Complete will identify a need to undertake OOHW activities in accordance with their works program and schedule.

4.2 Step 2 – Prepare OOHW works application

4.2.1 Identify scope and justification for OOHW

The OOHW Application template provided in Appendix A to this procedure would be completed by the Contractor. This includes details on:

- the proposed scope of works
- location of works
- duration of works
- justification for OOHW
- predicted noise impacts
- location of sensitive receivers
- consultation required
- approval required.

4.2.2 Out of hours works noise assessment

A construction noise assessment will be undertaken to assess the noise impacts for activities proposed outside standard construction hours are. A range of plant and equipment will be required to undertake activities associated with OOHW. In accordance with the ICNG (DECC, 2009), items to consider during these assessments include:

- All noise sources related to the proposed construction works, including vehicles that operate on site
- Location and height of noise sources on site
- Type of noise, such as airborne or ground-borne noise
- Proposed movement alarms on plant and vehicles
- Alternative work methods (including noise mitigation measures) and justification of the selected work methods
- Equipment or plant noise levels – references should be provided for all noise source levels in the assessment
- All stages of the construction works
- All residences and other sensitive land uses potentially impacted
- Site features (including topography, buildings and surrounding land uses) that affect noise propagation
- Proposed construction hours and the percentage of time the equipment operates
- Other concurrent construction works in the vicinity that may contribute additional noise.

To determine the relevant construction noise impacts, the construction scenarios detailed in Table 6-1 of the CNVMP would be reviewed to determine potential impacts from the OOHW. Potential impacts on sensitive receivers would be determined through use of project noise modelling.

4.2.3 Out of hours work noise impact categories

A risk assessment process has been adopted to identify the risk of intrusive noise impacts at sensitive receivers where construction noise levels are predicted to exceed the Noise Management Level (NML). The noise impact category (A to E) is defined by calculated noise levels and broadly identifies the potential for intrusive noise impacts. The noise impact levels also guide the level of consultation and noise mitigation measures required to manage these impacts at sensitive receivers.

Considering the MCoA, the rating background level (RBL) and the highly noise affected criterion in the ICNG (DECC, 2009) of 75 dB(A), the noise impact categories in Table 4-1 have been adopted in this OOHW assessment process. Relevant NML criteria for the project are detailed in Section 5.6 of the CNVMP.

Table 4-1 Noise impact categories for out of hours work

OOHW Category	Noise level	Potential for intrusive noise impacts
A	No exceedence above the NML	Very low
B	1–5 dBA above NML	Low
C	6–15 dBA above NML	Medium
D	16–25 dBA above NML	High
E	> 25 dBA above NML	Very high

Depending on the applicable noise impact category, the relevant mitigation measures will be assessed and implemented where reasonable and feasible. Feasible work practices are practical to implement, while reasonable work practices take into account the balance of costs and benefits and community views (DECC, 2009).

4.2.4 Initial noise level calculation

As outlined in the ICNG (DECC, 2009), the initial noise level prediction, to determine the magnitude of expected noise levels and initial noise impact category, may be carried out through a non-computer modeled rough calculation. This would take into account the distance and any shielding between the source and the residences or other sensitive land uses.

If the calculated noise levels identify noise levels above the NML (ie Category B–E, refer to Table 4-1), more detailed calculations will be carried out and a construction noise impact assessment will be prepared.

4.2.5 Detailed noise level calculations

For OOHW that fall into Categories B–E, a construction noise impact statement will be prepared to assess the construction scenario for each OOHW activity. The construction noise impact statement will include:

- Details on the nature and scope of each activity, including details on times, vehicles, plant and equipment to be used to carry out the activity.
- Details on the justification for each activity (refer to Section 3 for justification of standard OOHW).

- Predicted noise levels and exceedances above NML for the relevant locations identified in Table 2-1. Noise levels should be modelled 'after mitigation'.
- Analysis to justify the use of selected construction methods, plant and equipment compared to alternatives (if applicable).
- Appropriate measures to minimise the noise and vibration impacts on noise sensitive receivers.
- An assessment of sleep disturbance where works are planned to occur over more than two consecutive nights.
- For Category E works, nominated representative noise monitoring locations.

This information will be used to determine the OOHW noise impact category of the activity for all locations predicted to experience noise levels above NMLs. This information will also be used to determine the consultation requirements and/or measures required to manage noise impacts (refer Section 4.3 and 4.2.6).

If vibration intensive plant is likely to be used during OOHW, the construction noise impact statement will also include predicted ground vibration levels at various distances from the plant. Vibration criteria relevant to the project are outlined in Section 5.4 of the CNVMP. Exceedences of the vibration criteria should be considered qualitatively when categorising risk of OOHW activities.

4.2.6 Identification of appropriate mitigation measures

There are a number of additional mitigation measures that could be applied to manage OOHW noise impacts from the project. These additional mitigations measures will be implemented where reasonable and feasible and will directly relate to the extent of noise impact of the proposed OOHW as categorised in Section 4.2. The higher the noise impact from the proposed activities, the greater the level of mitigation and consultation required for the proposed works. Additional mitigation measures to be applied are outlined in Table 4-2.

An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community. Should one of the mitigation measures detailed in Table 4-2 not be able to be provided then this would be detailed in the OOHW Application submitted for approval, including justification and additional measures to be implemented. It should be noted that there may be personal circumstances among the sensitive receivers where the below approach to specific additional mitigation measures is not best suited. The Pacific Complete Community & Stakeholder Relations Manager has the authority to amend the approach taking into account due consideration of the personal circumstances that may apply.

Table 4-2 Proposed mitigation measures

Mitigation measure	OOHW Category				
	Cat A	Cat B	Cat C	Cat D	Cat E
Scheduling of noise intensive or high noise impact works		X	X	X	X
Investigate alternative plant and equipment and/or construction techniques		X	X	X	X
General community consultation (letter box drops, information sessions etc.)	X	X	X	X	X
Notification to Council[3]		X	X	X	X
Provide community update including a six-month 'look ahead' for likely OOHW	X	X	X	X	X
Use of temporary hoarding			X	X	X
Respite periods				X	X
Addressed notifications				X	X
Representative noise monitoring[1]					X
Face to face consultation					X
Respite offer/act of good will					X
Reasonable temporary relocation offer[2]					X
Negotiated agreement[4]					X

Notes:
1. Representative noise monitoring is to be carried out during OOHW Category E activities (eg first night and in response to a complaint) for a representative sample of noise-affected locations (as identified in the construction noise impact statement) to confirm the efficacy of the predicted impacts.
2. An offer of temporary accommodation is considered reasonable where the activities fall within Category E for more than two consecutive nights; and where work would be carried out within the night-time period.
3. Notification to Council will be targeted to areas relevant to each Council
4. A negotiated agreement may be considered for those receivers whose amenity will be very highly affected. Negotiated agreements will be carried out in accordance with Section 8.3 of the *NSW Industrial Noise Policy* (EPA, 2000).

4.3 Step 3 – Consultation

Prior to OOHW being approved and commencing, consultation will occur in accordance with the Project Community Communications Strategy (CCS), to ensure the community and stakeholders are informed of proposed OOHW in a proactive and progressive manner. The CCS provides details of the approach to consultation throughout the project corridor including preferred consultation techniques for specific communities (Refer to Figure 3-2 of the CCS).

The consultation requirements, and order of consultation for each OOHW noise impact category are detailed in Table 4-3. These consultation steps are separate to each other and can only be combined and undertaken concurrently following approval by Pacific Complete. Pacific Complete has the authority to reject these requests it deems inappropriate.

Table 4-3 Consultation requirements

Step	Consultation	Category				
		Cat A	Cat B	Cat C	Cat D	Cat E
1	Consultation with Pacific Complete	X	X	X	X	X
2	Consultation with Roads and Maritme[1]				X	X
3	Community notification		X	X	X	X
4	Community consultation		X	X	X	X
5	Notification to Council[1]		X	X	X	X
6	Notification to Environmental Review Group				X	X
7	Consultation with Environment Protection Authority				X	X
8	Consultation with Project Environmental Representative		X	X	X	X

[1]Note: Road and Maritime will be consulted on Category D & E OOHW, or OOHW activities that are proposed to be longer than six months in duration.

Any comments received during consultation would be considered and the works modified where necessary, eg including provision of respite measures. Comments provided will be documented in the relevant section of the OOHW assessment form.

4.3.1 Consultation with Pacific Complete

Contractors engaged on the project will be required to consult with Pacific Complete for all OOHW activities. The Pacific Complete Environment Manager will review all OOHW applications to determine and endorse the appropriate OOHW consultation requirements and approval pathways as outlined in this procedure.

4.3.2 Roads and Maritime Services

Prior to OOHW that falls with Category D & E, or activities that are proposed to extend for greater than six months duration, Pacific Complete will consult with Roads and Maritime to discuss an OOHW proposal from a Contractor. Roads and Maritime will be consulted prior to the wider community or agencies and has the authority to reject OOHW applications that it deems inappropriate.

In addition Roads and Maritime will be issued with a monthly report as outlined in Section 4.3.5 below which details the process followed and outcomes for these OOHW activities.

4.3.3 Community notifications

The Project Community Communications Strategy (CCS) details the preferred methods and approaches to community consultation with the various communities along the project length. General consultation methods and requirements are outlined in Table 4-4.

Table 4-4 Community consultation measures

Measure	When to consider	What is required?
General community consultation (letter box drops, information sessions etc.)	Category A - E	Notification to noise affected sensitive receivers as identified in the construction noise impact statement.
Provide community update including a six-month 'look ahead' for likely OOHW	Category C - E	A bi-annual update to the community to provide an indicative six month 'look ahead' for all proposed OOHW. May be via letterbox drops, Project website etc.
Addressed notifications	Category D - E	Individual notifications to residents
Face to face consultation	Category E	Individual meetings with potentially affected residents
Respite offer/act of good will	Category E	Subject to consultation with affected residents
Reasonable temporary relocation offer	Category E	Subject to consultation, in accordance with project temporary accommodation procedure
Negotiated agreement	Category E	A negotiated agreement may be considered for those receivers whose amenity will be very highly affected. Negotiated agreements will be carried out in accordance with Section 8.3 of the *NSW Industrial Noise Policy* (EPA, 2000).

4.3.4 Local councils

Prior to OOHW that falls within Category B – E, the Project team will notify local council. Council notification will occur in accordance with the Project Community Communications Strategy. Consultation will be targeted to works that specifically impact on local roads under Council control or Council Assets.

4.3.5 Environment Protection Authority (EPA)

In accordance with relevant requirements for the EPL, a monthly report will be issued to EPA which will provide evidence to demonstrate that the proposed OOHW is justified, that the community has been adequately consulted and that the mitigation measures are feasible and reasonable. Documents to be provided to the EPA with the monthly report are outlined in in Table 4-5 below.

Table 4-5 Monthly report to be provided to EPA

Requirement	Documentation required
The proposed OOHW is justified and all feasible and reasonable mitigation measures have been identified.	• Construction noise impact statement. • Details of acoustic monitoring (where relevant)
That appropriate consultation with potentially affected sensitive receivers and appropriate notification has been undertaken. That issues raised have been addressed.	• Evidence of consultation with the community. • Evidence of notification to council. • Copy or summary of feedback from the community. • Summary of how issues raised during consultation have been addressed.

4.3.6 Project Environmental Representative (ER)

As part of the OOHW approval process for Category B to Category E works, the PC Environment Manager will provide the Environmental Representative with the OOHW assessment form for comment.

The OOHW assessment form (and accompanying documents) are to provide evidence to demonstrate that the proposed OOHW is justified, that the community has been adequately consulted and that the mitigation measures are feasible and reasonable. This information will be provided at same time as provision of information to the EPA.

The final OOHW application with supporting documents will be provided to the ER for approval in accordance with approval requirements detailed in Table 4-6. Application will include details of consultation and responses to any issues raised by community or stakeholders.

4.4 Step 4 – Out of hours works approval pathways

The procedure to obtain approval for OOHW outside of the standard construction hours is identified in Chapter 4. OOHW will be approved by either the Pacific Complete Environment Manager (OOHW Categories A–C), and the Environmental Representative (OOHW Categories D & E) as detailed in Section 4.3.

Table 4-6 Approval of out of hours work

Category	Approval body	Information required for out of hours work approval
A	Pacific Complete Environment Manager	• OOHW assessment form.
B–C	Pacific Complete Environment Manager	• Construction noise impact statement • Evidence of consultation with the community • Evidence of notification to council • Evidence of consultation • OOHW assessment form.
D–E	Environment Representative	• Construction noise impact statement • Evidence of consultation with the community • Evidence of notification to council • Evidence of consultation with EPA • OOHW assessment form.

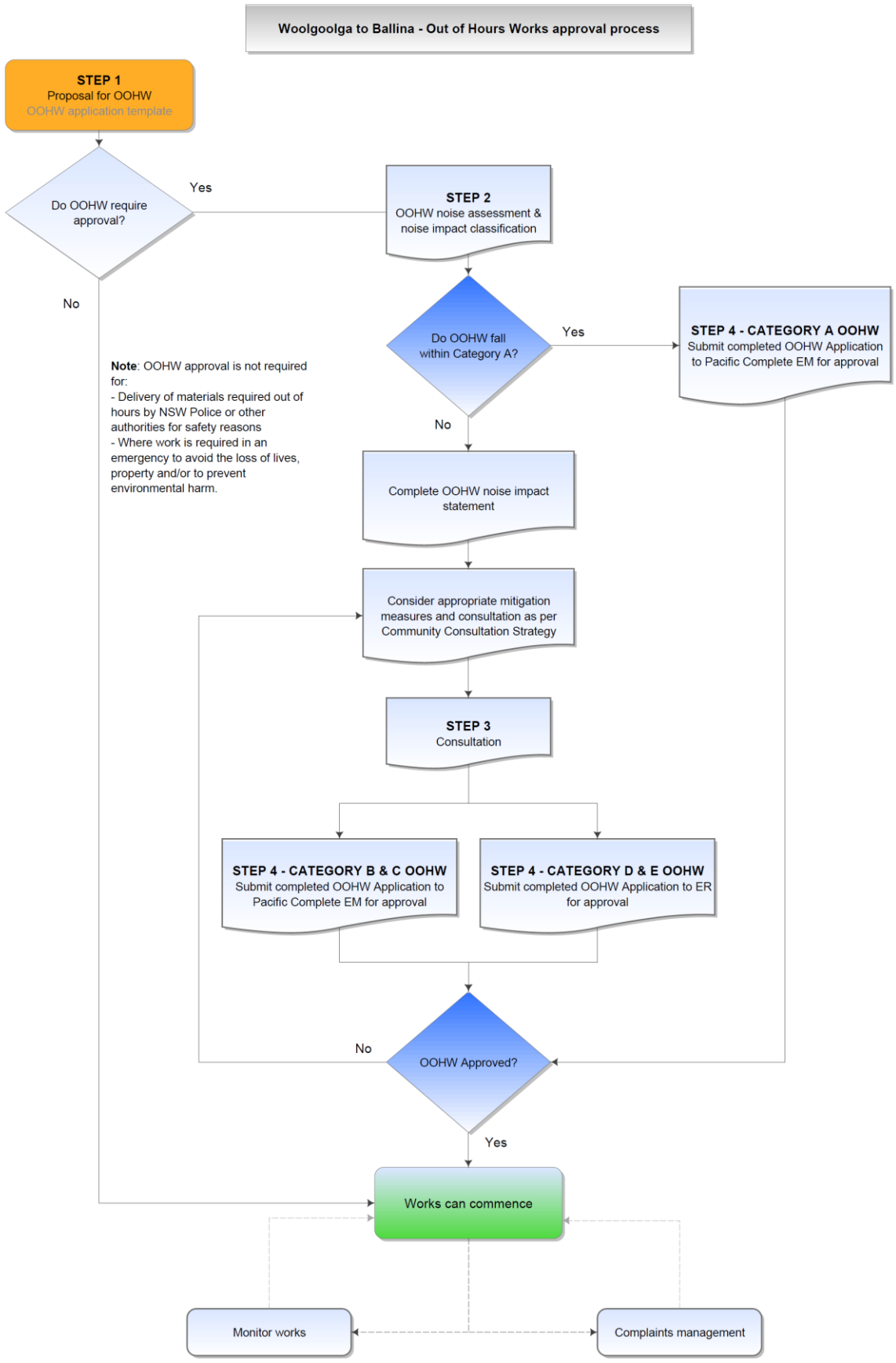

Figure 4-1 Out of hours work approval pathway

5 Monitoring and auditing

5.1 Monitoring out of hours works

All OOHW activities will be overseen by the Pacific Complete Construction Manager responsible for OOHW activities or delegate. Each Contractor will be required to comply with this OOHW procedure and may be required to undertake their own monitoring in accordance with this procedure, and report to Pacific Complete Environment Manager.

For Category D & E activities attended noise monitoring will be undertaken by an appropriate experienced person, for the first night of the OOHW activity. Attended noise monitoring will occur at a representative sample of noise-affected locations (as identified in the construction noise impact statement). If actual noise is higher than predicted noise, works would cease until:

- Appropriate noise mitigation measures are implemented to reduce the noise sufficiently, or
- Additional mitigation measures can be negotiated to the satisfaction of the affected receiver(s).

All OOHW monitoring will be carried out by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

5.2 Complaints management

If a complaint is made during OOHW, it will be investigated in accordance with the Community Consultation Strategy for the project. If it is identified (whether through observation or attended noise monitoring) that the noise level is excessive, works in the vicinity of the complaint would cease until:

- Appropriate noise mitigation measures are implemented to reduce the noise sufficiently, or
- Additional mitigation measures can be negotiated to the satisfaction of the affected receiver(s).

Section 6.3.2 of the CEMP outlines the complaints and enquiries procedure for the project. Information on all complaints received, including how they were addressed and whether resolution was reached and whether mediation was required or used, will be included in a complaints register and issued as part of the monthly report to EPA. Construction contractors would be required to address complaints and maintain the complaints register.

5.3 Managing non-conformance

Where a non-conformance is detected (either through monitoring or complaint) and is directly attributable to the project (ie are influenced by factors under the direct control of the project eg noise from construction equipment), the process to manage a non-conformity, including corrective, preventative actions and opportunities for improvement, are as described in Section 8.6 of the CEMP.

5.4 Reporting non-conformance

The Environmental Representative and Pacific Complete Project Director will be advised of any complaints from the community and action taken within 24 hours of the complaint.

The Pacific Complete Environment Manager will include details of complaints, noise monitoring exceedences or other non-conformance identified in their monthly report.

The Department of Planning and Environment (DP&E) will be notified of any non-conformance through compliance reporting required under the Compliance Tracking Program.

EPA will be notified as required by the EPL to be issued for the project.

Refer to Section 8 of the CEMP for further detail on the monitoring, auditing and reporting requirements for the project.

6 References

DECC (2009) *Interim Construction Noise Guideline*, Department of Environment and Climate Change, July 2009.

EPA (2000) *NSW Industrial Noise Policy*, Environment Protection Authority, January 2000.

Appendix D
Unattended noise monitoring results

Noise monitoring locations and project noise catchment areas in the EIS

(extract from Chapter 15 of the EIS) (Roads and Maritime 2012)

Project section	Logger identifier	Distance from highway (metres)		Location	Project noise catchment area
		Existing	Project		
1	1	175	125	47 Kangaroo Trail Road, Corindi Beach	1-c
1	2	30	520	3674 Pacific Highway, Corindi Beach	1-a
1	3	105	555	7 Dirty Creek Road, Dirty Creek	1-a
1	4	35	45	4470 Pacific Highway, Halfway Creek	1-c
1	5	240	240	4644 Pacific Highway, Halfway Creek	1-b
1	6	80	80	4925 Pacific Highway, Halfway Creek	1-d
2	7	250	265	5092 Pacific Highway, Halfway Creek	2-b
2	8	130	190	5559 Pacific Highway, Wells Crossing	2-d
3	9	160	215	6639 Pacific Highway, Glenugie	3-e
3	10	8215	360	247 Wants Lane, Glenugie	3-e
3	11	9450	245	961 Wooli Road, Pillar Valley	3-b
3*	12	155	8420	44 Edward Olgivie Drive, Clarenza	-
3	13	11670	135	106 Firth-Heinz Road, Pillar Valley	3-c
-*	14	45	11540	Candole Street, Tucabia	-
-*	15	40	11590	9 School Lane, Swan Creek	-
3	16	5610	90	625 Tucabia-Tyndale Road, Tucabia	3-d
-*	17	230	8270	1853 Pacific Highway	-
-*	18	65	4500	2319 Pacific Highway	-
4	19	630	370	130 Fitzgerald Lane, Tyndale	4-b
4	20	60	320	2991 Pacific Highway, Tyndale	4-e
4	21	65	495	3358 Pacific Highway, Tyndale	4-f
-*	22	65	670	425 Shark Creek Road, Shark Creek	-
-*	23	100	1020	3718 Pacific Highway, Shark Creek	-
-*	24	105	1015	86 O'maras Lane, Gulmarrad	-
4	25	895	250	125 Clyde Essex Drive, Gulmarrad	4-b
4	26	355	1020	4 Highlands, Gulmarrad	4-a
4	27	35	180	4064 Pacific Highway, Gulmarrad	4-d
4	28	260	330	40 Cameron Street, Maclean	4-e
4	29	60	75	9A Jubilee Street, Townsend	4-c

Note: for further details and graphical outputs refer to Appendix F of the Working Paper: Noise and Vibration assessment (November 2012) undertaken for the Woolgoolga to Ballina Upgrade EIS.

Project section	Logger identifier	Distance from highway (metres)		Location	Project noise catchment area
		Existing	Project		
4	30	465	485	13 Scullin Street, Townsend	4-a
5	31	360	330	35 James Creek Road, James Creek	5-b
5	32	320	355	8 Martins Point Road, Harwood	5-e
5	33	205	170	1 Petticoat Lane, Harwood	5-c
5	34	140	185	40 Morpeth Street, Harwood	5-d
5	35	45	60	4928 Pacific Highway, Harwood	5-c
5	36	25	10	5055 Pacific Highway, Chatsworth	5-d
5	37	300	325	50 Serpentine Channel Road, Harwood	5-d
5	38	600	600	389 Chatsworth Road, Chatsworth	5-f
5	39	550	555	395 Chatsworth Road, Chatsworth	5-f
5	40	110	105	53 Old Pacific Highway, Woombah	5-c
5	41	465	480	Pacific Highway, Mororo	5-a
6	42	50	65	6530 Pacific Highway, Jackybulbin	6-c
-	43	60	70	7175 Pacific Highway, Tabbimoble	-
7	44	170	210	8120 Pacific Highway, Tabbimoble	7-c
7	45	215	215	Pacific Highway, The Gap	7-c
7	46	375	340	65 Whites Road New Italy	7-e
7	47	55	70	8750 Pacific Highway, The Gap	7-c
8**	48	85	75	60 The Gap Road, Trustums Hill	8-b
8	49	385	385	60 The Gap Road, Trustums Hill	8-b
8	50	140	140	20 The Gap Road, Trustums Hill	8-c
8	51	65	145	32 Trustums Hill Road, Woodburn	8-d
8	52	125	355	82 Trustums Hill Road, Woodburn	8-e
8	53	25	1080	165 Woodburn Evans, Woodburn	8-e
8*	54	35	1450	63 River Street, Woodburn	-
-*	55	330	330	9810 Pacific Highway, Woodburn	-
-*	56	380	1370	9810 Pacific Highway, Broadwater	-
9	57	30	600	4 Pacific Highway, Broadwater	9-f
9	58	100	760	85 Broadwater – Evans Head Road, Broadwater	
9*	59	40	485	10770 Pacific Highway, Broadwater	9-d
9*	60	30	2170	10950 Pacific Highway, East Wardell	-
10*	61	45	3140	11184 Pacific Highway, East Wardell	-
10	62	3140	145	1202 Wardell Road, Wardell	10-f
10	63	3250	200	1175 Wardell Road, Wardell	10-e
-*	64	255	310	848 Pimlico Road, Wardell	-
10	65	1120	350	109 Meridian Drive, Coolgardie	10-e
11	66	65	35	3 McAndrews Lane, Pimlico	11-d
11	67	590	570	55 Whytes Lane, Pimlico	11-f
11	68	570	555	151 Uralba Road, Uralba	11-f

*Modelling calibration point for existing alignment

**Calibration point for project