McConnell Dowell Constructors - OHL Joint Venture

CLIENT: ROADS AND MARITIME SERVICES

PROJECT: PACIFIC HIGHWAY UPGRADE - KUNDABUNG TO KEMPSEY

LOCATION: NSW

PROJECT NO.: 2602

Quality Management System

APPENDIX B3 - CONSTRUCTION NOISE AND VIBRATION MANAGEMENT SUB-PLAN

QMS number **025–Y007–2602**

Revision History

Rev	Date	Details	Author	Approved
0	04/11/14	Issued for Construction	J. Hamilton	DoE
1	06/05/2015	Update noise monitoring requirements	J. Hamilton	ER

 Based on MMS Template MMS # 010-J010-000 Rev3 12Sep2013

HOME WITHOUT HARM
EVERYONE EVERYDAY

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GLOSSARY/ ABBREVIATIONS

Term/ Abbreviation	Definition
Airblast overpressure	The pressure cause by a shockwave over and above normal atmospheric pressure.
ANZECC	Australian and New Zealand Environment and Conservation Council
CEMP	Construction Environmental Management Plan
CCS	Community Communications Strategy
CoA	Condition of Approval
CNVMP	Construction Noise and Vibration Management Sub-Plan (this Plan)
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation. Now superseded by Office of Environment and Heritage (NSW)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now New South Wales Office of Environment and Heritage (OEH))
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.
ENMM	Environmental Noise Management Manual
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.
Hz	Hertz. The International System of Units (SI) unit of frequency. It is defined as the number of cycles per second of a wave.
JV	McConnell Dowell-OHL Joint Venture
ICNG	Interim Construction Noise Guideline – DECC NSW, 2009
$L_{Aeq\ (15min)}$	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.
Mm/s	Millimetres per second
m/s^2	Metres per second squared
NCA	Noise Catchment Area
OEH	NSW Office of Environment and Heritage
Peak Particle Velocity	The parameter used to measure ground vibration. Measured in mm/s or mms^{-1}.
POEO Act	Protection of the Environment Operations Act
RBL	The Rating Background Level for each period is the medium value of the assessment background level values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night).
RMS	Roads and Maritime Services
SoC	Statement of Commitments
SWL	Sound Power Level

SPL	Sound Pressure Level

1.0 INTRODUCTION

1.1 CONTEXT

This Construction Noise and Vibration Management Sub Plan (CNVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the upgrade of the Pacific Highway between Kundabung and Kempsey (hereafter referred to as 'K2K', the Project).

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

1.2 BACKGROUND

For the purposes of approvals the project was assessed as Oxley Highway to Kempsey. The McConnell Dowel OHL Joint Venture ('the JV') is delivering the 13.7km K2K section of the Oxley Highway to Kempsey Pacific Highway Upgrade, which this CNVMP covers. The Oxley Highway to Kundabung section is being delivered by others and is not included in this Plan.

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

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

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

1.3 ENVIRONMENTAL MANAGEMENT SYSTEMS OVERVIEW

The overall Environmental Management System for the Project is described in the Construction Environmental Management Plan (CEMP) (QMS#025-Y001-2602).

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

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

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

The review and document control processes for this Plan are described in Section 1.6 and Chapter 9 and 10 of the CEMP.

2.0 PURPOSE AND OBJECTIVES

2.1 PURPOSE

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

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

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

2.2 OBJECTIVES

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

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

2.3 TARGETS

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

- Full compliance with the relevant legislative requirements, CoA and SoC.
- Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the ICNG (DECC, 2009).
- That blasting activities are only undertaken at designated times and remain within established/agreed criteria.
- Complaints from the community and stakeholders are minimised.

3.0 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 Plan include:

- RMS QA Specification G36 – Environmental Protection (Management System).
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001).
- Interim Construction Noise Guideline (ICNG) (DECC 2009).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 – *"Evaluation and measurement of vibration in buildings"*.
- German 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 CoA relevant to this Plan are listed Table 3-1 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other Project management documents.

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

CoA No.	Condition Requirements	Document Reference
B31 c)	As part of the Construction Environment Management Plan for the project required under condition B30 of this approval, the Proponent shall prepare and implement the following:	
	A Construction Noise and Vibration Management Sub-plan to detail how construction noise and vibration impacts will be minimised and managed. The sub-plan shall be developed in consultation with the EPA and include, but not necessarily be limited to:	This plan
	i. identification of nearest sensitive receptors and relevant construction noise and vibration goals applicable to the project;	Chapter 4 Chapter 5
	ii. identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to impact on surrounding sensitive receivers including expected noise/ vibration levels;	Chapter 7 Appendix A
	iii. identification of feasible and reasonable measures proposed to be implemented to minimise construction noise and vibration impacts (including construction traffic noise impacts);	Chapter 8
	iv. procedure for dealing with out-of-hour works in accordance with condition C4, including procedures for notifying the Director General concerning complaints received in relation to the extended hours approved under condition C4(d);	Appendix C
	v. procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/ vibration dampeners or alternative construction methodology, and pre- and post- construction dilapidation surveys of sensitive structures where blasting and/ or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria);	Chapter 8 Section 9.3 Appendix B
	vi. procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints; and	Chapter 8,
	vii. a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where significant exceedences of relevant noise and vibration goals are detected;	Section 9.3 Section 8.3 of the CEMP

C3	The Proponent shall only undertake construction activities associated with the project during the following standard construction hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; and (b) 8:00am to 1:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Chapter 8
C4	Works outside of the construction hours identified in conditions C3 may be undertaken in the following circumstances: (d) works that generate noise that is i. no more that 5 dB(A() above rating background level at any residence; or ii. no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive land uses; or (e) for delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (f) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (g) construction works undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints; or (h) with the approval of the Director General in accordance with condition C5..	Chapter 8 Appendix C
C5	Construction activities (Out of Hours work) may be allowed to occur outside the construction hours specified in condition C3 with the prior written approval of the Director General. Requests for Out of Hours approval will be considered for construction activities which cannot be undertaken during the construction hours specified in condition C3 for technical or other justifiable reasons and will be considered on a case by case or activity-specific basis. Request for Out of Hours work must be accompanied by:details of the nature and need for activities to be conducted during the varied construction hours; (a) details of the nature and need for activities to be conducted during the varied construction hours; (b) written evidence to the EPA and the Director General that activities undertaken during the varied construction hours are justified, appropriate consultation with potentially affected receivers and notification of the relevant Council has been undertaken, issues raised have been addressed, and all feasible and reasonable mitigation measures have been put in place; and (c) evidence of consultation with the EPA on the proposed variation in standard construction hours. Despite the above, Out of Hours work may also occur in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration Management Sub-plan for this project, where that plan provides a process for considering the above on a case by case or activity specific basis by the Proponent, including factors (a) to (c) above.	Chapter 8 Appendix C
C6	Blasting associated with the project shall only be undertaken during the following hours: (a) 9:00 am to 5:00 pm, Mondays to Fridays, inclusive; (b) 9:00 am to 1:00 pm on Saturdays; and	Chapter 8 Appendix B

<table>
<tr><td></td><td>(c) at no time on Sundays or public holidays.
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></td></tr>
<tr><td>C7</td><td>The Proponent shall implement all feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009) during construction activities, Any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Plan required under condition B31(c).</td><td>Chapter 8
Section 9.3
Section 9.4</td></tr>
<tr><td>C8</td><td>The Proponent shall implement all feasible and reasonable mitigation measures with the aim of achieving the following construction vibration goals:
(d) for structural damage, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures; and
(e) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).</td><td>Chapter 8
Appendix B</td></tr>
<tr><td>C9</td><td>The Proponent shall ensure that airblast overpressure generated by blasting associated with the project does not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.
Table 1 Airblast overpressure criteria
<table>
<tr><th>Airblast overpressure (dB(Lin Peak))</th><th>Allowable exceedance</th></tr>
<tr><td>115</td><td>5% of total number of blasts over a 12 month period</td></tr>
<tr><td>120</td><td>0%</td></tr>
</table></td><td>Chapter 8
Appendix B</td></tr>
<tr><td>C10</td><td>The Proponent shall ensure that ground vibration generated by blasting associated with the project does not exceed the criteria specified in Table 2 when measured at the most affected residence or other sensitive receiver.
Table 2 Peak particle velocity criteria
<table>
<tr><th>Receiver</th><th>Peak particle velocity (mm/s)</th><th>Allowable exceedance</th></tr>
<tr><td rowspan="2">Residence on privately owned land</td><td>5</td><td>5% of total number of blasts over a 12 month period</td></tr>
<tr><td>10</td><td>0%</td></tr>
<tr><td>Non-Aboriginal heritage item</td><td>3</td><td>0%</td></tr>
</table></td><td>Chapter 8
Appendix B</td></tr>
<tr><td>C11</td><td>To ensure that the criteria specified in conditions C9 and C10 are satisfied at the most affected residence or other sensitive receiver, blasting trials shall be undertaken prior to the commencement of the project‘s blasting program, with results from the trial blasts used</td><td>Chapter 8</td></tr>
</table>

	to determine site specific blast design to satisfy the relevant criteria.	Appendix B
C12	The blasting criteria identified in conditions C9 and/or C10 may be exceeded where the Proponent has a written agreement with the EPA and the relevant landowner to exceed the criteria identified in conditions C9 and/ or C10 and the Director General has approved the exceedance. In obtaining the Director General approval for any such exceedance the Proponent shall submit to the Director General: (a) details of the proposed blasting program and justification for the proposed increase to blasting criteria including alternatives considered (where relevant); (b) an assessment of 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) details of the blast management, mitigation and monitoring procedures to be implemented; and (d) details of consultation undertaken (including clear identification of proposed blast limits and potential property impacts) and agreement reached with the relevant landowners and EPA (including a copy of the agreement in relation to increased blasting limits). Unless otherwise agreed by the Director-General, 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; (b) the blasting limit agreed to under any agreement can at no time exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL; and (c) these provisions under condition C12 (to increase applicable blast criteria in agreement with the relevant landowners) do not apply where the property is a non-Aboriginal heritage item.	Chapter 8 Appendix B

3.3 STATEMENT OF COMMITMENTS

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

Table 3-2: Statements of commitment relevant to this CNVMP

Outcome	Ref #	Commitment	Timing	CNVMP Reference
Minimise construction noise and vibration	**CN1**	All feasible and reasonable mitigation and management measures to minimise construction noise and vibration at sensitive receivers will be investigated. Noise and vibration will be monitored to measure against	Construction	Chapter 8

Outcome	Ref #	Commitment	Timing	CNVMP Reference
impacts.		predicted levels. Where required, feasible and reasonable mitigation measures will be implemented.		
	CN2	All reasonable attempts will be made to contact sensitive receivers that will be affected by blasting at least 48 hours prior. Blasting will normally be limited to between 9am and 5pm Monday to Friday and between 9am and 1pm Saturday. No blasting will take place outside these hours without approval from Department of Planning and following consultation with and/or notification of local residents and DECCW.	Construction	Chapter 8
	CN3	Construction will normally be limited to the following hours: • Between 6am and 6pm Monday to Friday. • Between 7am and 4pm Saturday. There would be no works outside these hours, or on Sundays or public holidays, except: (d) For works that do not cause construction noise to be audible at any sensitive receivers. (e) For the delivery of materials required outside these hours by the Police or other authorities for safety reasons. (f) Where work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. (g) For any other work as agreed through negotiations between the RTA and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works. (h) Where the work is identified in the construction noise and vibration management plan and approved as part of the construction environmental management plan. (i) As otherwise agreed by the DECCW. Local residents and the DECCW will be informed of the timing and duration of work approved under items (d) and (e) at least 48 hours before that work commences. Hours of work will be addressed in the construction noise and vibration management plan, which will be finalised in consultation with	Construction	Chapter 8

Outcome	Ref #	Commitment	Timing	CNVMP Reference
		the Department of Planning and the DECCW.		

4.0 EXISTING ENVIRONMENT

4.1 SENSITIVE RECEIVERS

The Project is located within the Port Macquarie and Kempsey local government areas. Land use in the area predominately consists of state forest. Residential areas are concentrated in Kundabung and scattered residential and rural properties along Ravenswood Road and Kemps Road.

The EA noise assessment identified and considered potential noise impacts for the worst affected receivers in a number of Noise Catchment Areas (NCAs) along the 13.7 kilometre alignment. For ease of reference, specific areas of the Project have been grouped together into noise catchment areas (NCAs).

Table 4-1 describes the location of each noise catchment area (shown in Figures 4-1a and 4-1b). These NCAs have been adopted for this Sub Plan.

Table 4-1 Noise catchment areas

Noise Catchment Area	Location
NCA01	North of Old Coast Road (western side)
NCA02	Kundabung Road to Kemps Road (eastern side)
NCA03	Pipers Creek to Beams Road (western side)
NCA04	Area north of Kundabung and across Ravenswood Road (eastern side)
NCA05	Upper Smiths Creek Road to Pipers Creek (western side)
NCA06	Smiths Creek to Upper Smiths Creek Road (western side)
NCA07	Kundabung area (eastern side)
NCA08	Mingaletta Road to Upper Smiths Creek Road (western side)
NCA09	Wharf Road area (eastern side)
NCA10	Mingaletta Road area (eastern side)

4.2 AMBIENT NOISE

Table 4-2 summarises the measured noise levels undertaken in 2006 for the Environmental Assessment and subsequently for the Concept Design review in 2012. Locations were selected to be representative of receivers that would experience a noise impact from the existing highway or from the Project.

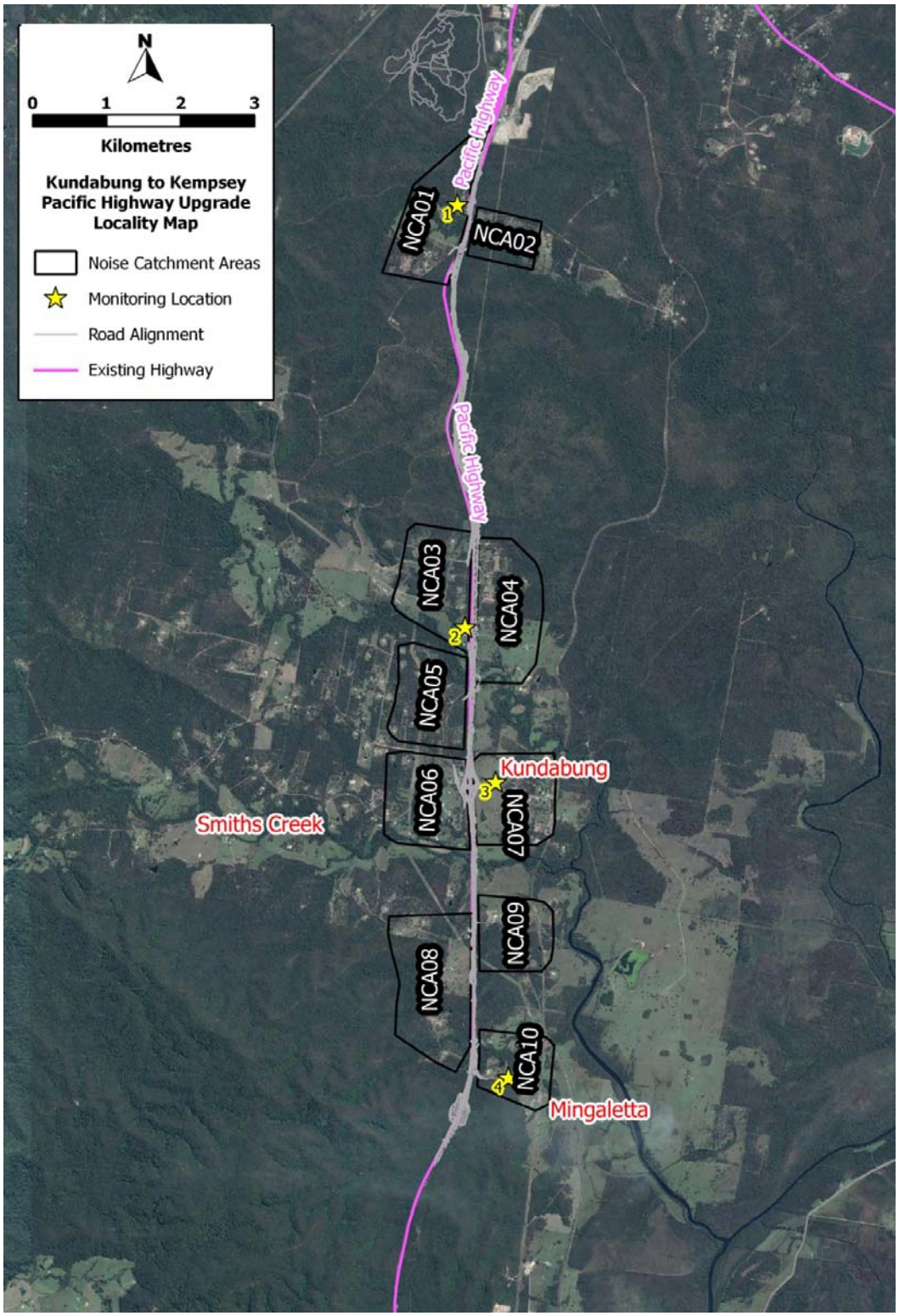
A summary of the noise monitoring results is provided in

Table 4-2.

Table 4-2 Ambient noise levels for NCA

Site	NCA	Monitoring Period (Dec 2006) Aug 2012	Day Leq, 15hr (dBA)	Night Leq, 9hr (dBA)	Rating Background Level (RBL) (dB(A))		
					Day	Evening	Night
1	NCA01	2006	58	56	47	47	46 (insects)
1a	NCA01	2012	55.1	54.4	45	43	35
2	NCA03	2006	56	55	43	43	41
2a	NCA03	2012	55	54	44	44	37
3	NCA07	2006	52	50.5	36	38	36
4	NCA10	2006	55	49	36	36	36
4a	NCA10	2012	49	50	38	40	37

Figure 4-1 Locality Map



5.0 NOISE AND VIBRATION CRITERIA FOR NSW

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

- The ICNG (DECC 2009), Assessing Vibration: A Technical Guideline (DEC 2006) (includes British and German Standards)
- The ANZECC, Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC 1990).

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

Vibration induced damage to structures or building contents will be addressed in accordance with *DIN 4150-3: Structural Vibration – effects of vibration on structures.*

5.1 CONSTRUCTION NOISE AND ASSESSMENT OBJECTIVES

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

The main objectives of the ICNG are to:

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

5.2 QUANTITATIVE NOISE ASSESSMENT CRITERIA

Construction noise assessment goals presented in the ICNG are referenced to noise management levels for residential, sensitive land uses and commercial/ industrial premises.

Residential Premises

Table 5-1 sets out management levels 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 10dB with windows open for adequate ventilation.

Table 5-1 Noise at residents using quantitative assessment

Time of day	Management level $L_{Aeq,(15min)}$*	How to apply
Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • 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 + 5dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

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

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

Other Land Uses

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

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

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

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

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

Notes:

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 ADOPTED PROJECT NOISE MANAGEMENT LEVELS

Based on measured noise levels described in Section 4.2, the Project-specific construction noise objectives for each representative monitoring location have been determined and are presented in Table 5-3. Considering the possibility of works outside standard construction hours additional management levels for these times are also included in the construction noise objectives.

Appendix D identifies sensitive receivers, noise catchment areas and noise monitoring locations.

Table 5-3: Project-specific construction noise objectives

Location	Approx. Setback from existing highway (m)[1]	Standard hours 7am – 6pm Mon-Fri / 8am – 1pm Sat		Extended hours 6am – 7am Mon-Fri / 7am – 8am Sat		Extended hours 1pm – 4pm Sat	
		RBL dB(A)	Noise objective	RBL dB(A)	Noise objective	RBL dB(A)	Noise objective
NCA01	41	45 / 44	55 / 54	50 / 46	55 / 51	46 / 44	51 / 49
NCA02	181	37 / 36	47 / 46	37 / 37	42 / 42	37 / 36	42 / 41
NCA03	71	43 / 45	53 / 55	49/ 48	54 / 53	47 / 44	52 / 49
NCA04	73	43 / 45	53 / 55	49/ 48	54 / 53	47 / 44	52 / 49
NCA05	123	37 / 36	47 / 46	37 / 37	42 / 42	37 / 36	42 / 41
NCA06	67	43 / 45	53 / 55	49/ 48	54 / 53	47 / 44	52 / 49
NCA07	230	37 / 36	47 / 46	37 / 37	42 / 42	37 / 36	42 / 41
NCA08	37	45 / 44	55 / 54	50 / 46	55 / 51	46 / 44	51 / 49
NCA09	185	38 / 38	48 / 48	45 / 45	50 / 50	43 / 37	48 / 42
NCA10	233	38 / 38	48 / 48	45 / 45	50 / 50	43 / 37	48 / 42

1 – Note: Setback refers to minimum NCA setback to nearest lane of existing highway. Approval to undertake out of hours works, meeting the requirements of CoA C4 for extended hours, shall be subject to the process outlined in Table 5-1 of the Out of Hours Procedure (Appendix C) on a case-by-case basis.

5.4 VIBRATION CRITERIA

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

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

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

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

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

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

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

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

Location	Assessment period	Preferred Values	Maximum Values
Residences	Daytime	0.2	0.4
	Night-time	0.14	0.28
Offices, schools, educational institutions and places of worship	Day or night-time	0.4	0.8
Workshops	Day or night-time	0.8	1.6

Table 5-5: Impulsive vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values	Maximum Values
Residences	Daytime	6	12
	Night-time	2	4
Offices, schools, educational institutions and places of worship	Day or night-time	13	26
Workshops	Day or night-time	13	26

Table 5-6 Intermittent vibration dose values ($m/s^{1.75}$)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 EPA Vibration Guideline (2.4.1), for determining vibration dose data has been used to calculate the dose values given in Table 5.6 above.

Calculating vibration dose value:

Where vibration comprises repeated events, each of a similar value and duration, a VDV may be calculated. The following formula requires the overall weighted rms acceleration as determined in Section 2.3 over the frequency range 1 to 80 Hz: where VDV is the vibration dose value in $m/s^{1.75}$, a(t) = frequency-weighted acceleration (m/s2) and T is the total period of the day (in seconds) during which vibration may occur.

Table 5-7: Structural damage criteria

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

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

5.5 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.

At this stage, the likely requirements for blasting to assist with construction have not been established. Albeit the following conservative blast assessment parameters detailed in CoA C9 and C10 have been adopted for predicting and assessing blast impacts and are summarised in Table 5-8 and 5-9.

Table 5-8: Airblast overpressure criteria

Airblast overpressure (dB(Lin Peak))	Allowable exceedance
115	5% of total number of blasts over a 12 month period
120	0%

Table 5-9: Peak particle velocity criteria

Receiver	Peak particle velocity (mm/s)	Allowable exceedance
Residence on privately owned land	5	5% of total number of blasts over a 12 month period
	10	0%
Non-Aboriginal heritage item	3	0%

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.

6.0 ENVIRONMENTAL ASPECTS AND IMPACTS

6.1 ENVIRONMENTAL ASPECTS

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

- Site establishment.
- Clearing and grubbing.
- Demolition.
- Earthworks and drainage.
- Blasting (refer to the Blast Management Program).
- Concrete batching (batch plant).
- Bridgeworks (piling).
- Paving.
- Road furnishing.

6.2 IMPACTS

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

- The type of equipment in use;
- The number of equipment simultaneously in use;
- Ground condition;
- Topography and other physical barriers;

- Proximity to sensitive receivers;
- The condition of sensitive receivers;
- Duration of construction works; and
- Proximity of heavy traffic areas such as the highway.

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

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

7.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

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

7.1 CONSTRUCTION ACTIVITIES

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

Table 7-1: Construction scenarios and associated plant and equipment

Scenario reference no.	Construction scenario	Typical plant and equipment required	Sound Power Level (dB(A)) of Each Plant
A	Site establishment	10-15t Excavator x 1	104
		Truck & Dog x 1	104
		100t Crane x 1	105
B	Clearing and grubbing	D10 Dozer x 2	114
		25t Excavator x 2	107
		Wood Chipper x 2	117
C	Earthworks	631G Scraper x 8	119
		40t Moxy x 10	112
		45-65t Excavator x 2	112
		D10 Dozer x 4	114
D	Drilling and blasting	Crusher and Screen x1	119
		Front End Loader x 1	111
		Drill Rig	110
E	Quarrying – crushing and screening and rock hammering	Cone Crusher Jaw Crusher Screen Loader	120 120 108

		Excavator	107
F	Drainage infrastructure	Franna Excavator	105 107
G	Bridge works	200t Crane x 1	105
		Delivery Truck x 1	112
		Driven Pile x 1	120
		Concrete Truck and Pump x 1	108
H	Paving and concrete sawing	Concrete Saw x 1	115
		825 Compactor x1	109
		14G Grader x 1	109
		Multilane Paver x 1	111
		Batch Plant x 1	112
		Front End Loader (50%) x 1	108
I	Road furniture installation	Local noise impacts only with no anticipated impacts on sensitive receivers.	

7.2 CONSTRUCTION NOISE IMPACTS

7.2.1 General Construction

Table 7-2 provides a summary of predicted noise impacts from each related construction scenario. Noise management level thresholds for each key sensitive receiver location have also been provided. Predicted noise levels for each construction scenario have been derived by calculating the combined noise output from the sound power levels of each piece of equipment listed in Appendix A.

Table 7-2 Noise impact on representative sensitive receivers

Sensitive receiver location	Scenario reference no.	Daytime NML[1]	Extended hours am NML[1]	Extended hours pm NML[1]	Predicted noise level range
NCA01	A	55	55	51	NA
	B				45-72
	C				40-62
	D				47-69
	E				N/A
	F				39-60
	G				43-69
	H				42-69
	I				N/A
NCA02	A	47	42	42	N/A
	B				45-61
	C				43-55
	D				46-58
	E				N/A

Sensitive receiver location	Scenario reference no.	Daytime NML[1]	Extended hours am NML[1]	Extended hours pm NML[1]	Predicted noise level range
	F				22-35
	G				42-58
	H				42-58
	I				N/A
NCA03	A	53	54	52	19-24
	B				43-68
	C				41-60
	D				43-65
	E				19-24
	F				30-52
	G				40-66
	H				40-66
	I				14-26
NCA04	A	53	54	52	19-26
	B				47-72
	C				42-60
	D				45-69
	E				19-26
	F				32-51
	G				44-69
	H				44-69
	I				14-28
NCA05	A	47	42	42	22-36
	B				44-63
	C				43-57
	D				42-60
	E				22-34
	F				39-56
	G				42-60
	H				41-61
	I				24-37
NCA06	A	53	54	52	30-50
	B				44-78
	C				42-67
	D				41-75

Sensitive receiver location	Scenario reference no.	Daytime NML[1]	Extended hours am NML[1]	Extended hours pm NML[1]	Predicted noise level range
	E				30-46
	F				32-52
	G				41-75
	H				40-74
	I				32-48
NCA07	A	47	42	42	54-62
	B				55-70
	C				48-62
	D				52-67
	E				41-46
	F				38-45
	G				52-67
	H				52-67
	I				44-50
NCA08	A	55	55	52	18-35
	B				44-68
	C				43-63
	D				41-65
	E				19-37
	F				30-56
	G				41-65
	H				40-65
	I				10-37
NCA09	A	48	50	48	23-28
	B				44-61
	C				45-57
	D				41-59
	E				24-31
	F				35-47
	G				41-59
	H				41-58
NCA10	A	48	50	48	N/A
	B				45-60
	C				42-57
	D				42-57

Sensitive receiver location	Scenario reference no.	Daytime NML[1]	Extended hours am NML[1]	Extended hours pm NML[1]	Predicted noise level range
	E				N/A
	F				11-28
	G				42-57
	H				41-57
	I				N/A

Note 1: Worst case NML's presented ie in the case of Daytime NML, the lower of Mon-Fri 7:00am- 6:00pm & Sat 8:00am -1:00pm

Table 7-2 shows that some stages of construction will result in the NMLs being exceeded at all NCAs. Whilst this is common for such construction projects, management of noise levels as far as practicable will be required in accordance with the mitigation measures listed in Section 8.0 of this document.

In the event of an exceedence, the JV will adopt management measures in accordance with Section 6 of the Interim Construction Noise Guideline (DECC, 2009). The following are provided as examples of mitigation measures:

Programming/scheduling of works:

- Where possible, organise deliveries and work to be undertaken during approved hours;
- Schedule noisy activities at times of high background noise (for example local road traffic);
- Design roads, access and gates so as to avoid noise impacts on nearby receivers.

Alternative construction techniques:

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.

Plant and equipment:

- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences;
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Reduce throttle setting and turn off equipment when not being used;
- Place damping material into bins to reduce noise from metal chutes;
- Ensure all plant and equipment is maintained in good working order.

Community Consultation:

- Provide, reasonably ahead of time, information such as total work time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For works outside standard hours, inform affected residents and other sensitive land use occupants between five and 14 days before commencement;
- Maintain good communication between the community and project staff;
- Give complaints a fair hearing;
- Consult with sensitive receivers when scheduling noisy activities.

Where construction activities are expected to exceed the highly affected noise criteria further mitigation measures will be implemented. The following are provided as examples:

- Scheduling work during times of high background RBL's
- Additional noise monitoring
- Face to face consultation with potentially affected sensitive receivers
- Additional respite periods during works generating high noise emissions

7.2.2 Compound and stockpile operation (including access)

The Project will require a main site compound, and a number of ancillary facilities and stockpile sites. These compound and ancillary facilities will accommodate a range of activities, plant and equipment including, but not limited to:

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

Not all sites will serve the same purpose and may include only one, or many combinations of the activities listed above. Table 7-3 summaries the likely combination of activities, plant and equipment anticipated at facilities for the Project. Appendix A4 of the CEMP and Appendix I of the SWMP provide a list and assessment of all ancillary facilities and stockpile sites on the Project, respectively.

Table 7-3 Likely construction facilities and associated attributes

Facility type	Activities	Typical plant and equipment required
Main compound	• Staff and worker parking. • Office accommodation. • Equipment maintenance and storage. • etc	• Loader • Small excavator • Truck and dog • Light vehicles • Compactors (small roller) • Graders
Concrete batch plant	• Aggregate handling and storage. • Concrete processing. • Etc.	• Batch Plant • Loader • Truck and dog • Concrete tippers
Ancillary facility	• Light vehicle parking. • Small site office. • Material storage and handling. • etc	• Loader • Truck and dog • Concrete tippers
Stockpile facility	• Material handling and storage. • etc	• Loader. • Excavator. • Truck and dog. • Light vehicles.

Table 7-4 provides the predicted noise levels at various distances from each facility type.

Table 7-4 Predicted noise levels from facility type ($L_{Aeq\ (15min)}$)

Facility	Approx. Distance to Nearest Sensitive Receiver	Distance from facility				
		50 metres	100 metres	200 metres	300 metres	500 metres
Main Compound	200	62	55	49	45	40
Concrete Batch Plant	275	66	60	53	49	44
Ancillary Facility	Multiple locations, to be confirmed	70	63	57	53	48
Stockpile Facility	Multiple locations, to be confirmed	69	62	56	52	47

As shown in Table 7-4 above, the A-weighted equivalent continuous (energy average) sound pressure level of the construction works decreases as the distance to the facility increases.

From the data presented in Table 7-4, it is predicted that under a worst case scenario there is potential for an exceedence of the noise objectives outlined in Table 5-3. Where noise objectives are potentially exceeded, a number of management and mitigation measures are proposed, including:

- An assessment of compliance with the criteria outlined in CoA C28, including a noise impact assessment;
- Consultation to be undertaken with potentially affected noise sensitive receivers, explaining the predicted noise exceedence (for the nearest resident), the proposed safeguards, and any potential impacts from security measures, such as lighting.
- Implementation and monitoring of the management and mitigation measures outlined in Table 8-1, as well as any additional measures identified as a result of the noise impact assessment.

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

7.3 CONSTRUCTION VIBRATION IMPACTS

Table 7-5 lists vibration intensive plant likely to be used during construction and provides 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 7-5 Typical plant vibration levels

Plant description	Vibration level (mm/s)						
	5 metres	10 metres	25 metres	50 metres	Structural Damage (mm/s)		
					Commercial Buildings	Dwellings	Sensitive structures
Vibratory roller (1-2 tonne)	Not proposed as part of this project				40	15	8
Vibratory roller (2-4 tonne)	Not proposed as part of this project						
Vibratory roller (4-6 tonne)	Not proposed as part of this project						
Vibratory roller (7-13 tonne)	Not proposed as part of this project						
Vibratory roller (13-18 tonne)	7.5	3.5	1.0	0.1			
Vibratory roller (>18 tonne)	Not proposed as part of this project						
Small hydraulic hammer	Not proposed as part of this project						
Medium hydraulic hammer	Not proposed as part of this project						
Large hydraulic hammer	Not proposed as part of this project						
Vibratory pile driver	Not proposed as part of this project						
Impact pile driver	11.5	3.4	0.7	0.1			
Drilling of blasting holes	0.3	0.15	0.1	0.01			
Pile boring	Not proposed as part of this project						
Jackhammer (hand held)	Not proposed as part of this project						

Table 7.5 outlines the typical plant vibration levels for plant that is expected to generate vibration on the K2K project. NOTE: VDV limits (human comfort criteria) cannot be compared to Table 7.5 as VDV values are dependent on the duration of the vibration event. They are also calculated in different units.

The only construction activities with potential to cause vibration in excess of the criteria are vibratory rolling and pile driving. Whilst there is no potential for building damage, it is possible that discomfort could be caused when these activities occur closer than 50m from a residence. Residents will be notified in accordance with the **Community Consultation Strategy (QMS# 030-Y010-2602)** and the **Blast Management Procedure (QMS# 025E006-2602).**

7.3.1 Blasting assessment

Blasting will be required to remove rock in many of the cuts. 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 management procedure as follows

- Geotechnical conditions reviewed
- Location and separation distance of nearest receivers identified
- Project overall blasting site laws used to estimate MIC for this blast location
- Small scale trial blast undertaken in conjunction with monitoring in near and far field and notification of local community
- Project overall blasting site law modified for this blasting region

Further assessment of potential blasting impacts is discussed in the Blast Management Program contained in Appendix B.

8.0 ENVIRONMENTAL CONTROL MEASURES

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

Table 8-1 Noise and vibration management and mitigation measures

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
GENERAL					
NV1	Training will be provided to all Project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted awareness training. Noise and vibration training requirements will be as per Section 9.2 of this plan.	Environmental Awareness Training Material	Pre-Construction, Construction	Environmental Manager	G36, Section 9.2
NV2	Public address systems used at any construction site will not be used outside normal construction hours, except where prior consultation has been undertaken with affected residents. Public address systems would be designed to limit noise spillage off-site.	Out of Hours Works Procedure	Construction	Superintendent	
NV3	Work compounds, parking areas, equipment and material stockpile sites will be positioned in accordance with ancillary facility and stockpile criteria detailed in Appendix A4 of the CEMP and Appendix I of the CSWMP, respectively.	CEMP CSWMP	Construction	Environment Manager	G36, EA
NV4	Noise management measures, eg screening, cladding or enclosures are implemented prior to use of ancillary facilities and fixed plant.	Ancillary Facilities Assessment	Construction	Foreman	EA
NV5	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.	Site Compound Establishment EWMS Public Road Accesses and Managing Mud Tracking Procedure Complaints and Enquiries	Construction	Foreman	

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
		Procedure			
NV6	Compounds, refuelling areas and where possible sensitive works areas will be designed to promote one-way traffic so that vehicles reversing movements are minimised.	Ancillary Facilities Assessment	Construction	Foreman	
NV7	Truck routes to and from the worksite will be via major roads where possible, in accordance with the Construction Traffic Management Plan.	Construction Traffic Management Sub-Plan	Construction	Superintendent	
NV8	Where possible operational noise mitigation measures, eg at property treatments, noise mounds, will be installed as early as possible during construction where they would assist in managing construction noise.	Sensitive Area Plans	Construction	Construction Manager	SoC ON1, G36, EA
PLANT & EQUIPMENT					
NV9	Where feasible and reasonable, noisy/high vibration equipment and/or construction processes will be substituted by alternative low noise and vibration emitting equipment and/or construction process.	Low noise emitting equipment Plant & Equipment Sound Power Levels	Construction	Foreman	G36 CoA B31(c)(v)
NV10	Where necessary, place screening, cladding or enclosures prior to the use of fixed plant under regular operation that may impact upon noise-sensitive receivers.	Screening or enclosures for plant Plant & Equipment Sound Power Levels	Construction	Foreman	G36
NV11	Saw-cutting will not be undertaken at night or for periods longer than one (1) hour without a minimum break of 15 mins per hour. Shielding will be put in	Plant & Equipment	Construction	Foreman	G36

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	place where possible to minimise noise impacts.	Sound Power Levels			
NV12	Plant or machinery will not be permitted to 'warm up' before the nominated working hours.	Out of Hours Works Procedure	Construction	Operators	
NV13	Switching off engines when equipment is not in use for extended periods (ie 30 minutes).	-	Construction	Superintendent	
NV14	Where possible, the occurrence of consecutive works within the same locality, and coincidence of noisy plant/equipment working close together and adjacent to sensitive receivers will be minimised.	Sensitive Area Plans	Construction	Foreman	G36
NV15	Unless required for technical reasons, undertake high noise generating work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents.	Out of Hours Works Procedure	Construction	Foreman	G36
NV16	Manually adjustable or ambient noise-sensitive or 'quacker' type reversing alarms on plant and/or flashing lights will be used at night.	Out of Hours Works Procedure	Construction	Superintendent	G36
NV17	Where possible, maintenance work on construction plant will be undertaken away from noise-sensitive receivers.	Sensitive Area Plans	Construction	Foreman	G36
NV19	All construction plant and equipment used on the site will be, in addition to other relevant requirements: • Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications; • Maintained in an efficient condition; • Operated in a proper and efficient manner.	Well maintained plant and equipment	Construction	Superintendent	G36, EA
NV20	Loading and unloading will be carried out as far as practical away from sensitive receivers.	Sensitive Area Plans	Construction	Foreman	
NV21	Truck movements will be kept to a minimum, i.e. that trucks are sufficiently	-	Construction	Foreman	

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	utilised for each trip.				
NV22	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7.00am start time unless required by road safety considerations.	Sensitive Area Plans Out of Hours Works Procedure	Construction	Foreman	
NV23	Noisy plant working simultaneously close together will be avoided to the greatest extent practical adjacent to noise affected sensitive receivers.	Sensitive Area Plans	Construction	Foreman	
NV24	Whenever practical, at the end of shifts, excavation and/or ripping plant will be taken from their work areas and left overnight away from the immediate vicinity of sensitive receivers. Warming up of the plant will then be conducted away from such receivers.	Sensitive Area Plans Out of Hours Works Procedure	Construction	Foreman	
NV25	Truck drivers will limit compression braking as far as practical.	Site induction	Construction	Operators	
NV26	Where possible, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to reduce transmission of noise between work sites and receiver locations.	Sensitive Area Plans	Construction	Foreman	
CONSTRUCTION HOURS					
NV27	Construction works associated with the Project, other than blasting, will only be undertaken during the following hours: • 7.00am to 6.00pm Mondays to Fridays, inclusive • 8.00am to 1.00pm on Saturdays. • At no time on Sundays or public holidays. Unless carried out in accordance with NV28.	Out of Hours Works Procedure	Construction	Construction Manager	CoA C3, CoA C4, CoA C5
NV28	Works outside of the construction hours identified in NV27 will only be undertaken in the following circumstances:	Out of Hours Works	Construction	Construction Manager	CoA C4, SoC CN3

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	• Works that generate noise that is (i) no more that 5 dB(A) above rating background level at any residence; or (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive land uses; or • For delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or • Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or • Construction works undertaken through sparsely populated areas (being those areas in which sensitive receptors are located greater than 200 metres away from the project boundary). In this case construction is permissible during the following hours: 6.00am to 6.00pm Monday to Friday and 7.00am to 4.00pm Saturdays and at no time on Sundays or public holidays. These works hours may be reviewed and/ or revoked by the Director General in consultation with the EPA in the case of excessive or unresolved noise complaints; or • With the approval of the Director General in accordance with CoA C5 (refer NV31).	Procedure			
NV29	Rock breaking, rock hammering, sheet piling, pile driving and any similar activity will be scheduled only between the hours of 7.00am to 6.00pm Monday to Friday; and 8.00am to 12.00pm Saturday, except where works are to be undertaken outside proposed construction hours as outlined above.	Out of Hours Works Procedure	Construction	Construction Manager	Good Practice subject to community liaison
NV30	Where appropriate, negotiated agreements will be entered into with sensitive receivers when exceedances of noise criteria are predicted, and after all reasonable and feasible noise mitigation measures have been considered and implemented. Negotiated agreements will be implemented in accordance with the Interim Construction Noise Guideline (2009) and the NSW Industrial Noise Policy (2000).	Out of Hours Works Procedure	Construction	Foreman	
NV31	Any proposal to undertake works outside of the standard working hours identified in NV27 will be subject to the processes and assessment	Out of Hours Works	Construction	Environment Manager	CoA C5

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	requirement contained in Condition C5 and included in the Out of Hours Works Procedure (see Appendix C)	Procedure			
BLAST MANAGEMENT					
NV32	Blasting shall only be undertaken during the following hours: • 9.00am to 5.00pm Monday to Friday, inclusive; • 9.00am to 1.00pm on Saturdays; and • At no time on Sundays or public holidays. 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.	Blasting EWMS	Construction	Construction Manager	CoA C6
NV33	All blasting associated with the Project will be conducted within the air blast overpressure and Peak Particle Velocity Criteria outlined within Table 5-8 and Table 5-9. This requirement does not apply where written agreement from the affected landowner and the EPA is obtained, and the Director-General has approved the exceedence. When seeking approval from the Director-General the requirements outlined in Table 3-1, CoA 12 will be addressed.	Blasting EWMS	Construction	Foremen/Specialist Sub-contractor	CoA 9, CoA 10, CoA 12
NV34	Blasting will be undertaken in accordance with the Blast Management Program contained in Appendix B of this document.	Blasting EWMS	Construction	Foremen/Specialist Sub-contractor	CoA 6, CoA7, CoA8, CoA9, CoA10, CoA11, CoA 12
NV35	Blasting trials would be undertaken with results from the trials used to determine site law and site-specific blast designs to satisfy relevant performance criteria.	Blasting EWMS	Construction	Foremen/Specialist Sub-contractor	C11
NV36	The timing for blasting will consider site-specific weather conditions, such as temperature inversions.	Blasting EWMS	Construction	Foremen	EA
CONSULTATION & COMPLAINTS MANAGEMENT					
NV37	Residents/sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the	Community Communicatio	Pre-Construction, Construction	Communications Manager	CoA B31(c)(vi), Good practice

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	Community Communications Strategy. Information will include: • the types of activities to be undertaken; • the timing of activities, including expected start and finish; • the location of activities; and • details of the community information line and how to make an enquiry and/or complaint. •	ns Strategy Complaints & Enquiries Procedure			
NV38	Consultation with affected education institutions during construction works in their vicinity will be undertaken in an attempt to limit audible construction works during important events, such as examination periods.	Community Communicatio ns Strategy	Pre-Construction, Construction	Communications Manager	Good practice
NV39	All reasonable attempts will be made to contact sensitive receivers that will be affected by blasting. The contact will be at least 48 hours before a blast and will include a schedule of blast time(s), a phone contact name and number.	Community Communicatio ns Strategy Complaints & Enquiries Procedure	Pre-Construction, Construction	Communications Manager	SoC CN2
NV40	Where complaints relating to noise or vibration impacts as a result of extended working hours cannot be satisfactorily resolved with the affected residents then works hours will revert back to standard working hours at that particular location for that particular activity. Resident(s) will be consulted before recommencing any works outside standard working hours. The Director-General will be notified of any complaints received in relation to working outside of standard hours as outlined in Appendix C.	Community Communicatio ns Strategy Complaints & Enquiries Procedure	Construction	Superintendent, Communications Manager	Good practice
NV41	Prior consultation and notification would be undertaken with nearby residents that may be affected by high levels of noise or vibration that exceed the relevant criteria. Ongoing consultation with all potentially affected residents	Community Communicatio ns Strategy	Pre-Construction, Construction	Communications Manager	EA

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
	will be carried out throughout construction.	Complaints & Enquiries Procedure			
NV42	Circumstances may arise during construction where works outside of standard construction hours are essential and sensitive receivers are assessed to be highly noise affected (ie experience noise levels greater than 75 dBA). Where this is the case, and works are approved in accordance with CoA C5, opportunities to minimise impacts on highly noise effected receivers, including the provision of alternative accommodation, would be considered in consultation with those affected receiver(s). Refer to Appendix C.	Community Communications Strategy Complaints & Enquiries Procedure Out of Hours Works Procedure	Construction	Communications Manager	Good practice
NV43	All complaints received will be managed in accordance with the Community Communications Strategy.	Community Communications Strategy	Construction	Communications Manager	CoA B28
SURVEY, MONITORING & REPORTING					
NV44	Initial noise monitoring of plant and equipment will be undertaken to ensure the noise performance levels predicted in this CNVMP are being met.	Noise monitoring equipment	Pre-Construction, Construction	Environmental Advisor, Noise Specialist	Good practice
NV45	Noise and vibration monitoring will be undertaken in accordance with Section 9.3. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where significant exceedances of relevant noise and vibration goals are detected.	Noise monitoring equipment Environmental Monitoring	Construction	Environmental Advisor, Noise Specialist	CoA B31 c) vii

ID	Measure/Requirement	Resources needed	When to implement	Responsibility	Reference
		Procedure			
NV46	Building Condition Inspections for each public utility, structure and building will be carried out prior to, and following construction where: • blasting operations are within 500m or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2mm/s, whichever is the greater; • pile driving activities are within 250m or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2mm/s, whichever is the greater; • other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2mm/s.	Building Condition Inspection Report	Pre-Construction, Construction	Engineer	G36/EA
NV47	The Building Condition Inspection report will include as a minimum: • floor plan of the subject building; • record site details – age, construction, site slope and provision of drainage, presence of trees; • type of defects and their positions and extends on the floor plan; • photo of external view and photo of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks; • how doors sit in the jambs – out of line may indicate foundation settlement; • external signs of reactive clay foundation soil; e.g. lifting of slabs, uneven kerbing. •	Building Condition Inspection Report	Pre-Construction, Construction	Engineer	G36

9.0 COMPLIANCE MANAGEMENT

9.1 ROLES AND RESPONSIBILITIES

The K2K team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

9.2 TRAINING

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

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

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

9.3 INSPECTIONS AND MONITORING

Weekly and other routine inspections by Environmental Advisors, RMS, Environmental Review Group (ERG) representatives and Environmental Representative (ER) will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Chapter 8 of the CEMP.

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

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- Pre-construction noise monitoring will be undertaken, with noise monitoring continuing throughout construction at nominated sensitive receiver locations to determine the effectiveness of mitigation strategies (as outlined in Chapter 8).
- Monthly noise monitoring will be undertaken by the site the environmental team at selected sensitive receivers (refer to Section 4.1) to determine the effectiveness of mitigation measures against predicted impacts. The monitoring would be attended and configured to continuously record the statistical noise levels in 15 minute intervals.
- Where complaints are received, additional noise monitoring may be undertaken at sensitive receivers to determine if the actual construction noise generated exceeds the predicted 'worst case' construction noise levels identified in Section 7.2 of this Plan.

- Noise monitoring may be carried out in response to exceedances of the construction noise levels identified in Section 5.3 of this Plan, or for the purpose of refining construction methods or techniques to minimise noise.
- Ongoing spot checks of noise intensive plant and equipment will also be undertaken throughout construction.

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

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

Acoustic instrumentation employed in the noise monitoring surveys will comply with the requirements of AS/IEC 61672.1 “Electroacoustics – Sound level meters – Specifications” and carry appropriate NATA (or manufacturer) calibration certificates.

9.3.2 Vibration Monitoring

The following vibration monitoring will be undertaken:

- For the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work when works are located within the distances nominated in Table 7.5 and a likely exceedance is expected. This will ensure that safe vibration levels specified in Section 7.3.1 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out within the established buffer zones, or where there is considered to be a risk that levels may exceed the relevant structural damage goals.
- Vibration monitoring may be carried out in response to complaints, exceedances, or for the purpose of refining construction methods or techniques to minimise vibrations.
- Vibration monitoring will continue throughout construction, where appropriate, at nominated sensitive receiver locations to determine the effectiveness of mitigation strategies (as outlined in Chapter 8).

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

Vibration monitoring will be carried out in accordance with:

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

9.4 NON-CONFORMANCES

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

9.5 COMPLAINTS

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

9.6 AUDITING

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

Audit requirements are detailed in Section 8.3 of the CEMP.

9.7 REPORTING

Reporting requirements and responsibilities are documented in Section 8.5 of the CEMP.

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

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

10.0 REVIEW AND IMPROVEMENT

10.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement. This will be achieved through the process documented in Section 9 of the CEMP.

The continuous improvement process will be designed to:

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

10.2 CNVMP UPDATE AND AMENDMENT

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

Only the Environment Manager, 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 A – PLANT AND EQUIPMENT SOUND POWER LEVELS

Predicted sound power levels are detailed below for typical plant that may be used during the general construction works.

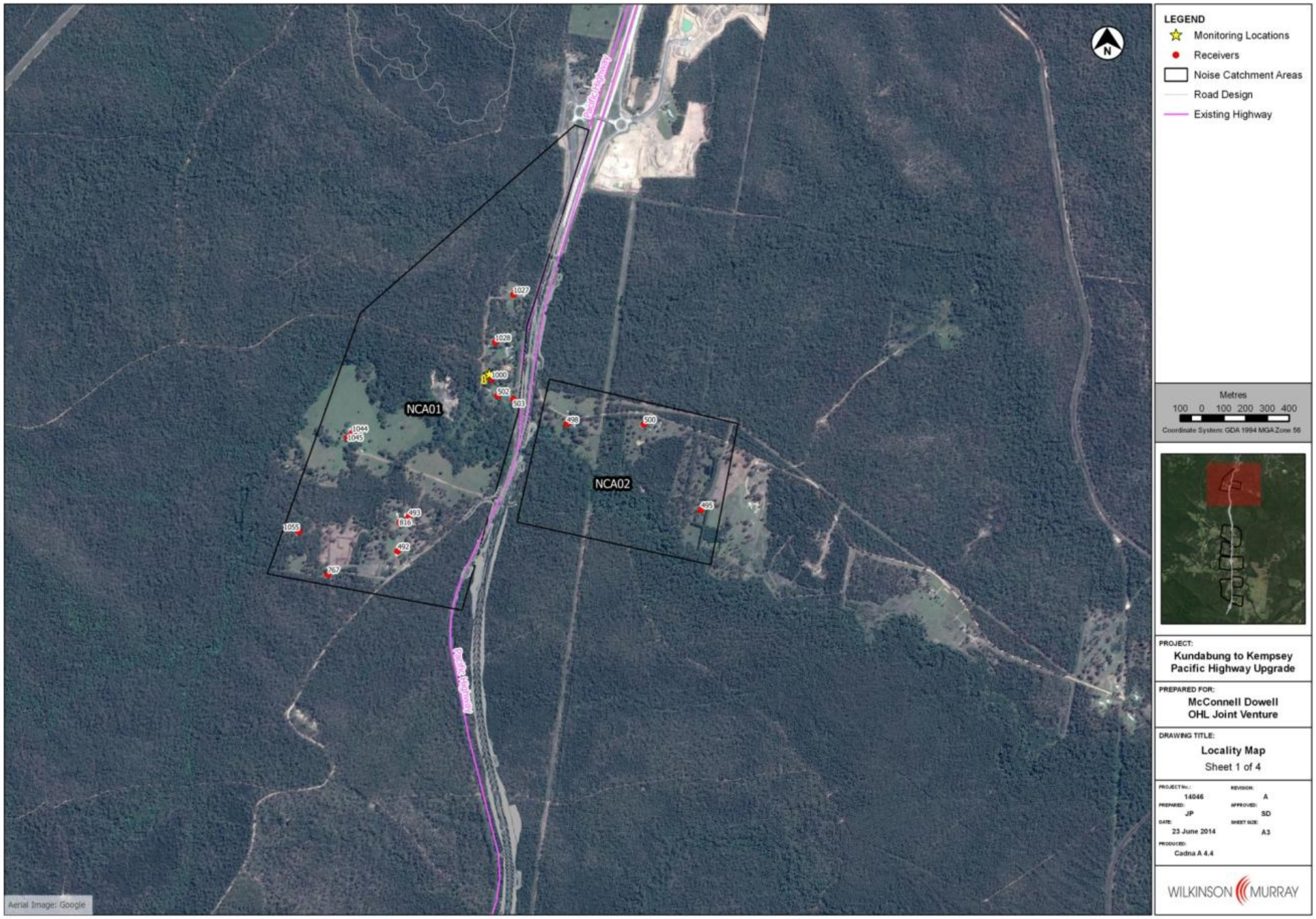
The Table below will be amended and reviewed as further construction methodologies are developed.

Plant Item	Typical Sound Power Level dB(A)
10-15t Excavator	104
25t Excavator	107
45-65t Excavator	112
Truck & Dog	104
40t Moxy / Delivery Truck	112
Front End Loader	111
200t Crane	105
Wood Chipper	117
D10 Dozer	114
631G Scraper	119
Crusher and Screen	119
Driven Pile	120
Batch Plant	112
Water cart	109
Grader	109
Front End Loader	109
Asphalt Paver	100

APPENDIX B – BLAST MANAGEMENT PROGRAM

APPENDIX C – OUT OF HOURS WORKS PROCEDURE

APPENDIX D – SENSITIVE RECEIVERS, NOISE CATCHMENT AREAS AND NOISE MONITORING LOCATIONS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Monitoring Locations
Receivers
Noise Catchment Areas
Road Design
Existing Highway
Metres
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NCA02
Pacific Highway
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503
1044
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498
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493
816
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Aerial Image: Google
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Kundabung to Kempsey Pacific Highway Upgrade
PREPARED FOR:
McConnell Dowell OHL Joint Venture
DRAWING TITLE:
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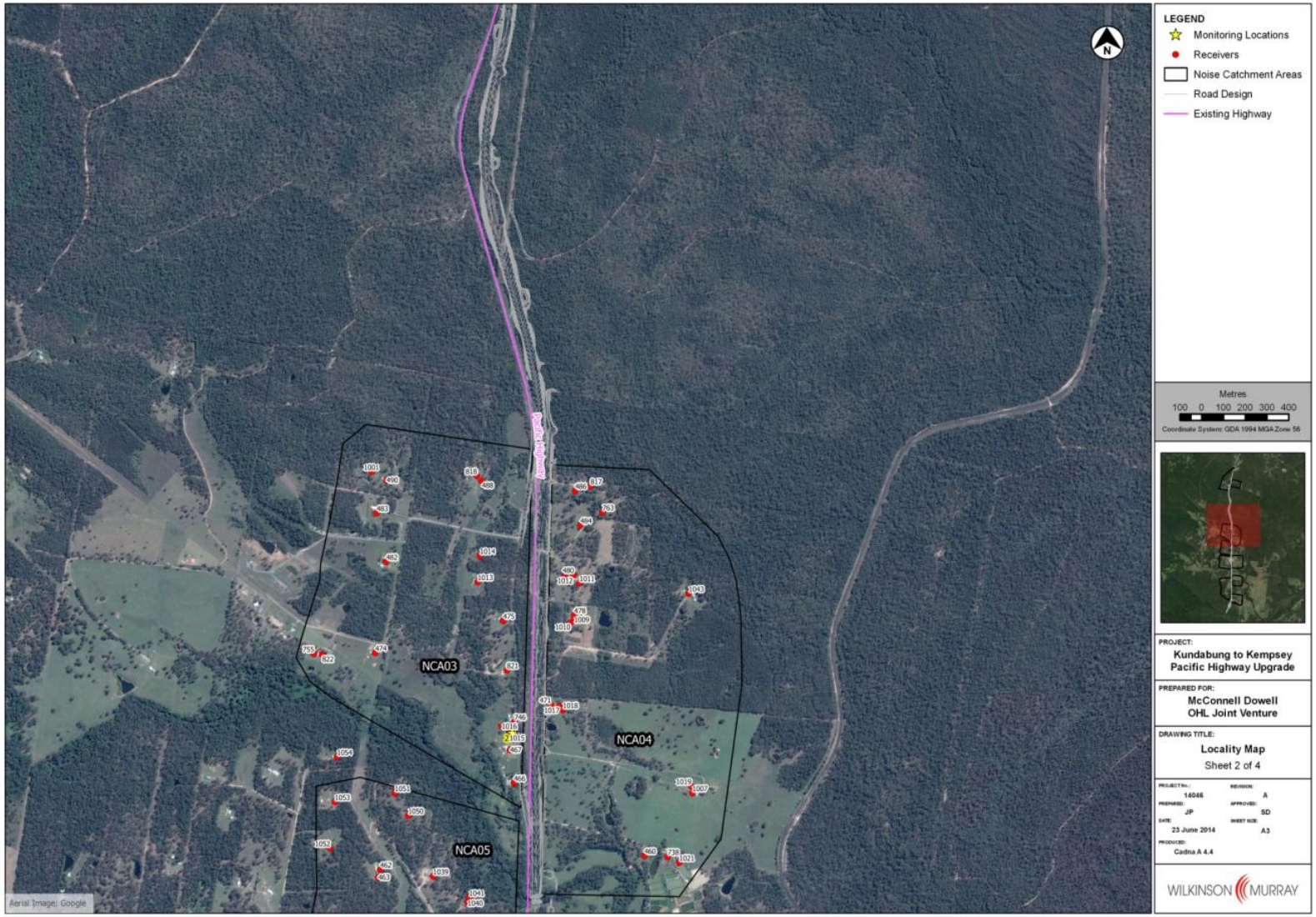
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Pacific Highway
Aerial Image: Google
PROJECT:
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PREPARED FOR:
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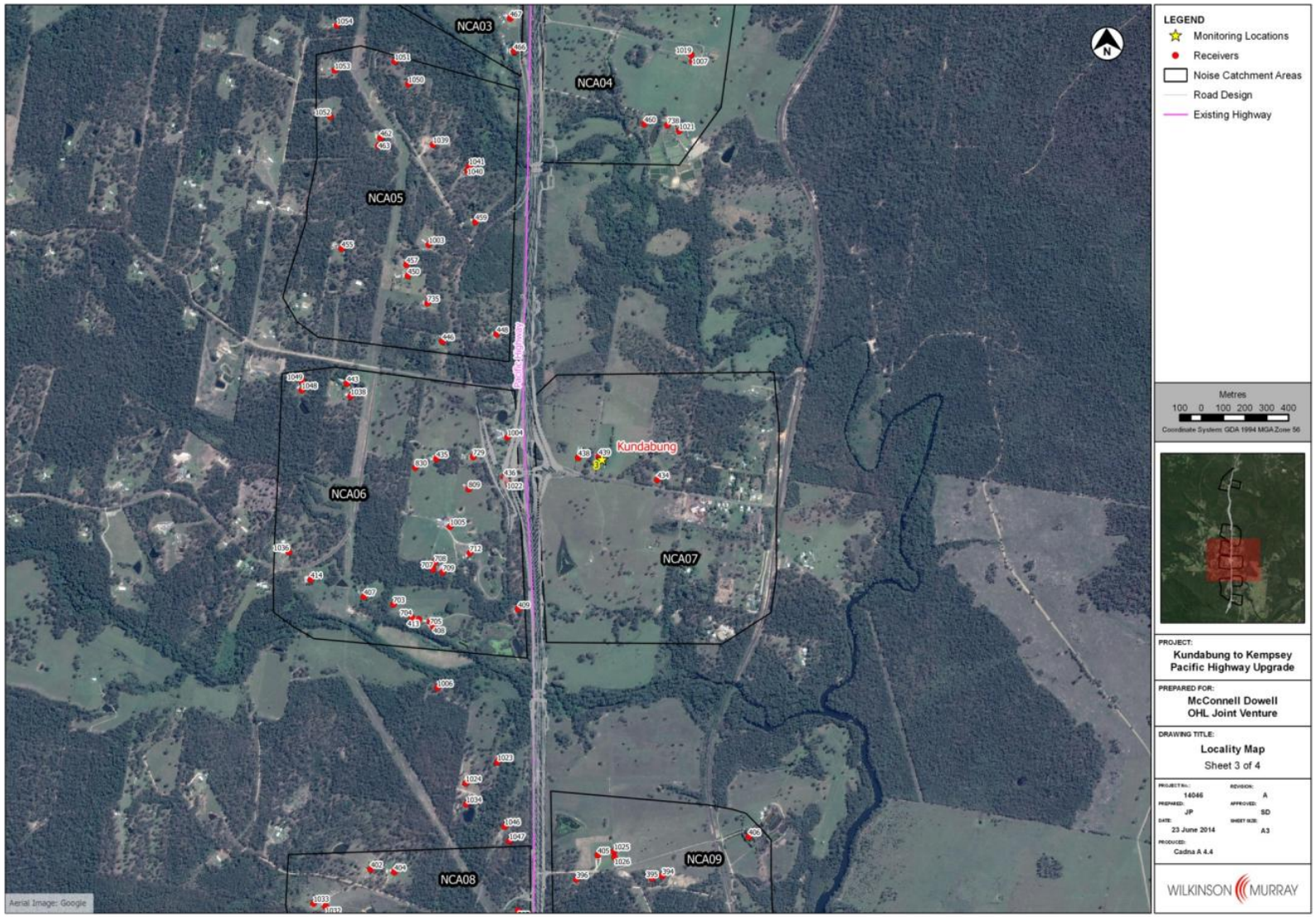
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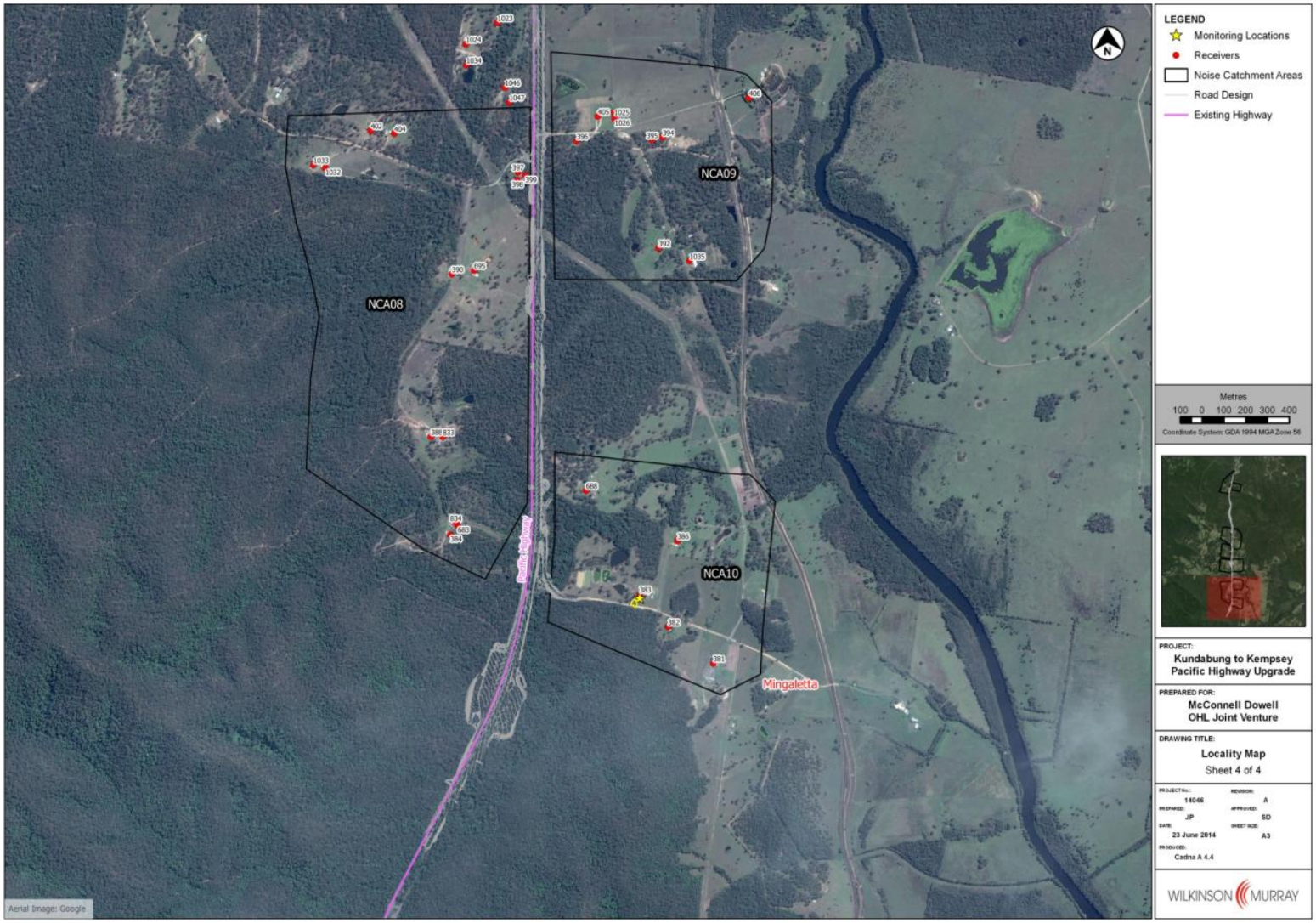
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