

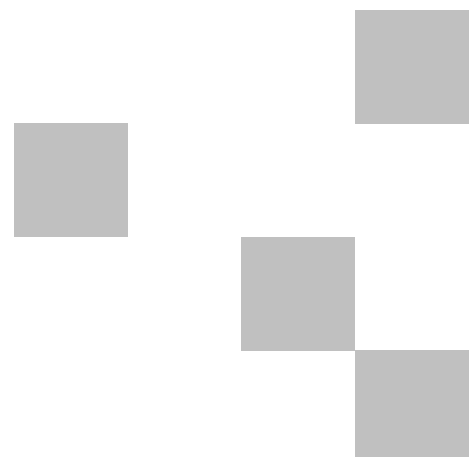


APPENDIX B3

Noise and Vibration Management Sub Plan

Toolijooa Road Fill Works stage of Foxground and Berry bypass

JANUARY 2014



Document control

File name	TRFW_FBB_Appendix B3_NVMP_Rev4.docx
Report name	Toolijooa Road Fill Works stage of Foxground and Berry bypass Noise and Vibration Management Sub Plan
Revision number	Rev 4

Plan approved by:



Andrew Burns

Contractor PM



Shannon Chisholm

Contractor EM



Ron De Rooy

RMS representative

Revision history

Revision	Date	Description	Approval
0	14/10/2013	Draft for internal review	
1	16/10/2013	Draft for RMS review	
2	5/11/2013	Draft for ER review	
3	11/11/2013	Draft for DP&I review	
4	22/01/2014	2 nd Draft for RMS review (DP&I comments addressed)	

Distribution of controlled copies

Copy no.	Issued to	Version
1		
2		
3		
4		
5		

Contents

1	Introduction	1
1.1	Context	1
1.2	Background.....	1
1.3	Environmental management document system.....	1
2	Purpose and objectives	2
2.1	Purpose	2
2.2	Objectives.....	2
2.3	Targets	2
3	Environmental requirements.....	3
3.1	Relevant legislation and guidelines	3
3.2	Minister’s Conditions of Approval.....	4
3.3	Statement of commitments	7
4	Consultation	8
4.1	Consultation with the EPA.....	8
4.2	Consultation with sensitive receivers.....	8
4.3	Ongoing consultation during construction	8
5	Existing environment.....	9
5.1	Sensitive receivers.....	9
5.2	Noise Monitoring.....	9
5.3	Noise Catchment Areas	10
6	Noise and vibration criteria	12
6.1	Construction noise goals.....	12
6.2	Quantitative noise criteria.....	12
6.3	Vibration goals	14
7	Environmental aspects and impacts	17
7.1	Environmental aspects.....	17
7.2	Impacts	17
8	Construction noise and vibration assessment	18
8.1	Construction activities	18
8.2	Construction noise impacts	18
8.3	Construction vibration assessment	19
9	Environmental control measures	21
9.1	Construction Hours	21
10	Compliance management	25
10.1	Roles and responsibilities	25
10.2	Training.....	25
10.3	Inspections and monitoring	25
10.4	Non-conformances.....	26

10.5	Complaints.....	26
10.6	Auditing.....	27
10.7	Reporting.....	27
11	Review and improvement.....	28
11.1	Continuous improvement.....	28
11.2	Update and amendment.....	28

Appendices

Appendix A Indicative Plant and Equipment Sound Power Levels

Tables

Table 3-1	Conditions of Approval relevant to noise and vibration.....	4
Table 3-2	Statements of commitment relevant to this NVMP.....	7
Table 5-1	Noise logging locations.....	9
Table 5-2	Background noise monitoring results (dB(A)).....	10
Table 5-3	Noise catchment areas.....	10
Table 6-1	Residential Noise Management Levels.....	12
Table 6-2	Project-specific NMLs (dB(A)).....	13
Table 6-3	Structural damage criteria – Heritage Structures.....	14
Table 6-4	Transient Vibration Guide Values for Cosmetic Damage (BS 7385: Part 2:1993).....	15
Table 6-5	Preferred and maximum vibration acceleration criteria.....	16
Table 8-1	Sound power levels for project construction scenarios.....	18
Table 8-2	Predicted levels of construction noise during standard construction hours (daytime).....	18
Table 8-3	Recommended safe working distances for vibration intensive plant (construction noise strategy, TfNSW 2011).....	19
Table 9-1	Noise and vibration management and mitigation measures.....	22

Figures

Figure 5-1	Noise Catchment Area 1 Including Background Noise Logging, Sensitive Receiver and Noise Monitoring Locations.....	11
Figure 6-1	Summary of Project Vibration Criteria for Structures.....	15

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	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	<i>Environmental Planning and Assessment Act 1979</i>
ER	Environmental Representative
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements
INP	Industrial Noise Policy
Leq	Equivalent continuous sound level - the constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy
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
L ₉₀	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L ₉₀
NCA	Noise catchment area
NML	Noise management level

OEH	Office of Environment and Heritage
Project, the	The Princes Highway Upgrade - Foxground and Berry Bypass Project, defined as <i>“The construction and operation of approximately 11.6 kilometres of two lane divided carriageways (with the exception of the cutting through Toolijooa Ridge which comprises two lanes plus a climbing lane in each direction), with provisions for the possible future widening to three lanes within the road corridor (if required in the future).”</i>
RBL	The Rating Background Level for each period is the medium value of the assessment background level 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	Revised Statement of Commitments included in the Submissions Report
Sound Power Level (SWL)	The total sound emitted by a source
Sound Pressure Level	The amount of sound at a specified point

1 Introduction

1.1 Context

This Construction Noise and Vibration Management Sub Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Toolijooa Road Fill Works stage of the Foxground and Berry bypass Project (the Project).

This NVMP 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 *Foxground and Berry bypass Environmental Assessment* (EA) (AECOM, 2012) and all applicable legislation.

1.2 Background

As part of the EA development, a detailed construction and operational noise and vibration assessment was prepared to address the Director General's Requirements issued by the then Department of Planning. The EA assessed the predicted noise and vibration impacts during the construction of the Project. The noise and vibration assessment was included in the EA as *Volume 2 Appendix E Technical paper: Noise and vibration*.

The EA concluded that there will be some noise and vibration impacts during construction and the extent will vary depending on the type of activity in progress and the proximity to sensitive receivers. These impacts will be mitigated through the implementation of the construction noise mitigation and management measures provided in this NVMP.

1.3 Environmental management document system

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

The NVMP is part of Fulton Hogan's environmental management framework for the Toolijooa Road Fill Works stage of the Project. In accordance with the requirements of CoA B36(c), this NVMP has been developed in consultation with the NSW Environment Protection Authority (EPA). Further details of the consultation are provided in Chapter 4 of this NVMP.

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

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

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

2 Purpose and objectives

2.1 Purpose

The purpose of this NVMP is to describe how Fulton Hogan proposes to manage potential noise and vibration impacts during construction of the Toolijooa Road Fill Works stage of the Project.

2.2 Objectives

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

- identifying sensitive receivers and ensuring appropriate environmental controls and procedures are implemented during construction activities;
- minimising potential adverse noise and vibration impacts to the environment and community;
- managing impacts if they occur through a systematic analysis of mitigation strategies;
- ensuring appropriate measures are implemented to address the relevant CoA and SoC outlined in Table 3.1 and Table 3.2 below and the mitigation measures detailed in the EA; and
- ensuring appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 of this NVMP.

2.3 Targets

Targets have been established for the management of noise and vibration impacts during the Toolijooa Road Fill Works stage of the Project to ensure:

- compliance with the relevant legislative requirements, CoA and SoC;
- feasible and reasonable noise mitigation measures are implemented with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECC, 2009); and
- 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); and
- *Protection of the Environment Operations (Noise Control) Regulation 2008*.

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

3.1.2 Guidelines

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

- *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA 1999);
- *NSW Industrial Noise Policy* (INP) (EPA 2000);
- *Road Noise Policy* (RNP) (EPA 2011);
- *RTA Environmental Noise Management Manual* (ENMM) (RTA 2001a);
- *Interim Construction Noise Guideline* (ICNG) (DECC 2009);
- *Assessing Vibration: A Technical Guideline* (DEC 2006);
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990) Australian and New Zealand Environment and Conservation Council (ANZECC); and
- German Standard *DIN 4150 - Part 3 - Structural Vibration in Buildings - Effects on Structures*.

3.2 Minister's Conditions of Approval

The CoA relevant to this NVMP 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
CoA B36	As part of the Construction Environment Management Plan for the Project required under condition B35, the Proponent shall prepare and implement the following sub plan(s):	This NVMP
	(c) 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:	
	(i) identification of nearest sensitive receptors and relevant construction noise and vibration goals applicable to the Project;	
	(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;	Section 7.1 Section 8.1 Appendix A – Indicative Plant and Equipment Sound Power Levels
	(iii) identification of feasible and reasonable measures proposed to be implemented to minimise construction noise and vibration impacts (including construction traffic noise impacts);	Chapter 9
	(iv) procedures for dealing with out-of-hour works in accordance with condition C4 and C6, including procedures for notifying the Director General concerning complaints received in relation to the extended hours approved under condition C4(e);	As no out-of-hour works will be undertaken during the Toolijooa Road Fill Works stage, this component of the condition is not considered relevant.
(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);	As no blasting will be undertaken during the Toolijooa Road Fill Works stage, this component of the condition is not considered relevant.	
(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 10 Community Communication	

CoA No.	Condition Requirements	Document Reference
	(vii) a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where significant exceedances of relevant noise and vibration goals are detected;	Strategy Section 10.3 Section 8.5 of the CEMP
C3	The Proponent shall only undertake construction activities associated with the Project during the following standard construction hours: (i) 7:00am to 6:00pm Mondays to Fridays, inclusive; and (ii) 8:00am to 1:00pm Saturdays; and (iii) at no time on Sundays or public holidays.	Section 9.1
C4	Works outside of the standard construction hours identified in condition C3 may 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; or (ii) no more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009) at other sensitive land uses; or (b) for 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; (d) For the area between Toolijooa Road and Tindalls Lane, encompassing Toolijooa cut, Broughton Creek floodplain and major bridge works (outside of Berry township) low noise impact activities and works as follows: (i) between 6:00am and 7:00am Monday to Friday; and (ii) between 6:00pm and 7:00pm Monday to Friday; and (iii) 1:00pm and 5:00pm on Saturdays; and (iv) at no time after 6pm on a day preceding a public holiday long weekend; and (e) with the approval of the Director General in accordance with condition C6.	As no out-of-hour works will be undertaken during the Toolijooa Road Fill Works stage, this component of the condition is not considered relevant.
C5	Except as expressly permitted by an Environment Protection Licence issued for the Project, high noise impact activities and works shall only be undertaken: (a) between the hours of 8:00am to 6:00pm Mondays to Fridays; (b) between the hours of 8:00am to 1:00pm Saturdays; 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.	Section 9.1
C6	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	As no out-of-hour works will be undertaken during the Toolijooa Road Fill Works stage, this component of the

CoA No.	Condition Requirements	Document Reference
	<p>accompanied by:</p> <ul style="list-style-type: none"> (a) details of the nature and need for activities to be conducted during the varied construction hours; (b) written evidence to the EPA and the Director General that activities undertaken during the varied construction hours are justified, appropriate consultation with potentially affected receivers and notification of the relevant Council has been undertaken, issues raised have been addressed, and all feasible and reasonable mitigation measures have been put in place; and (c) evidence of consultation with the EPA on the proposed variation in standard construction hours. <p>Despite the above, Out of Hours work may also occur in accordance with an approved Construction 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.</p>	condition is not considered relevant.
C8	<p>The Proponent shall implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the <i>Interim Construction Noise Guideline</i> (DECC, 2009) during construction activities. Any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration Management Sub plan required under condition B36.</p>	Chapter 9 Section 10.3 Section 10.4
C9	<p>The Proponent shall implement all feasible and reasonable mitigation measures with the aim of achieving the following construction vibration goals:</p> <ul style="list-style-type: none"> (a) for structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration - 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 for vibration in buildings. Guide for measurement of vibration and evaluation of their effects on buildings; and (c) 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). 	Chapter 9 Section 6.4

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 EA influencing the outcome and implementation.

Table 3-2 Statements of commitment relevant to this NVMP

Outcome	Ref #	Commitment	Timing	Reference Document	NVMP Reference
Minimise construction noise and vibration impacts	NV1	Mitigation and management measures, such as noise barriers, pre-dilapidation surveys and monitoring, will be used to minimise construction noise and vibration at sensitive receivers.	Construction	<p><i>Interim Construction Noise Guideline</i> (DECC 2009).</p> <p><i>Assessing Vibration: A Technical Guide</i> (DEC 2006).</p> <p><i>NSW Industrial Noise Policy</i> (EPA 2000).</p> <p><i>Environmental Noise Management Manual</i> (RTA 2001).</p> <p>AS 2436-1981 <i>Guide to noise control on construction, maintenance and demolition sites.</i></p> <p><i>Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration</i> (Australian and New Zealand Environment Conservation Council (ANZECC, 1990).</p> <p><i>Assessing Vibration: A Technical Guideline</i> (Department of Environment and Conservation (DEC), 2006).</p> <p>German Standard DIN 4150 Part 3.</p> <p>Section 7.2 of the environmental assessment.</p> <p>Response to submissions.</p>	Chapter 9 Section 10.3

4 Consultation

4.1 Consultation with the EPA

In accordance with the requirements of CoA B36(c), this NVMP has been developed in consultation with the EPA. A summary of consultation undertaken during the preparation of this NVMP is provided in Appendix A2 of the CEMP.

4.2 Consultation with sensitive receivers

Consultation will be undertaken with noise sensitive receivers 1, 3, 5 and 6 (refer Figure 5-1). The consultation process is documented in section 1.3 of the CEMP.

4.3 Ongoing consultation during construction

In consultation with noise sensitive receivers, contact details of relevant Fulton Hogan personnel, were provided. Noise sensitive receivers can therefore contact Fulton Hogan if they are concerned about the noise levels generated during the construction of the Toolijooa Road Fill Works. Noise complaints will be dealt with as documented in section 10 of this NVMP and in accordance with the Community Communication Strategy.

5 Existing environment

The Project study area, for the purposes of the EA noise assessment, extends from the junction of Toolijooa Road and the Princes Highway south of Gerringong to the junction of the Princes Highway and Schofields Lane, south of Berry. Defining features include Toolijooa Ridge, the Broughton Creek floodplain and the Foxground bends area. The study area incorporates a mix of land uses including pastureland and agricultural properties, rural residential areas and the town of Berry with its associated urban residential, recreational, commercial and light industrial areas.

5.1 Sensitive receivers

The rural areas within the vicinity of the Toolijooa Road Fill Works are dominated by pastureland and rural settlement patterns. Generally, the existing noise levels experienced at residences in this area is relatively low except for the sensitive receivers located in close proximity to the existing highway. In particular, residences located next to the existing highway between Toolijooa Road and Tindalls Lane are exposed to high traffic noise levels due to the braking and acceleration of vehicles on the steep grades and sharp bends that characterise this section of the existing highway.

The noise assessment undertaken as part of the EA process identified and considered potential noise impacts for 591 noise sensitive receiver locations, shown in Appendix E of the EA. A few rural residences are scattered at varying distances to the north, south and east of the Toolijooa Road Fill Works site. No other noise sensitive receivers such as schools or hospitals are located within the vicinity of the Toolijooa Road Fill Works site.

The location of the sensitive noise receivers are shown in Figure 5-1 and on the Sensitive Area Maps (Appendix A7).

5.2 Noise Monitoring

Background noise monitoring was conducted as part of the EA noise assessment. Background noise levels for the area reflect the daily traffic volume patterns. Traffic noise is the dominant noise source in the area. The detailed results of the noise monitoring are provided in the Noise and Vibration Technical Paper at Appendix E in the EA.

The background noise monitoring (logging) location relevant to the Toolijooa Road Fill Works stage is listed in Table 5-1 below and shown on Figure 5-1.

Table 5-1 Noise logging locations

Logger	Serial number	Address	Comments
BG2	194802	10 Austral Park Road, Broughton	460 m from existing alignment

A summary of the noise monitoring results from the EA that are relevant to the Toolijooa Road Fill Works stage are provided in Table 5-2.

Table 5-2 Background noise monitoring results (dB(A))

Noise logging location	Rating background level (RBL) dB(A)		
	Day (7am to 6pm) L_{A90}	Evening (6pm to 10pm) L_{A90}	Night (10pm to 7am) L_{A90}
BG2	40	41 (40) ²	40

Note 1: Night time L_{A90} has been adjusted to the lower evening L_{A90} .

Note 2: The numbers in brackets indicated the RBL with the INP adjustments included.

5.3 Noise Catchment Areas

Six Noise Catchment Areas (NCAs) representing the existing noise environments have been adopted for the Project. A description of the NCA within which the Toolijooa Road Fill Works stage is located is provided below in Table 5-3 and its location is shown on Figure 5-1.

Table 5-3 Noise catchment areas

NCA	Chainage		Representative logger	Notes
NCA1	Start	7500	BG2	BG2 is considered to be more representative of this NCA and provides a more conservative assessment.
	End	11100		

NOISE CATCHMENT AREA 1 INCLUDING BACKGROUND NOISE LOGGING, SENSITIVE RECEIVER AND NOISE MONITORING LOCATIONS

Toolijooa Road Fill Works Noise and Vibration Management Plan

FIGURE 5-1



AECOM, AECOM Design Solutions Pty Ltd disclaims all liability for all claims, expenses, losses, damages and costs any person/company may incur as a result of reliance on the accuracy or completeness of this document or its capacity to achieve any purpose.

6 Noise and vibration criteria

The following Chapter identifies the noise and vibration criteria relevant to the Toolijooa Road Fill Works stage of the Project that are required under the Project Approval and the EA.

6.1 Construction noise goals

CoA C8 requires that all feasible and reasonable noise mitigation measures be implemented with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) during construction activities. The main objectives of the ICNG are to:

- identify and minimise noise from construction works;
- focus on applying all ‘feasible’ and ‘reasonable’ work practices to minimise construction noise impacts;
- encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours;
- reduce time spent dealing with complaints at the project implementation stage; and
- provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

Under the Project Approval, “reasonable and feasible” is defined as the “*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.*”

6.2 Quantitative noise criteria

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

6.2.1 Residential Criteria

Table 6-1 sets out the NMLs at residences and how they are to be applied. The NMLs are based on the rating background level (RBL), which is the background noise level measured in the relevant assessment period (refer Table 5-2 above).

Table 6-1 Residential Noise Management Levels

Time of day	Noise Management Level $L_{Aeq(15\text{ min})}^*$	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> • Where the predicted or measured $L_{Aeq(15\text{ min})}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as

Time of day	Noise Management Level $L_{Aeq}(15\text{ min})^*$	How to apply
-------------	--	--------------

contact details.

Highly noise affected 75 dB(A)		<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <ul style="list-style-type: none"> Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

The construction NMLs specific to the Toolijooa Road Fill Works stage of the Project are presented in **Table 6-2**.

Table 6-2 Project-specific NMLs (dB(A))

NCA	Day (7am -6pm)		Evening (6pm-10pm)		Night (10pm-6am)		Morning Shoulder (6am-7pm)	
	RBL (LA_{90})	NML ($LA_{eq}(15\text{min})$)	RBL (LA_{90})	NML ($LA_{eq}(15\text{min})$)	RBL (LA_{90})	NML ($LA_{eq}(15\text{min})$)	RBL (LA_{90})	NML ($LA_{eq}(15\text{min})$)
1	40	50	40	45	40	45	40	45

Extended construction work hours have been assessed in accordance with the INP shoulder periods. The morning shoulder period is 6am to 7am Monday to Friday. The RBL for the morning shoulder period is the mid-point between the night-time and daytime RBL and the NML is the RBL + 5dB(A). Noise levels are between 0 - 3 dB(A) less stringent than the night-time NMLs.

6.2.2 Sleep disturbance criteria

The ECRTN suggests that for night-time activities, the $LA_{1(60\text{ second})}$ noise levels should be calculated and compared with the RBL plus 15 dB(A) as the sleep disturbance screening criterion. Further assessment is recommended where the screening criterion is exceeded, with consideration given to how often these exceedances occur.

The ECRTN also suggests that:

- maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions.
- one or two events per night with maximum internal noise levels of 65 dB(A) to 70 dB(A) are not likely to affect health and wellbeing significantly.

Given that a building with an open window provides up to 10 dB(A) noise attenuation from outside to inside, it is reasonable to assume that external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

6.3 Vibration goals

CoA C9 requires that all feasible and reasonable mitigation measures be implemented for the Project with the aim of achieving the following construction vibration goals:

- for structural damage to heritage structures, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration - effects of vibration on structures*;
- for damage to other buildings and/or structures, the vibration limits set out in the British Standard *BS 7385-1:1990 - Evaluation and measurement for vibration in buildings. Guide for measurement of vibration and evaluation of their effects on buildings*; and
- for human exposure, the acceptable vibration values set out in *Environmental Noise Management Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).

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

6.3.1 Heritage Structures

The German standard DIN 4150: *Part 3 – 1999 Effects of Vibration on Structure* (DIN 1999) guideline values for peak particle velocity (mm/s) are summarised in Table 6-3. The values applicable to Heritage Structures are shown bold in Table 6-3 and graphically on Figure 6-1.

Table 6-3 Structural damage criteria – Heritage Structures

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

* For frequencies above 100 Hz, at least the values specified in this column shall be applied.
Values referred to are at the base of the building

6.3.2 Other buildings and structures

British Standard *BS 7385: Part 2: 1993 'Evaluation and measurement for vibration in buildings Part 2. Guide to damage levels from ground borne vibration'* gives guidance on the levels of vibration above which building structures could be damaged. These values apply to buildings other than heritage buildings, including residential, industrial and commercial buildings, for the Project.

For the purposes of BS 7385 damage is classified as cosmetic (formation of hairline cracks), minor (formation of large cracks) or major (damage to structural elements). Guideline values given in the Standard are associated with the threshold of cosmetic damage only, usually in wall and/or ceiling lining materials. The BS 7385 values for vibration limits above which cosmetic damage could occur are provided in Table 6-4 and Figure 6-1 below.

Table 6-4 Transient Vibration Guide Values for Cosmetic Damage (BS 7385: Part 2:1993)

Line (see Fig 6.2)	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 to 15 Hz	15 Hz and above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 1. Values referred to are at the base of the building

Note 2: For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

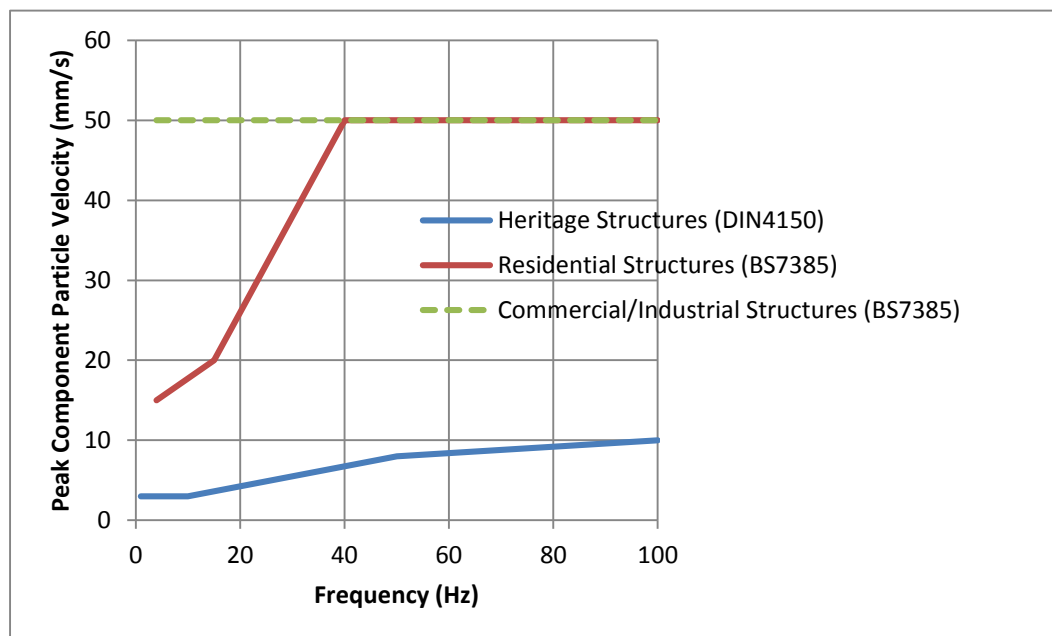


Figure 6-1 Summary of Project Vibration Criteria for Structures

6.3.3 Human Exposure

In accordance with CoA C9, the vibration criteria for the Project relating to human comfort are sourced from *Assessing Vibration – A Technical Guideline* (DEC, 2006) and include:

- continuous vibration from uninterrupted sources;

- impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period; and
- intermittent vibration such as from drilling, compacting or activities that would result in continuous vibration if operated continuously.

Table 6-5 identifies the relevant human exposure criteria for the Project.

Table 6-5 Preferred and maximum vibration acceleration criteria

Location	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s ²) in the vertical direction)				
Residences	0.010	0.020	0.007	0.014
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s ²) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Intermittent Vibration (m/s^{1.75})				
Residences	0.2	0.4	0.13	0.26

7 Environmental aspects and impacts

7.1 Environmental aspects

The Toolijooa Road Fill Works stage of the Project will involve a range of activities incorporating various heavy machinery, plant and equipment. 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; and
- earthworks and drainage.

Details of predicted sound power levels for the construction activities are provided in Section 8.

7.2 Impacts

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

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

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

Noise and vibration impacts attributable to the Toolijooa Road Fill Works Stage of the Project are anticipated. Further details of the predicted noise impacts are provided in Chapter 8. Chapter 9 provides a suite of mitigation measures that will be implemented to avoid or minimise these impacts on the receiving community and / or built environment.

8 Construction noise and vibration assessment

A range of plant and equipment will be required to undertake activities associated with the Toolijooa Road Fill Works stage of the Project. A summary of anticipated construction scenarios and predicted noise levels relevant to the Toolijooa Road Fill Works stage 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.

8.1 Construction activities

Table 8-1 provides a summary of construction scenarios, associated plant and equipment required and sound power levels (SWLs) relevant to the Toolijooa Road Fill Works stage of the Project, based on the assessment provided in the EA. Appendix A provides sound power level for individual items of equipment.

Table 8-1 Sound power levels for project construction scenarios

Scenario Ref	Construction Scenario	Typical equipment used	SWL Range (dB(A))	Expected working hours
A	Site establishment / landscaping	Excavators, chainsaws, mulching plant and chipper, cranes, generators, bobcat, powered hand tools, air compressor.	105-110	Standard
B	Earthworks	Road trucks, compactor, grader, multi-tyred and vibratory rollers, backhoe, sweeper, compressor, generators.	112-120	Standard

8.2 Construction noise impacts

8.2.1 General construction

Table 8-2 provides a summary of predicted noise impacts and NMLs for NCA1.

Table 8-2 Predicted levels of construction noise during standard construction hours (daytime)

NCA	Daytime NML	Extended hours AM NML*	Extended hours PM NML*	Scenario	Predicted noise level			
					Representative	Receivers exceeding NMLs	Worst Case	Receivers exceeding NMLs
NCA1	50	45	45	A	60	3	65	4
				B	67	4	75	12

* Refer to Section 6.2.1 for a definition for extended hours

For each of the construction activities described in Table 8-1, a worst case and representative scenario was assessed to predict impacts on nearby sensitive receivers during standard hours of construction. This does not factor in reductions on noise levels that can be achieved through reasonable and feasible mitigation measures.

The representative scenario reflects a most likely scenario, in which not all the equipment would be in use at the same time. The worst case scenario represents a larger number of the equipment being in operation at the same time. The results for each scenario and the number of sensitive receivers that would be impacted are provided in Table 8-2.

It should be noted that the worst case scenarios do not necessarily represent the noise impact at sensitive receivers for an extended period of time. Highly noisy activities, are only likely to occur for a small period within the total construction period. The worst case scenario would be ameliorated by the implementation of appropriate mitigation measures, as outlined in Chapter 9.

It is difficult to ascertain accurately from the construction noise modelling results (refer to the noise contour figures in Appendix F of *Volume 2 Appendix E Technical paper: Noise and vibration* of the EA) exactly which sensitive receivers within the vicinity of the proposed Toolijooa Road Fill Works stage exceed the NMLs. However it is likely that sensitive receivers 1, 3, 5 and 6 (refer Figure 5-1) will exceed the representative NMLs and possibly the worst case NMLs. An additional sensitive receiver that was not identified in the EA, but has the potential to exceed the NMLs is the farm residence to the east of Toolijooa Road at 295 Princes Highway, Gerringong (refer Figure 5-1). It is likely that these sensitive receivers would require noise mitigation, as detailed in Chapter 9.

According to the construction noise impact assessment results provided in the EA, there are no highly noise affected sensitive receivers (above 75dB(A)) in NCA1 and therefore within the vicinity of the Toolijooa Road Fill Works stage. If it was found during construction noise monitoring that receivers within the vicinity of the Toolijooa Road Fill Works were highly noise affected, then these sensitive receivers would require noise mitigation, as detailed in Chapter 9.

8.3 Construction vibration assessment

8.3.1 Vibration assessment

Table 8-3 list vibration intensive plant likely to be used during construction of the Toolijooa Road Fill Works and provides recommended safe working distances that relate to cosmetic / structural damage and human discomfort for the proposed works.

Table 8-3 Recommended safe working distances for vibration intensive plant (construction noise strategy, TfNSW 2011)

Plant description	Rating / description	Safe working distance	
		Cosmetic damage (m)*	Human response (m)**
Vibratory roller	< 50 kN (Typically 1-2t)	5	15-20
Vibratory roller (2-4 tonne)	< 100 kN (Typically 2-4t)	6	20
Vibratory roller (4-6 tonne)	< 200 kN (Typically 4-6t)	12	40
Vibratory roller (7-13 tonne)	< 300 kN (Typically 7-13t)	15	100
Vibratory roller (13-18 tonne)	> 300 kN (Typically 13-18t)	20	100
Vibratory roller (>18 tonne)	> 300 kN (> 18 t)	25	100
Jackhammer	Handheld	1 Nominal	Avoid contact with structure

*BS 7385

**OH&E Assessing Vibration – A Technical Guideline

The extent of the potential construction vibration impact is dependent on the type of equipment, the activity being undertaken and the separation distance. Earthworks at the Toolijooa Road Fill Works site are expected to be the major vibration-causing activity, given the use of vibratory rollers. There is a higher likelihood that these activities would cause human annoyance up to 100 m from the construction area. For structural impacts, the likelihood of cosmetic damage to buildings, would be higher, up to 25 m from the Toolijooa

Road Fill Works stage of the Project. The closest building to the proposed Toolijooa Road Fill Works is a residence on the opposite (northern) side of the Princes Highway, approximately 40 m at its closest point (refer sensitive receiver 3 in Figure 5-1). It is therefore unlikely that the proposed Toolijooa Road Fill Works will cause any structural impacts or cosmetic damage to neighbouring buildings.

There are likely to be instances where vibration intensive activities occur outside the safe working distance for human response and cannot be avoided. In these instances, the mitigation and management measures outlined in Chapter 9 will be implemented.

9 Environmental control measures

A range of environmental requirements and control measures are identified in 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 9-1.

9.1 Construction Hours

9.1.1 Standard construction hours

In accordance with CoA C3, the Contractor will only undertake construction activities associated with the Toolijooa Road Fill Works stage of the Project during the following standard construction hours:

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

9.1.2 High noise impact activities and works

In accordance with CoA C5, except as expressly permitted by the Project Environment Protection Licence (EPL), high noise impact activities and works shall only be undertaken:

- (d) between the hours of 8:00am to 6:00pm Mondays to Fridays;
- (e) between the hours of 8:00am to 1:00pm Saturdays; and
- (f) 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.

Although high noise impact activities and works are highly unlikely to be undertaken during the construction of the Toolijooa Road Fill Works, if they are required, they will be undertaken in accordance with the requirements stipulated above.

Table 9-1 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
CONSTRUCTION NOISE					
NVMM1	Prepare and implement a CNVMP that identifies reasonable and feasible approaches to reduce noise impacts during construction including for ancillary facilities.	CoA B36(c) EA Table 7-47	Pre-construction Construction Operation	Environmental Manager	This NVMP
NVMM2	Inform the community at least 48 hours before any out of hours work is to be undertaken and provide the following information: <ul style="list-style-type: none"> • Programmed times and locations of construction work. • Construction noise and vibration impact predictions. • Construction noise and vibration mitigation measures being implemented on site. 	EA Table 7-47	Pre-construction	Communications Manager	Community Communication Strategy
NVMM3 - 4	Not used.				
NVMM5	Implement a hot line and complaints handling procedure for noise and other construction related complaints.	CoA B31 CoA B36(c)(vi) EA Table 7-47	Pre-construction Construction Operation	Communications Manager	NVMP Chapter 9 Community Communication Strategy
NVMM6	Noise intensive construction works would be carried out during standard construction hours wherever practicable.	CoA C5 EA Table 7-47	Construction	Construction Manager	NVMP S9.1
NVMM7	Not used.				
NVMM8	Appropriate plant would be selected for each task, to minimise the noise impact.	EA Table 7-47	Construction	Foreman Operators	NVMP App A - Plant and equipment sound power levels
NVMM9	Deliveries would be carried out during standard construction hours.	CoA C3 EA Table 7-47	Construction	Foreman	
NVMM10	Non-tonal reversing alarms would be fitted on all construction equipment where possible.	EA Table 7-47	Construction	Foreman Operators	
NVMM11	If it is safe, night-time activities would be planned and conducted in such a manner as to eliminate or minimise the	CoA C4 EA Table 7-47	Construction	Construction Manager	

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
	need for audible warning alarms.			Foreman	
NVMM12	The offset distance between noisy plant items and nearby residential receivers would be maximised.	EA Table 7-47	Construction	Foreman	
NVMM13	Noisy equipment would be oriented away from residential receivers.	EA Table 7-47	Construction	Foreman Operators	
NVMM14	Site access points and roads would be positioned as far as practicable away from residential receivers.	EA Table 7-47	Construction	Foreman	
NVMM15	Structures or enclosures would be used to shield residential receivers from noise sources where practicable.	EA Table 7-47 SoC NV1	Construction	Foreman	
NVMM16	Trucks would travel via internal haul routes and major roads and routes where practicable and would not be allowed to queue near residential dwellings.	EA Table 7-47	Construction	Foreman	
NVMM17	Respite periods would be considered during times of noise intensive works where sensitive receivers would be adversely impacted for extended periods. These could include late start and/or early finishes.	EA Table 7-47	Construction	Construction Manager	NVMP S9.1
NVMM18	Noise intensive works would be carried out during standard working hours to minimise the potential impacts on sensitive receivers.	EA Table 7-47	Pre-construction Construction	Construction Manager	NVMP S9.1
NVMM19 - 20	Not used.				
CONSTRUCTION VIBRATION					
NVMM21	Prepare and implement a CNVMP that identifies reasonable and feasible approaches to reduce vibration impacts during construction including for ancillary facilities.	EA Table 7-47 CoA B36(c)	Pre-construction Construction	Environmental Manager	NVMP Section 9
NVMM22	Vibration intensive works would not occur outside the safe working distances outlined in Table 7-43 of the EA unless necessary.	EA Table 7-47	Construction	Foreman	NVMP Section 8.3
NVMM23	If vibration intensive works would be required outside the safe working distances outlined in Table 7-43 of the EA, alternative equipment would be used to ensure these distances are not exceeded.	EA Table 7-47	Construction	Foreman	NVMP Section 8.3

ID	Measure / Requirement	Reference	When to implement	Responsibility	Where Addressed
NVMM24	If vibration intensive plant is to be used within the safe working distance for cosmetic damage, works would not proceed until attended vibration measurements are undertaken.	EA Table 7-47	Construction	Foreman Noise specialist	NVMP Section 8.3
NVMM25	Not used.				
NVMM26	Dilapidation surveys of the affected properties would be considered, and if required, undertaken prior to the commencement of construction.	CoA 36(c)(v) SoC NV1 EA Table 7-47	Pre-construction Construction	Environmental Officer Noise Specialist	
NVMM27	Not used.				

10 Compliance management

10.1 Roles and responsibilities

The Fulton Hogan Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 10 of this NVMP.

10.2 Training

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

- existence and requirements of this NVMP;
- relevant legislation;
- restricting all work to within standard construction hours;
- location of noise sensitive areas;
- general noise and vibration management measures;
- complaints reporting;
- specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

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

10.3 Inspections and monitoring

Weekly and other routine inspections by Environmental Officers, RMS, and the ER will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Section 8.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Toolijooa Road Fill Works stage of the Project. Monitoring will be undertaken by the Environmental Manager during construction of the Toolijooa Road Fill Works stage of the Project.

10.3.1 Noise monitoring

Noise will be monitored during construction of the Toolijooa Road Fill Works as follows:

- on a monthly basis at noise monitoring locations indicated in Figure 5-1, to determine the effectiveness of mitigation measures against predicted impacts. Monitoring locations are considered representative of other sensitive receivers within the particular noise catchment;
- 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 8.2 of this NVMP;
- noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise; and
- ongoing spot checks of noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with manufactures specifications.

Where actual noise levels are found to 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 AS1259.2-1990 *Acoustics – Sound Level Meters, Part 2: Integrating – Averaging* and carry appropriate NATA (or manufacturer) calibration certificates.

10.3.2 Vibration monitoring

As discussed in Section 8.3, it is unlikely that any vibration intensive activities will take place outside the safe working distances specified in Table 8-5 and therefore vibration monitoring is unlikely to be required during construction of the Toolijooa Road Fill Works stage.

However if vibration intensive activities were found to be required within the safe working distances specified in Table 8-5, vibration will be monitored during construction of the Toolijooa Road Fill Works as follows:

- for the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work within 50 m of buildings to ensure that safe vibration levels specified in Section 6.3 are not exceeded and to confirm safe working distances identified in Section 8.3.1;
- 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.

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 *Assessing Vibration: A Technical Guideline* (DECC 2006).

10.4 Non-conformances

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

10.5 Complaints

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

resident complaints will be responded to in a timely manner and action taken will be recorded in accordance with the CCS.

10.6 Auditing

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

10.7 Reporting

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

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

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

11 Review and improvement

11.1 Continuous improvement

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

The continuous improvement process will be designed to:

- identify areas of opportunity for improvement of environmental management and performance;
- determine the cause or causes of non-conformances and deficiencies;
- develop and implement a plan of corrective and preventative actions to address any non-conformances and deficiencies;
- verify the effectiveness of the corrective and preventative actions;
- document any changes in procedures resulting from process improvement; and
- make comparisons with objectives and targets.

11.2 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 NVMP. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation, as described in Section 1.6 of the CEMP.

A copy of the updated NVMP 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

Indicative Plant and Equipment Sound Power Levels

Plant and equipment sound power levels (SWL) relevant to the Toolijooa Road Fill Works stage of the Project

Activity	Typical equipment used	Typical and maximum SWL dB(A)
Site Establishment / Landscaping	Typical SWL¹	105 - 110
	Chainsaws	110 - 118
	Mulching plant and chipper	113 - 121
	Cranes	104 - 112
	Generators	101 - 109
	Bobcat	104 - 112
	Powered hand tools	108 - 116
	Air compressor	109 - 117
	Excavators	99 - 107
Earthworks	Typical SWL¹	112 - 120
	Compactors	104 - 112
	Grader	103 - 111
	Multi-tyred and vibratory rollers	97 - 105
	Backhoe	103 - 111
	Sweeper	104 - 112
	Compressor	109 - 117
	Generators	101 - 109
	Road trucks	95 - 103

Source: EA Appendix E.

Note 1: The Typical SWL is for a 'typical site'. It represents a range of the equipment listed at various distances around the site with varying duty cycles. The levels have been refined from predictions and measurements undertaken at similar sites over many different projects. The typical levels are not a summation of all the equipment listed in this table.