Southern Sydney Freight Line
Construction Noise and Vibration Management Sub Plan

January 2009

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NCSI Certified Quality System ISO 9001

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Date: .....17 November 2008

Distribution: .....

Contents

Contents (continued)

Page Number

List of tables

List of Appendices

1. Introduction

1.1 Purpose and objectives

This Construction Noise and Vibration Management Sub Plan forms part of the Construction Environmental Management Plan (CEMP) for the Southern Sydney Freight Line. This Sub Plan has been developed for the purposes of guiding construction activity and work site management to mitigate the impacts of airborne noise and vibration in response to Conditions of Approval (CoA) No's 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50 and 60 (details included in Section 1.1.1).

The objective of the Construction Noise and Vibration Management Sub Plan (CNVMSP) is to provide a concise document to ensure that best practice is used to minimise construction noise and vibration impacts, particularly upon residential and other noise sensitive receivers.

The scope of this Sub Plan is to identify:

- Activities that may create construction noise and vibration.
- Surrounding residences, sensitive areas and habitats that may be impacted by construction noise and vibration.
- Relevant criteria and guidelines.
- The activities most likely to exceed criteria for airborne noise and vibration.
- Potential controls for airborne noise and vibration.
- Protocols for inspection and recording of conditions of property prior to exposure to vibration from construction works.
- Protocols for testing, monitoring and reporting of construction noise and vibration.
- Procedures for notifying residents of activities likely to result in exceedance of relevant noise and vibration criteria.
- Emergency and incident response procedures in the event of non-compliance and/or noise complaints.
- Protocols for preparation of site specific construction noise and vibration impact statements.

A glossary of noise terminology is included as Appendix A for further reference.

1.1.1 Conditions of Approval

The following CoA's relate to potential construction noise and vibration impacts from the project, and these are addressed within this Sub Plan.

Condition No.	Subject
39	The Proponent must prepare a Construction Noise and Vibration Management Sub Plan (CNVMSP) as part of the CEMP in consultation with Relevant Government Departments, Councils and Stakeholders and the CLG(s) to provide a framework for managing and mitigating construction noise and vibration impacts. The CNVMSP must provide details of general noise and vibration control and management measures to be implemented during construction. Detailed analysis and assessment of potential noise impacts and/or mitigation measures must be undertaken for each construction stage, major construction activity and construction compound in Noise and Vibration Impact Statements required by CoA 40.
40	Noise and Vibration Impact Statement(s) (NVIS) are to be prepared for each construction stage, major construction activity and construction compound prior to commencement of construction. The NVIS(s) must be prepared by a recognised acoustic consultant and address proposed construction and construction-related works including but not limited to: (a) a description of each construction activity including Ancillary Facilities, and their associated noise sources; (b) identification of all potentially affected noise sensitive receivers; (c) determination of appropriate noise and vibration objectives for each identified noise sensitive receiver; (d) the construction vibration objective specified in these Conditions of Approval; (e) assessment of potential noise impacts from the proposed construction methods including noise from construction vehicles and noise impacts from required traffic diversions; (f) examination of all reasonable and feasible noise mitigation measures including the use of alternative construction methods where potential noise impacts exceed the relevant objectives; (g) description and commitment to work practices which limit noise; (h) description of specific noise mitigation treatments and time restrictions including respite periods. Where possible programming of night works affecting residential and other sensitive areas over consecutive nights in the same locality shall be avoided; (i) justification for any activities outside the construction hours specified in CoA 43 - 44; (j) noise monitoring proposed and consideration of additional Reasonable and Feasible noise mitigation measures where noise objectives are exceeded; (k) consideration of erecting operational stage Reasonable and Feasible noise mitigation measures prior to construction commencement; (l) noise audit systems including recording of daily hours of construction, progressive impact assessments as the work proceeds, conducting informal checks by the EMR, providing active and continuous communication links to relevant Councils, residents etc; (m) procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity; and (n) an education program for construction personnel about noise minimisation With respect to (f) above, the Proponent shall consider the use of a range of structural and non-structural measures during construction including barriers, scheduling of construction activities to minimise impacts and temporary relocation of affected residents.
41	The CNVMSP will outline monitoring requirements for the project. This monitoring program will include the following measures: (a) Environmental noise and vibration monitoring will be undertaken within one week after commencement of each new stage of the construction works and monthly

Condition No.	Subject
	thereafter. This monitoring programme will be reviewed after six months, subject to the proposed construction activities; (b) Noise monitoring will be undertaken using a calibrated sound level meter. The measurements would determine the LA_{10},15min airborne construction noise levels received external to any sensitive receiver. In respect of airborne noise, in many instances, existing ambient noise levels would be high due to traffic. Where required, an estimate of the LA_{10} levels may be made from spot checks of short duration maximum noise level emissions from the site (e.g. during breaks in traffic); and (c) Vibration levels would be monitored using an appropriate vibration monitoring system when perceptible vibration levels are likely.
42	The Proponent must obtain independent verification of the adequacy of the noise impact assessment and proposed mitigation measures presented in the NVIS's prior to submitting the report to the Director-General. The findings of the independent verification must be submitted to the Director-General with the CNVMSP.
43	Construction will be restricted to between the hours of 7:00am to 6:00pm (Monday to Friday), 8:00am to 1:00pm (Saturday) and at no time on Sundays or public holidays except: (a) for the delivery of materials required outside these hours by the Police or other authorities for safety reasons; or (b) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (c) where the work is identified in the Construction Noise and Vibration Management Plan and approved as part of the CEMP; or (d) any works requiring track possessions subject to the following: i the associated noise levels would be similar to the noise levels associated with programmed maintenance works; ii works which do no include high noise generating works including sheet piling, pile driving, rock hammering/breaking etc. unless otherwise agreed by the director-general following consultation with the DEC; and iii notification of the community at least 14 days in advance of such works including likely times and duration; or (e) any works within the rail corridor (with the exception of track possessions), subject to the approval of the DEC as part of the process in developing the Construction Noise and Vibration Management Plan; or (f) any other work as agreed by the Director-General in consultation with the DEC and considered essential to the project and where it can be demonstrated that it would achieve a better environmental outcome, through the Construction Noise and Vibration Management Sub Plan process. Local residents will be informed of the timing and duration of work approved under item (c) at least 48 hours before that work commences.
44	Rock breaking, rock hammering, sheet piling, pile driving and any similar activity must only occur between the following hours unless otherwise approved in the Construction Noise and Vibration Management Sub Plan: (a) 9am to 12pm and 2pm to 5pm Monday to Friday; and (b) 9am to 12pm Saturday.
45	The construction noise objective for the Project is to manage noise from Construction activities (as measured by a LA_{10} (15 minute) descriptor) so as to not exceed the background L_{90} noise level by more than 5 dB(A) at any residence or other noise sensitive receiver. Where this cannot be achieved, all Reasonable and Feasible noise mitigation and management measures are to be implemented to achieve the construction noise objective to the greatest extent possible. Any activities that may cause noise emissions that exceed the objective shall be identified and managed in accordance with the Noise and Vibration Impact Statements. For the purposes of the noise objective for this Condition, 5 dB(A) must be added to the measured level if the noise from the activity is substantially tonal or impulsive in nature in accordance with Chapter 4 of the NSW Industrial Noise Policy.
46	Vibration caused by Construction and received at any structure outside the Project

Condition No.	Subject
	must: (a) For structural damage vibration be limited to German Standard DIN 4150 Part 3 Structural Vibration in Buildings. Effects on Structures; and (b) For human exposure to vibration be limited to evaluation criteria presented in British Standard BS 6472 – Guide to Evaluate Human Exposure to Vibration in Buildings 1Hz to 80Hz) for low probability of comment. These limits apply unless otherwise approved in the CNVMSP.
47	The Proponent must consult with education institutions and minimise the impact of noise generating Construction works in their vicinity. The Proponent must ensure that Construction works audible at an institution are not timetabled during important events, such as examination periods, unless arrangements acceptable to the affected institutions are made at no cost to the affected institutions.
48	The Proponent must ensure that public address systems used at any Construction work site are not used outside the Construction hours detailed in the Conditions of Approval unless otherwise approved through the Construction Noise and Vibration Management Sub Plan. Public address systems must be designed to minimise noise spillage off-site.
49	Wherever practical, piling activities must be completed using bored piles unless otherwise agreed by the Director-General. If driven piles are proposed, reasons why they are required must be specified in the CEMP.
50	Blasting is not permitted during construction unless otherwise approved by the DEC in an Environmental Protection Licence.
60	The Proponent must prepare and implement a Biodiversity Management Sub Plan (BMSP) in consultation with Relevant Government Departments and Councils and the CLG and in accordance with the SoC as part of the CEMP. The BMSP must include: (b) methods to manage impacts on flora and fauna species (terrestrial and aquatic) and their habitat which may be directly or indirectly affected by the Project. These will include: ix. boring of piles at Cabramatta Creek bridge to minimise impacts to an existing camp of the threatened Grey-headed Flying-fox at Cabramatta.

1.2 Work description

Details of the construction activities and the work packages for the SSFL project are detailed in Section 2.3 of the Master CEMP.

1.3 Existing environment and site specific issues

The environment surrounding the rail corridor encompasses rural, suburban and urban spaces. Within these there are both residential and commercial buildings that would be affected by noise associated with the construction works. The areas around the corridor are most densely populated at the northern end in terms of both residential and commercial receivers.

1.3.1 Residential and non-residential NCA's

The various residential areas potentially affected by the proposed works have been split into a number of Noise Catchment Areas (NCAs). The NCA locations, baseline noise monitoring locations and indicative track possession areas have been mapped on the project Constraints maps and are presented in Appendix B. These are the areas that have been identified in the project Noise and Vibration Assessment Report, (Report No. 05032, Version F, April 2006, Wilkinson Murray Pty. Ltd.) of the Environmental Assessment. Table 1-2 summarises the 59 NCA's, lists the streets included in the NCA and the type of premises that may be potentially exposed to construction noise and vibration.

Table 1-1 Residential and non-residential NCA's

NCA No.	Residential Streets	Comments
MAC1	Gilchrist Drive/Narellan Road intersection	Two single storey dwellings separated from the rail corridor by Gilchrist Oval
CAM1	Church of God Training Centre and Christian Life Centre	Located at 4 Watford Road.
LEU1	Kulgoa Street	Single and double storey dwellings
LEU2	O'Sullivan Road	Two storey townhouses
MIN1	Somerset Street	Small area of single storey residential on otherwise commercial street
MIN2	Minto Road	Single storey residences
MIN3	Victoria Road	One single storey and a number of double storey dwellings
ING1	Ingleburn Road	Single and double storey dwellings
	Stanley Road (South)	Single storey dwellings
ING2	Stanley Road (North)	Single storey dwellings
ING3	Redfern Street	Single storey dwellings
	Gordon Avenue	Single storey dwellings
	James Street	Single storey dwellings
MAQ1	Railway Parade (South)	Mainly single storey
MAQ2	Railway Parade (North)	Mixed single and double storey dwellings
	Clarence Street	Mixed single and double storey dwellings
MAQ3	Atchison Road	Single storey dwellings
	Railway Parade	Single storey dwellings
GLE1	Railway Parade	Mixed single and double storey dwellings
GLE2	Hurlstone Agricultural High School and Department of	Contains residential accommodation for boarders as well as teaching spaces. 150m west of west of rail

NCA No.	Residential Streets	Comments
	Education Regional Centre	corridor (near Glenfield station).
GLE3	Railway Parade	Mixed single and double storey dwellings
CAS1	Slessor Road	Single storey dwellings elevated above corridor
CAS2	Leacocks Lane	Mixed single and double storey dwellings
CAS3	Leacocks Lane	Mainly double storey dwellings
CAS4	Casula Road	Mainly double storey dwellings
	Buckland Road (South)	Mainly double storey dwellings
CAS5	Casula Regional Arts Centre	Accessed from Casula Road. Has an approved DA for a Theatre and Art Gallery
CAS6	Buckland Road (North)	Double storey dwellings
	St Andrew Boulevard	Double storey dwellings
	Lakewood Crescent	Double storey dwellings
LIV1	Congressional Drive	Mixed single and double storey dwellings
	Burkedale Place	Mixed single and double storey dwellings
	Owen Crescent	Mixed single and double storey dwellings
	Speed Street	Mixed single and double storey dwellings
LIV2	Riverpark Drive	Four storey apartment blocks and double and three storey townhouses
LIV3	Speed Street	Three, Four and Five storey apartment blocks
LIV4	Liverpool Hospital and TAFE	To west of rail corridor, child care centre no longer present
WFA2	Station Street	Single storey dwellings
WFA1	Warwick Street	Double storey townhouses
CAB1	Broomfield Street	Single storey dwellings
CAB2	150 Broomfield Street	Double storey dwellings
CAB3	Railway Parade	Mainly single storey, some double storey and for storey apartment block
CAB4	Broomfield Street	Mainly single storey, one double and one four storey
CAB5	Broomfield Street	Double and three storey dwellings
CAB6	Broomfield Street	Single storey dwellings
CVA1	Lansdowne Road	Mixed four storey, double storey and single storey
	Fraser Road	Mixed four storey, double storey and single storey
CVA2	Carcoola Street	Single storey dwellings backing straight onto corridor
CVA3	Carcoola Street	Single storey dwellings separated from corridor by road
	Premier Street	Single storey dwellings
CAR1	Fraser Road	Single storey dwellings
CAR2	Prospect Road	Mostly single storey dwellings, one double storey directly adjacent to corridor
CAR3	Fraser Road	Single storey dwellings
	Ramsay Street	Single storey dwellings
CAR4	Moore Street	Single storey dwellings adjacent to new Prospect Creek Bridge
CAR5	Sandal Street (North side)	Mixed double, three and four storey dwellings

NCA No.	Residential Streets	Comments
	Carramar Avenue	Mixed double, three and four storey dwellings
	River Avenue	Mixed double, three and four storey dwellings
CAR6	Sandal Crescent (South side)	Two and three storey dwellings
	Wattle Avenue	Two and three storey dwellings
CAR7	Wattle Avenue	Single storey at Eastern end, Double at Western
CAR8	75 Wattle Avenue	Two storey dwelling
VIL2	Wattle Avenue	Single storey dwellings
VIL1	Wattle Avenue	Single storey dwellings elevated above track
	Kirrang Avenue	Single storey dwellings elevated above track
	Villawood Road	Single storey dwellings elevated above track
VIL3	River Avenue	Single storey dwellings separated from track by road
CHE2	Waldren Road	Four storey dwellings
CHE1	Wellington Road	Double storey townhouses
	Chester Hill Road	Double storey townhouses
CHE3	Wellington Road	Mainly single story dwellings with some double storey and a three storey apartment block at Western end
CHE4	Southern side of Waldren road	Single storey dwellings
SEF3	Wellington Road	Mainly single storey, some double and four storey at Eastern end
SEF4	Waldren Road	Mixed single and double storey
SEF5	1/113 Wellington Road	Single storey
SEF2	Wellington Road	Mixed single and double storey
SEF1	Wellington Road	Single storey dwellings
RPK1	Dana Parade	Double storey dwellings
RPK2	Cooper Road	Single storey dwellings

2. Legislative requirements and guidelines

Table 2-1 below sets out the guideline documents referred to in the development of this document.

Table 2-1 Legislative requirements and guidelines

Relevant legislation (administering authority)	Summary of legislation requirements	Approvals/Permits or licences required
Environmental Planning and Assessment Act 1979 (Department of Planning, Campbelltown, Fairfield and Liverpool City Councils)	Planning approval required for any significant changes or additional requirements for the project.	Works must be undertaken in accordance with the conditions of approval and statement of conditions. Notify ARTC Project Director if any significant changes to the project are desired. ARTC Project Director to identify any further environmental assessment required.
Protection of the Environment Operations Act 1997 (Department of Environment and Climate Change)	This Act enforces licences and approvals formerly required under separate Acts relating to air, water and noise pollution, and waste management with a single integrated licence. No specific noise or vibration limits are included within the Act. Reference normally made to *Environmental Noise Control Manual.*	In accordance with section 75V of the Environmental Planning and Assessment Act 1979, the environmental protection licence cannot be refused if the relevant works are necessary for the carrying out of an approved project. Environmental Protection License 12971 issued November 2008
Protection of the Environment Operations (Noise Control) Regulation, 2000	Provides provisions on matters relating to noise emissions, maintenance of control equipment, use of certain articles and inspection and testing procedures.	
Environmental Noise Control Manual, 1985 (Department of Environment and Climate Change)	Provides guidance on the control of construction noise in terms of time limits and numerical performance criteria depending on the duration of the works.	
Environment Protection Authority Environmental Noise Control Manual (1994)	Describes noise control policies and procedures within a framework or relevant legislation, acoustic theory and technology. Noise goals for construction works outlined.	
NSW Industrial Noise Policy, 2000 (Department of Environment and Climate Change)	Provides guidance on noise from industry, measurement of background noise levels and conducting noise assessments	
Environmental Criteria for Road Traffic Noise, 1999 (Department of Environment and Climate Change)	Provides guidance on noise from road traffic, though not specifically in relation to construction traffic.	

Relevant legislation (administering authority)	Summary of legislation requirements	Approvals/Permits or licences required
Australian Standard AS 2436 Guide to noise Control on Construction, Maintenance and Demolition Sites (1981)	Outlines considerations for addressing noise emissions from construction works	
Australian Standard AS 1055 Acoustics – Description and Measurement of Environmental Noise (1997)	Outlines provisions for the measurement of environmental noise levels	
Australian Standard AS 2107 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (2000)	Recommends internal noise levels for various land-uses and habitable rooms	
Department of Environment and Conservation Assessing Vibration: a Technical guideline (2006)	Presents preferred and maximum vibrations values for use in assessing human response to vibration and provides recommendations for measurement and evaluation techniques.	
Department of Environment and Climate Change NSW, Construction Noise Guideline Draft for Consultation, August 2008	This guideline aims to provide assistance at managing noise from construction works regulated by DECC	
Environmental Noise Management – Technical guideline, Assessing Vibration (ENMAV) Department of Environment, 2006	Guide to assessing vibration	

Changes to legislation, regulations or guidelines during site works will require “corrective action’ to review and assess the impacts of the legislation on the environmental management of the site. Affected procedures will be modified accordingly.

3. Performance objectives

Existing baseline noise levels for the surrounding environment to the SSFL alignment were measured at ten unattended locations as part of the Noise and Vibration Report (Report No. 05032, Version F, April 2006, Wilkinson Murray Pty. Ltd.).

3.1 Noise objectives

3.1.1 Airborne construction noise

The construction works must be undertaken in accordance with the NSW EPA Environmental Noise Control Manual (ECNM). Chapter 171 of the ECNM provides the following acoustic design objectives for construction activities.

Table 3-1 Acoustic design objectives for construction activities

Construction period	Acoustic design objectives
<4 weeks	Received $L_{A10} \leq L_{A90}$ + 20 dB(A)
>4 weeks and <26 weeks	Received $L_{A10} \leq L_{A90}$ + 10 dB(A)
>26 weeks	Received $L_{A10} \leq L_{A90}$ + 5 dB(A)

Noise levels are measured at the nearest potentially affected receivers over a period of time not less than 15 minutes during any construction activity. For commercial premises, an exceedance of 5 dB(A) is permitted over the construction noise goals for residential premises detailed in Table 3-1.

Table 3-2 details adopted construction noise design objectives for some of the identified noise catchment areas from measured baseline noise environs. These objectives are based on the rating background level (RBL) background noise levels measured at the ten unattended monitoring locations presented in the Noise and Vibration Assessment Report (Report No. 05032, Version F, April 2006, Wilkinson Murray Pty. Ltd.).

Table 3-2 Adopted construction noise design objectives at noise monitoring locations in selected NCA's

Loc No.	NCA	Address	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
A	LEU1	22 Kulgoa Street, Leumeah	47	48	42
B	MIN1	16 Somerset Street, Minto	48	49	44
C	GLE3	24 Railway Parade, Glenfield	48	47	40
D	CAS1	21 Slessor Road, Casula	42	43	40
E	LIV2	86/3 Riverpark Drive, Liverpool	46	48	45
F	CAB2	150 Broomfield Street Cabramatta	45	47	41
G	CAR1	18 Fraser Road, Canley Vale	40	40	35
H	CAR8	75 Wattle Avenue, Carramar	40	40	35
I	SEF5	Unit 1, 113 Wellington Road, Sefton	47	51	43
J	SEF1	33 Wellington Road, Birrong	47	50	45

Due to the nature of track construction, the number of operations and the duration at any particular locations, the cumulative duration of construction works associated with this project may, exceed 26 weeks at many (if not most) nearby residences, and therefore noise criteria have been adopted based on this assumption.

The above criteria assume there will be no annoying characteristics associated with received construction noise levels. Where the character of the noise from the activity is substantially tonal or impulsive in nature in accordance with Chapter 4 of the NSW Industrial Noise Policy 2000, a correction will be applied to the rating level.

Specific noise design objectives have been assigned for all of the other 49 NCA's along the SSFL route and are presented in Table 3-3. These have been based on the design objectives presented in Table 3-2 for existing similar land-uses, surrounding noise sources and proximity to the noise monitoring location as follows:

- Suburban areas adjacent or opposite industrial zones (LEU1)
- Quiet suburban areas adjacent to parks, woodlands (CAS1)
- Suburban areas (SEF1) potentially influenced by traffic noise

Table 3-3 Adopted noise design objectives at all other NCA's

Monitored NCA locations	NCA	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night) (10pm – 7am)
LEU1	CAM1, LEU2, MIN 1, MIN2, ING1, ING2, ING3, CHE2, SEF2,	47	48	42
CAS1	MIN3, GLE1, GLE2, CAS2, CAS3, CAS4, CAS5, CAS6, LIV1, WFA1, WFA2, CAB1, CAR4, CAR5, CAR6,	42	43	40
SEF1	MAC1, LIV2, LIV3, LIV4, CAB2, CAB3, CAB4, CAB5, CAB6, CVA1, CVA2, CVA3, CAR2, CAR3, CAR7, VIL1, VIL2, VIL3, CHE1, CHE3, CHE4, SEF3, SEF4, RPK1, RPK2	47	50	45

During construction, where assigned noise design objectives are not considered suitable for a particular NCA, more appropriate objectives will be provided based on a review of the criteria described above.

TIDC released a Construction Noise Strategy (Rail projects) in November 2007. Section 5 provides some guidance on the need to provide additional management of noise when further mitigation at source is not feasible or reasonable. This approach will be adopted by the SSFL project.

Where the noise objectives cannot be achieved, ARTC will implement strategies included in the TIDC Construction Noise Strategy. Any activities that may cause noise levels exceeding the objective shall be identified and managed in accordance with the SSFL Noise and Vibration Assessment (April 2006).

3.1.2 Construction traffic noise

Noise from construction road traffic is to be managed in an effort to achieve a target of 55 dB(A) (daytime) in terms of the $L_{Aeq,1hr}$ descriptor.

This standard is based on the DECC's *Environmental Criteria for Road Traffic Noise (1999)* which indicates that for "Land use developments with potential to create additional traffic on local roads", $L_{Aeq,1hr}$ noise levels should not exceed 55 dB(A) during the day (7am to 10pm) and 50 dB(A) at night (10pm to 7am). This is termed the 'base criteria'. This applies to developments that could permanently change the traffic characteristics on the road, and hence application to temporary construction traffic is conservative.

DECC's *Environmental Criteria for Road Traffic Noise (1999)* states that in all cases, traffic arising from the development should not lead to an increase in existing noise levels by more than 2 dB(A). This is termed the 'allowance' criteria.

Road traffic noise criteria are specified for long-term planning goals that generally relate to a permanent situation rather than a temporary one during construction. Given this, the recommended 'allowance' criteria have been adopted as a guideline level within this management plan.

3.1.3 Regenerated noise

Regenerated noise (structure borne noise) can occur inside dwellings due to in-situ vibration transferral. Regenerated noise generally requires detailed consideration during the evening and night-time periods. During the day-time period, noise intrusion from airborne noise will be expected to dominate.

For the purposes of this management plan, tactile vibration limits have only been reference for the day time interval.

3.2 Vibration from construction

Two main issues will be present in relation to vibration levels from construction. These are expected to include disturbance to residents from intermittent vibration resulting from activities such as heavy vehicle passage and potential architectural / structural damage to off-site buildings.

Generally, if disturbance issues are controlled, there exists limited potential for structural damage to buildings.

Human comfort and structural damage limits vary across the frequency spectrum, although they are generally a constant level across the frequency range generated by most construction activities. Adopted vibration criteria have been outlined as follows.

3.2.1 Annoyance / human comfort

The NSW DEC *Environmental Noise Management Assessing Vibration: a technical guideline (2006)* provides recommendations for vibration criteria from continuous, impulsive and intermittent sources.

The construction works associated with the SSFL line, with vibration sources such as bulldozers, rockbreakers, piling rigs, vibratory roller and associated machinery, are defined

as intermittent sources. This type of vibration is assessed on the basis of vibration dose levels.

Table 3-4 Acceptable vibration dose levels for intermittent vibration (m/s$^{1.75}$)

Location	Daytime[1]	
	Preferred value	Maximum value
Critical areas[2]	0.10	0.20
Residences	0.20	0.40
Offices, schools, educational institutions and places of worship	0.40	0.80
Workshops	0.80	1.60

Notes: 1 Daytime is the period between 7:00am and 10:00pm

2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas

Sources BS 6472-1992

3.2.2 Structural damage

Although not specified by DECC, German Standard DIN 4150: Part 3-1986 provides guidance on vibration velocity for evaluating potential structural damage. The adopted limits are generally considered to be conservative. Table 3-5 presents the adopted limits.

Table 3-5 Adopted structural damage vibration levels

Building type	Vibration velocity			
	Frequency range at foundation			Plane of floor of uppermost storey
	< 10 Hz	10 – 50 Hz	50 – 100 Hz	All frequencies
Residential dwelling	5 mm/s	5 – 15 mm/s	15 – 20 mm/s	15 mm/s
'Sensitive' structure	3 mm/s	3-8 mm/s	8 – 10 mm/s	8 mm/s

Notes: Vibration levels between 1 Hz to 80 Hz based on "low probability of adverse comment"

The above values are measured in any direction at the foundation or maximum levels measured in x, y horizontal directions in the plane of the upper most floor

"Structural damage" within DIN 4150 also includes minor non-structural effects such as superficial cracking in cement render

Vibration levels higher than the 'safe limits' does not automatically imply that structural damage will occur

Where magnification occurs due to resonance, up to a 50% penalty may apply to the listed criteria

4. Potential impacts

4.1 Construction noise

The plant and equipment likely to be used in various phases of the construction process (as detailed in Chapter 5, Volume 1 of the Environmental Assessment) is outlined in Table 4-1. The actual construction method and staging may vary in detail from the description in the Environmental Assessment, as a result of detailed design changes and community consultations, and such changes are incorporated in this Sub Plan.

Table 4-1 Overview of construction Influences on NCA's

Phase	Typical works
Phase A - Service Relocation	Excavator, concrete truck, concrete pump, concrete vibrator, crane, jackhammer, flat bed truck
Phase B – Earthworks	Concrete truck, excavator, rockbreaker, bored piling rig, tip truck, flat bed truck, crane, vibratory roller
Phase B - Retaining walls (including track bed near Georges River and cutting at Sefton Park Junction)	Bored piling rig, road truck, crane, concrete truck, concrete pump, concrete vibrator, air track drill
Phase B - Station Works	Excavator, hydraulic hammer, tip truck, concrete truck, concrete pump, flat bed truck, crane, vibratory roller, loader, hand power tools
Phase B – Bridge Works	Excavator, hydraulic hammer, tip truck, piling rig, concrete truck, concrete pump, flat bed truck, crane, asphalt paver, vibratory roller, loader, hand power tools
Phase C – Track Laying	Track laying machine, tamping machine, ballast regulator, rail grinding machine

Source: Maunsell/Aecom, 2005a and WMPL

The nature of track construction is that the site of construction moves along the route of the railway line. Hence, receivers near any particular location are exposed to noise for only a small proportion of the total construction period but all NCAs identified along the rail corridor would be affected by some works. However, some activities such as bridge works and work at stations are more site specific and would therefore affect only some of the NCAs.

The NCAs affected by bridge and station works are identified in Tables 4-2 and 4-3 below. These exclude work to footbridges as the duration of such works would typically be less than for road and rail bridges; also the majority of these are associated with stations and are expected to form part of the station works.

Table 4-2 Construction influences on NCAs for bridge work

Location	NCA Influenced by Activities
Narellan Road	MAC1
Underbridge North of Lumeah Station	LEU1
Canal bridge North of Ingleburn Station	ING1
Casula Flyover	CAS2, CAS3, GLE3
Glenfield Creek	CAS3, CAS4
Wood Brook Road	LIV1, CAS6
Riverpark Drive	LIV2, LIV3
Extension over Georges River	LIV2
Sussex Street	CAB1, CAB2
Bareena Street	CVA2, CAB6
Prospect Creek	CAR4-CAR6 (inclusive)
The Horsley Drive	VIL2, CAR8
Chester Hill Road	CHE1, CHE3
Hector Street	SEF4, CHE3
Woods Road	SEF2

Table 4-3 Construction influences on NCAs for station work

Station	NCA Influenced by Activities
Lumeah	LEU2
Minto	MIN1
Casula	CAS4, CAS6
Warwick Farm	WFA1
Cabramatta	CAB4, CAB5
Sefton	SEF3 – SFE5 (inclusive)

At this stage detailed information on the construction schedule has not been finalised. As this information becomes available, the appropriate authorities will be advised and the information presented in each Noise and Vibration Impact Statement (NVIS).

Noise sources for the various phases of the site works include, but may not be limited to items listed in Table 4-4 below.

Table 4-4 Source noise levels for construction equipment

Plant	Typical Sound Power Level (dB(A))
Excavator	112
Concrete truck	112-115
Concrete pump	102
Concrete vibrator	108
Crane	115
Compressor and jackhammer	108
Road truck (tip truck or flat bed truck)	108
Rockbreaker	118
Bored piling rig	119
Vibratory roller	108
Air track drill	116
Hydraulic hammer	112
Loader	105
Hand power tools	100
Piling rig	119
Asphalt paver	105
Track laying plant (combined)	110 – 115

The above sound emission data will need to be verified by the ARTC and the construction contractors prior to the commencement of construction activity. The verification works will need to include an assessment of potential annoying characteristics. Assessment of noise emission levels from reversing alarms will also be presented.

For each of the construction activities listed in Table 4-1, a “minimum” and “maximum” list of simultaneously-operating equipment has been developed and the total sound power level of each was calculated from the values presented in Table 4-4.

Table 4-5 represents the maximum sound power output, and an allowance of 5 dB(A) has been made for the fact that all equipment would not operate at maximum power simultaneously for the duration of a measurement period (typically 15 minutes).

Table 4-5 Summary of construction noise source levels

Construction Phase	L_{A10} Sound Power Level (dB(A))	
	Minimum	Maximum
Service relocation	111	114
Earthworks	113	117
Retaining walls	111	117
Station works	111	115
Bridge works	113	117
Track works	105	110

The maximum noise levels in Table 4-5 have not accounted for sleep disturbance. Notwithstanding, it is not unreasonable to assume that the potential exists for elevated L_{A1} noise impacts during the night time period. The construction noise management measures outlined in Section 5 would provide control to both L_{A10} and L_{A1} noise impacts.

Assessment of potential construction noise impacts has been undertaken for each of the 59 noise catchment areas. Typical minima and maxima have been provided for each NCA and are presented in Table 8-5 of the Noise and Vibration Assessment Report (Report No. 05032, Version F, April 2006, Wilkinson Murray Pty. Ltd.). For ease of reference, these noise levels have been presented in Appendix C of this sub-plan. Noise impacts have been assessed, for means of comparative analysis to the ENCM construction noise design objectives. Table 8-5 of this report shows that maximum noise levels from construction activities would exceed the criteria at all NCAs. The maxima are noise levels to be expected when the noisiest plant items such as hydraulic hammers are in use. However, maximum noise levels would exist at any particular house for only a short period of time although areas close to bridge works and station works would be subject to construction noise for longer periods. Maximum noise levels would be temporary and as track work and other activities move along the corridor, the noise levels would drop below the noise criteria.

Predicted received construction noise impacts demonstrate potential exceedance of the construction noise design objectives at all NCA's. No noise management and mitigation strategies or treatments have been considered as part of the impact assessment.

4.1.1 Site compound activities

Construction work sites will be required at both Sefton and Glenfield due to the major civil works required at these locations, the length of construction activity and the large construction team size. The exact location of each site has yet to be confirmed. However, the Railcorp depot located within the Sefton Park Junction 'triangle' and the private landfill facility located on the eastern side of the Glenfield flyover. Are suitable due to their current use for railway or extractive industry purposes and location that does not immediately adjoin noise sensitive receivers.

Each site would be approximately 1,000 square metres in area and include demountable site offices, meal rooms, showers and parking facilities. The sites could be used to store some of the plant and equipment used in the construction and possibly some of the materials required for the civil works. The compounds would be removed after construction finishes and the site returned to the condition prior to the compound being established. The exact location, size and configuration of each site would be determined at the detailed design stage after the appointment of the contractor.

Noise impacts from the site compounds would be expected to be below the adopted noise design goals.

4.2 Construction vibration

The only vibration-sensitive receivers close enough to be potentially affected by construction activities are those approximately 15 metres from the nearest activities.

Table 4-6 provides estimated vibration levels at a range of distances from the various vibration generating activities.

Table 4-6 Estimated vibration levels

Activity	PPV Vibration Level (mm/s) at Distance		
	5m	10m	20m
Bored Piling Rig	0.3	0.2	<0.1
Rock Sawing	1	0.5	0.3
Hydraulic Hammering	8	3	1.5
Impact Piling Rig	-	12 - 30*	-

Source: RTA Environmental Noise Management Manual

Other sources of potential vibration from the construction works include bulldozers and vibratory rollers.

Bulldozers

At a distance of approximately 5 metres from the works, typical ground vibration levels from bulldozers operations range 1 – 2 mm/s. for distances greater than 20 metres levels are usually below 0.2mm/s.

Vibratory rollers

Highest levels of ground vibration resultant from vibratory roller operation are known to occur where the roller is brought to rest as a result of centrifugal force influence upon resonance with roller / ground natural frequency. Typical levels of ground vibration can be up to 1.5mm/s at a distance of 25 metres.

Safe working distances for vibratory rollers based on RTA recommendations are detailed in Table 4-7.

Table 4-7 Vibratory roller recommended safe working distances

Roller class	Weight (tonnes)	Centrifugal force kN	Distance from building (m)	
			Prevent structural damage	Minimise strongly adverse residential comment
I Very light	< 1.25	10 – 20	3	No effect
II Light	1 – 2	20 – 50	5	No effect
III Medium	2 – 4	50 – 100	6	12
IV Medium heavy	4 – 6	100 – 200	12	24
V Heavy	7 – 11	200 – 300	25	50
VI Very heavy	> 12	> 300	25	50

Note: source of data ARRB Special report No. 11 “Ground Vibrations: Damaging effects to Buildings”

Vibratory roller works are expected to occur less than 20 metres from buildings and residential receptors. To minimise vibration impact “Class III medium” or lower should be used.

Ground vibration may be perceptible by residents in close proximity to the construction works for relatively short periods of time when construction activities are immediately adjacent to dwellings.

The vibration criteria associated with damage to typical residential and modern commercial buildings (10 and 25 mm/s respectively) will be complied with at typical distances from most activities. Impact piling will be avoided as far as possible, and certainly not conducted within 20 metres of a building.

The *SSFL Vibration Impacts Report* (Connell Wagner, August 2008) identifies properties potentially at risk from vibration impacts. The Vibration Impacts Report recommends building surveys be undertaken for specified buildings prior to construction work commencing.

4.3 Construction Traffic

It is currently estimated that up to 30 trucks per day could use each of the approximately 200 gates along the proposed SSFL route over a period of one month during the earthworks phase. Many of these gates are located at the end of relatively quiet streets, with minimal existing traffic noise.

Assuming the following conditions:

- 30 trucks per hour distributed evenly over eight hours
- speeds of 60 kilometres per hour
- residential set-back of 15 metres from the road
- 50% acoustically soft ground (typical of a residential area)
- the estimated $L_{Aeq,1hr}$ noise level would be 54 dB(A), compared with the criterion of 55 dB(A).

The traffic levels will be managed in accordance with the Traffic Management Sub Plan to minimize their impact on the residential streets used, and ensure compliance with the

adopted criterion. Truck movements (specifically earthworks trucks) will be within standard hours.

Although construction traffic is not expected to be a key noise source influencing local ambient noise environs during the work program, control measures and management practices have been outlined in Section 5 and 6 of this document.

5. Management measures and mitigation strategies

This section outlines management measures and mitigation strategies to be undertaken as far as practicable to mitigate the potential impacts as they relate to pre-construction, construction and post-construction phases of the project.

5.1 Standard construction hours

Approved hours of construction

In accordance with the CoA, construction hours will be restricted to between the hours of 7:00am to 6:00pm (Monday to Friday), 8:00am to 1:00pm (Saturday) and at no time on Sundays or public holidays except:

(a) for the delivery of materials required outside these hours by the Police or other authorities for safety reasons; or

(b) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or

(c) where the work is identified in the CNVMSP and approved as part of the CEMP;

or

(d) any works requiring track possessions subject to the following:

i the associated noise levels would be similar to the noise levels associated with programmed maintenance works;

ii works which do no include high noise generating works including sheet piling, pile driving, rock hammering/breaking etc. unless otherwise agreed by the director-general following consultation with the DECC; and

iii notification of the community at least 14 days in advance of such works including likely times and duration; or

(e) any works within the rail corridor (with the exception of track possessions), subject to the approval of the DEC as part of the process in developing the CNVMSP; or

(f) any other work as agreed by the Director-General in consultation with the DECC and considered essential to the project and where it can be demonstrated that it would achieve a better environmental outcome, through the CNVMSP process.

Local residents will be informed of the timing and duration of work approved under item (c) at least 48 hours before that work commences.

As detailed in CoA 44, rock breaking, rock hammering, sheet piling and any other similar activity shall only be scheduled between the following hours, unless otherwise agreed by the DECC, to minimise the impact of both noise and vibration:

a) 9 am-12 pm, Monday to Saturday

b) 2 pm-5 pm, Monday to Friday

Construction outside of approved hours

From time to time the contractor may need to undertake works outside approved hours (out of hours work). This is required to satisfy the operational requirements of government

agencies or authorities (e.g. RTA, RailCorp, local councils), and to minimise community disruption or due to unforseen circumstances.

To minimise noise impacts, out of hours works will be planned and programmed where possible to ensure that the noisiest activities, in particular impulsive or tonal noise, occur during daytime periods or prior to 10 pm.

ARTC is required to seek approval from DoP and DECC for construction activities outside of the standard hours and provide supportive information as detailed in the EPL and relevant sub-plans. The Environmental Manager is responsible for managing the approvals and licensing applications for SSFL construction activities. For all out-of-hours work local residents will be notified in accordance with the Community Involvement Plan.

5.1.1 Track Possession Works

A rail track possession is a planned shutdown of a section of the rail network and may occur either from 12 am to 5am or over a 48 hour planned weekend possession with approximately two nights of work. During track possessions, out of hours work will be necessary for construction of elements that cannot be undertaken at other times due to safety considerations when working close to the running track or high voltage aerial lines.

A total of 14 possessions have been identified as available to this project across a two year period, 10 of which would be long weekend possessions.

Table 5-1 provides a summary of the preliminary review of out-of-hours works and their expected duration. The table also indicates the reasoning behind the requirement for these works. The duration of works is approximate and subject to refinement throughout the detailed design process.

Table 5-1 Preliminary summary of out-of-hours works

Description of works	Indicative duration	Reason for out-hours works
Delivery of bridge decks, rail bridge girders and rail	All possessions throughout the construction period	These materials would be delivered to work areas by trains. These works would be undertaken during daytime possessions where scheduling and resources allow although there is likely to be some night-time possession works for track delivery.
Modification/relocation of Railcorp 33 kV power supply lines on timber poles routes	All possessions throughout the construction period	The modification and/or relocation of the 33 kV power supply requires all power to be switched off to the rail system. These works can only be undertaken during rail possessions or scheduled mid-week engineering hours.
Replacement of the steel masts which support the overhead power lines with a gantry structure at specific locations	All possessions throughout the construction periods	Safe working distance requirements.
Testing and commissioning	All possessions throughout the construction period	Testing and commissioning of the rail system would be undertaken as works are progressively completed and all rail possessions would be utilised.

Description of works	Indicative duration	Reason for out-hours works
Communication and signal cables that need to be cut over.	Duration to be estimated following a detailed survey and services search is completed.	Out-of-hours works would only be undertaken where works require a service interruption.
Connection of SSFL and Railcorp tracks	All possessions throughout the construction period.	These works require that all power to be switched off to the rail system which can be undertaken during rail possessions.
Demolition of existing bridge	Various weekend possessions	The demolition works must be undertaken during a rail possession due to the proximity of the existing bridge to the rail track and to ensure public safety for pedestrians/motorists along Auburn road.
Piling for new bridge structure	Various weekend possessions	The piling works must be undertaken when no trains are operating due to the proximity of the track and to manage any pedestrian impacts.
Erection of new structure	Two weekend possessions	These works must be carried out when no trains are operating due to the interface with the rail operations.
Piling for bridge abutments Erection of new structures	Two weekend possessions	These works must be undertaken when no trains are operating due to the interface with the rail operations including overhead wiring and associated track work.
Construction of pedestrian footbridges and other station facilities	Partial weekend possessions over a six week period	These works are required to be undertaken out-of-hours due to the need to construct footings and lift the pedestrian bridge over the rail corridor. This must be undertaken when no trains are operating. In addition, revised pedestrian arrangements need to be in place prior to bridge works commencing.

5.2 Confirmation of Sensitive Receptors

Within seven days of the commencement of construction works associated with each stage of construction at each worksite, and every month thereafter, environmental noise and vibration levels will be measured at representative noise sensitive receivers (mostly residential) to test compliance with the noise and vibration objectives presented in Section 3.

At each work site or area, residences or other sensitive receivers (schools etc) likely to be affected by noise levels which exceed the objectives, or structures or equipment with potential to be damaged by ground borne vibration, will be identified during preparation of the Noise and Vibration Impact Statement (NVIS) for that site. Such receivers include:

- residential and commercial buildings
- pipe work or cables close to the works.

In addition to this, there will be some buildings and/or equipment within buildings which may be sensitive to vibration and/or regenerated noise where potential damage is not an issue. These will also be identified during preparation of the relevant NVIS. Such buildings and equipment may include:

- residential buildings
- commercial buildings
- studios
- research facilities with sensitive equipment, such as electron microscopes
- hospitals with sensitive equipment
- sensitive computer equipment.

For each of these, vibration criteria will be set to avoid either damage or vibration discomfort or noise annoyance. Based on the proposed construction activities, vibration levels to be expected will then be calculated and reported in the NVIS. A noise, vibration and regenerated noise monitoring regime will then be established in accordance with the probability of damage or discomfort / annoyance.

In the case of potential damage, the monitoring systems will include visible and audible signals set to be triggered at the appropriate damage criterion. Procedures will be adopted in regard to the required action in the event of these criteria being exceeded.

5.3 Construction noise and vibration impact statements

Construction Noise and Vibration Impact Statements (NVIS) have been prepared in accordance with Condition of Approval 40. The CNVIS Reports cover the areas of:

Birrong – Chester Hill

Chester Hill – Cabramatta

Cabramatta – Warwick Farm

Warwick Farm – Liverpool

Casula – Ingleburn

Ingleburn - Macarthur

The Construction NVIS provide the basis for determining the noise and vibration management mitigation measures to be implemented and to be included in this sub plan. The statements also indicate the anticipated noise and vibration levels and the effect of these levels on noise and vibration sensitive receivers. Noise Catchment Areas will be mapped as part of individual Construction Noise and Vibration Impact Statements for each stage of the construction prior to its commencement. Where relevant, specific details on potential impacts from out of hours work will be considered.

These statements will be prepared progressively as the project proceeds.

The noise impact statements will be prepared by an acoustic consultant and address construction and construction related works including:

a) a description of each construction activity including ancillary facilities, and their associated noise sources;

b) identification of all potentially affected noise sensitive receivers;

c) determination of appropriate noise and vibration objectives for each identified noise sensitive receiver;

d) the construction vibration objectives;

e) assessment of potential noise impacts from the proposed construction methods including noise from construction vehicles and noise impacts from required traffic diversions;

f) examination of all reasonable and feasible noise mitigation measures including the use of alternative construction methods where impact exceed the relevant objectives;

g) description and commitment to work practices which limit noise;

h) description of specific noise mitigation treatments and time restrictions including respite periods;

i) justification for any activities outside of the approved construction hours;

j) noise monitoring proposed and consideration of additional reasonable and feasible noise mitigation measures prior to construction commencement;

k) noise audit systems including recording daily hours of construction, progressive impact assessments as the work proceeds, conducting informal checks by the EMR, providing active and continuous communication links to the relevant Councils, residents and stakeholders;

l) procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity; and

m) an education program for construction personnel about noise minimisation.

Site-specific NVIS will be prepared for sites where OOH works are planned. These reports will be provided as support information with applications for approval of OOH works to Department of Planning and DECC where a licence variation to allow the OOH works is required.

5.4 Training and Awareness

All relevant site personnel will undergo a site induction prior to commencement to ensure that staff is adequately trained to recognise environmental aspects. The induction will incorporate the activities required to manage potential noise and vibration issues, as well as the procedures to be undertaken during the event of emergencies, such as suspected exceedances.

A brief summary of the noise and vibration management recommendations of this Sub Plan shall be prepared. This summary will be formally incorporated into all site induction procedures for staff and sub-contractors.

5.5 Communication

Communications on environmental aspects shall be established with external stakeholders. The procedures and strategies for communicating with external stakeholders are as described in the Community Involvement Sub Plan.

The community shall be informed of, and involved with, environmental aspects of the Project. The procedures and strategies for communicating with the community are also set out in the Community Involvement Sub Plan.

5.5.1 Notifying the Community

To ensure the community is adequately informed about the timing and scope of site establishment works, the following activities and procedures are proposed:

- Prior to commencement of the site establishment, the nature of the works, the areas in which the works will occur, the hours and duration of construction and details of how further information can be obtained (i.e. contact phone number, website) will be advertised in relevant local newspapers.
- Leaflets/flyers will be prepared and letterboxed to surrounding residents to describe the scope and timing of the works and to provide contact details for further information.
- Traffic disruptions and controls, noisy works activities, construction of temporary detours and work required outside the nominated working hours shall be advised to the local community at least 2 weeks prior to such works being undertaken.

Further details are contained within the Community Involvement Sub Plan.

5.6 Mitigation measures

All reasonable and feasible control measures shall be adopted to control construction noise impact on surrounding residential receivers. Specific noise mitigation measures relating to the specific activities and plan items on site will be developed as part of the Construction NVIS. These may include:

- Installation of temporary noise barriers around construction equipment;
- Selection of low noise equipment;
- Adoption of construction methods that minimise noise impact;
- Scheduling of noisy activities in daytime hours; and

- Siting of stationary plant as far away from noise-sensitive receivers as possible.

In addition, the noise barriers to be installed to control operational noise from the railway shall be scheduled to be installed at the earliest practical opportunity so that their benefit will also be realised for the construction works.

The TIDC Construction Noise Strategy (Rail projects) in November 2007 has been adopted by the SSFL project. Section 5 of the TIDC Construction Noise Strategy provides some guidance on the need to provide additional management of noise when further mitigation at source is not feasible or reasonable. The relevant section from the TIDC Construction Noise Strategy is reproduced below.

Where there is a potential for a project's construction noise and vibration objectives to be exceeded, a number of additional measures to mitigate such exceedances– primarily aimed at pro-active engagement with affected sensitive receivers – should be explored and have been included in this Strategy. The additional mitigation measures to be applied are outlined in Table 4 below. A full description of each measure is provided below the table.

Table 4 Additional Mitigation Measures

Measure	***Abbreviation***
Alternative accommodation	*AA*
Monitoring	*M*
Individual briefings	*IB*
Letterbox drops (+ Media Advert)	*LB*
Project specific respite offer ie movie tickets for evening works	*RO*
Phone calls	*PC*
Specific notifications	*SN*

Specific notifications (SN)

Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures Matrix (Tables 5-7). This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Phone calls (PC)

Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.

Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing

construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.

Project specific respite offer (RO)

Residents subjected to lengthy periods of noise or vibration may be eligible for a project specific respite offer. The purpose of such an offer is to provide residents with respite from an ongoing impact. The offer could comprise pre-purchased movie tickets or similar offer.

This measure is determined on a project-by-project basis, and may not be applicable to all.

Alternative accommodation (AA)

Alternative accommodation options should be provided for residents living in close proximity to construction works that are likely to incur noise levels significantly above the applicable level (Tables 5-7).

Applying Additional Mitigation Measures

In circumstances where - after application of the standard mitigation measures – the LA10,15min construction noise and vibration levels are still predicted to exceed the noise or vibration objectives, the relevant Additional Mitigation Measures Matrix (AMMM) (see Table 5 below) is to be used to determine the additional measures to be implemented.

Using the relevant AMMM, the following steps need to be carried out to determine the additional mitigation measures to be implemented:

1. Determine the time period when the work is to be undertaken.

2. Determine the level of exceedance.

3. From the relevant AMMM table, identify the additional mitigation measures to be implemented (using the abbreviation codes - expanded in Table 4).

Table 5 AMMM - Airborne construction noise

	Time Period	***Mitigation Measures***			
		LA10,15min noise level above background (RBL) Qualitative assessment of noise levels			
		0 to 10dBA Noticeable	*10 to 20dBA Clearly audible*	*20 to 30dBA Moderately intrusive*	*>30dBA Highly intrusive*
Standard	*Mon-Fri (7am-6pm) Sat (8am-1pm) Sun/Pub Hol (Nil)*			*LB, M*	*LB, M*
OOHW	*Mon-Fri (6am-10pm) Sun/Pub Hol (8am-6pm) Sat (1pm-10pm)*		*LB*	*M, LB*	*M, IB, LB, RO, PC, SN*
OOHW	*Mon-Fri (10pm-7am)*	*LB*	*M, LB*	*M, IB, LB, PC, SN*	*AA, M, IB, LB, PC, SN*

	Sat (10pm-8am) *Sun/Pub Hol (6pm-7am)*				

Notes: 1. For some types of construction activities (refer Appendix B), a qualitative assessment of the potential noise impacts can be undertaken in lieu of detailed noise modelling. For these activities, noise mitigation measures should be evaluated on the basis of the noise levels being noticeable, clearly audible, moderately intrusive or highly intrusive. The qualitative assessment should consider the type of equipment being used, the character of the noise emissions, time of day, the location of the nearest receivers and the noise sensitivity of the nearest receivers. Where a qualitative assessment is being undertaken, this will need to be approved by the Environmental Management Representative.

Noise and Vibration Impact Assessments undertaken for the SSFL Project have adopted two differences from the TIDC Strategy:

1) The current assessment uses LAeq rather than LA10. For many construction activities the numerical difference is likely to be small with LAeq typically being a few dBA lower.

2) Where noise levels exceed 75dBA rather than 30dBA above background can be considered the noise level at which a higher level of impact would occur.

Table 5-2 below describes a number of general mitigation measures that will be implemented project-wide. These measures are developed in more detail within each worksite NVIS.

Table 5-2 Environmental management and mitigation measures

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
Pre-construction				
Prepare a construction Noise and Vibration Management Sub Plan prior to construction	EM	Pre-construction	One off (updates as necessary)	n/a
Adopt best management practices (BMP) and best available technology economically achievable (BATEA) principles to reduce noise emissions	CW-PM	As above	On-going	n/a
All plant and equipment to be selected after considering noise emissions from the item	CW-PM	As above	On-going	n/a
Provide an induction of all project team members for noise and vibration management prior to commencement of works	CW-PM	As above	On-going	n/a
Complete ambient noise monitoring to confirm existing background noise levels	EMEM	As above	One off	n/a
If ambient noise levels differ substantially from those assumed in the EA, noise models will be revised in order to update the environmental noise criteria for the project. Further mitigation will be developed to achieve compliance with revised environmental noise criteria if required.	EM	As above	-	n/a
Construction				
Prepare a Construction Noise and Vibration Impact Statement (CNVIS) for each construction stage, major construction activity and construction compound prior to commencement of construction Noise Catchment Areas will be mapped as part of individual CNVIS. These will include specific details on potential impacts from out of work hours where relevant.	EM	All	Before commencement of each stage	CoA 40
Obtain Independent verification of adequacy of noise & vibration impact assessment	EM	All	Before commencement of each stage	CoA 42
Implement monitoring program as detailed in the sub-plan	CW-PM	All	Within 1 week of commencement of each stage and monthly thereafter	CoA 41
Limit construction works to 7.00am -6.00pm Monday to	CW-PM	All	As required	CoA 43

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
Friday and 8.00am-1.00pm Saturday and at no time on Sundays or public holidays except those activities detailed in Sections 5.2.1 and 5.2.2				
When works are required outside of normal hours, agreement will be sought from applicable regulatory authorities / environmental management representatives prior to commencing works	EM	All	As required	CoA 43
Apply all reasonable best practice noise mitigation and management measures.	CW-PM	All	On-going	CoA 40
Rock breaking, rock hammering, sheet piling and any other similar activity shall only be scheduled between the following hours unless otherwise agreed by the DEC: 9.00 am to 12.00 pm, Monday to Saturday; and 2.00 pm to 5.00 pm, Monday to Friday.	CW-PM	During rock-breaking, sheet piling etc.	On-going	CoA 44
Use of public address systems at any construction sites outside the standard working hours shall not be permitted unless otherwise approved through the Construction Noise and Vibration Management Sub-plan. Any public address system shall be designed and installed with their pointing axis directed away from residential buildings and sensitive receptors unless otherwise specified in the relevant Construction Noise & Vibration Impact Statement.	CW-PM	All	On-going	CoA 48
The construction noise objective for the Project is to manage noise from Construction activities (as measured by a L_{A10} (15 minute) descriptor) so as to not exceed the background L_{90} noise level by more than 5 dB(A) at any residence or other noise sensitive receiver. Where this cannot be achieved all reasonable and feasible noise source controls to reduce noise from all plant and equipment shall be investigated and applied. Examples of appropriate noise source controls could include selection of quiet equipment, efficient silencers, low noise mufflers	CW-PM	All	On-going	CoA 45

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
and alternatives to reversing alarms.				
Carry out environmental noise and vibration monitoring at all worksites. Where the levels exceed the targets, implement further controls.	CW-PM	All	Within a week of commencement of stage and then six monthly	CoA 41
If noise from a construction activity is substantially tonal or impulsive in nature (as described in Chapter 4 of the NSW Industrial Noise Policy), 5 dB(A) must be added to the measured construction noise when comparing the measured noise with construction noise objectives	CW-PM	All	On-going	CoA 45
Residential and affected land owners to be notified prior to works commencing in accordance with the CEMP	CLM	All	As required	n/a
Implement BMP to achieve noise goals presented in Table 3-2. BMP measures are outlined below.	CW-PM	All	On-going	n/a
Maximise offset distance between noisy plant items and nearby noise sensitive receivers and orient equipment away from sensitive areas where practical.	CW-PM	All	On-going	CoA 45
Identify noise intensive works and schedule these activities at times to minimise impact on sensitive receivers (typically the mid-day period where there is limited transportation noise influence and peak hours where transportation noise dominates.	CW-PM	All	On-going	n/a
No engines to be started, or on-site activities (including entry or departure from the site) to be undertaken prior to the specified start times	CW-PM	All	On-going	n/a
Ensure all equipment and plant used on-site meets the typical noise levels presented in AS 2436 and is consistent with previously assumed sound power levels (Table 4-4)	CW-PM	All	On-going	n/a
Noise levels will be monitored from individual items of plant to ensure no deterioration in noise emissions as a consequence of poor maintenance. Assessment of potential annoying characteristics (such as tonality) will be required.	CW-PM	All	On-going	n/a
Monitor equipment noise levels at 7m (for any equipment that is	CW-PM	All	When brought to site and six	CoA 41

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
to be used between 10.00 pm and 7.00 am (Section 3.3). Carry out maintenance on equipment whose level exceeds that shown in Table 4-4 or other requirements as defined for the specific site.			monthly	
All equipment to be adequately maintained and kept in good working order	CW-PM	All	On-going	n/a
All equipment to be operated in appropriate and efficient manner	CW-PM	All	On-going	n/a
Any unusually noisy equipment will be investigated and rectified	CW-PM	All	On-going	n/a
Wherever elevated noise emissions from equipment is measured, quiet or silenced equipment will be used	CW-PM	All	On-going	n/a
Where sustained and elevated off-site noise impacts are present, residential grade silencers and acoustic treatment to mobile source engine blocks will be implemented	CW-PM	All	On-going	n/a
Simultaneous operations of noisy plant operating adjacent to sensitive receivers will be avoided. Operators of construction equipment will be made aware of potential noise issues and of techniques to minimise noise impacts.	CW-PM	All	On-going	n/a
Quiet work practices will be applied throughout the works program. These will include: ▪ Orientating exhaust outlets away from sensitive residents ▪ No unnecessary revving or idling when within 50 metres of receivers	CW-PM	All	On-going	n/a
Minimise consecutive night-time works in the same locality where applicable.	CW-PM	All	On-going	n/a
Signage will be posted on site to ensure workers are aware of the work hours on-site for noisy activities	CW-PM	All	On-going	n/a
Use of reactive reversing alarms may be required during the early morning (7am – 9am) periods	CW-PM	All	On-going	n/a
Respite periods for noise-generating activities and tonal as required by EPL 12971 must	CW-PM	All	On-going	n/a

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
be included within the works program				
Site awareness training / environmental inductions to include a section on noise mitigation measures. Further training will be provided as necessary via toolbox talks	CW-PM	All	On-going	n/a
Receive record and investigate noise or vibration complaints.	EM	All	On-going	n/a
Wherever practical, piling activities shall be completed using bored piles. If driven piles are proposed to be used, reasons they are required shall be specified and agreement of the Director-General obtained following consultation with the DECC.	CW-PM EM	During piling.	On-going As required	CoA 49 CoA49
Affected pre-schools, schools, universities and any other affected permanent educational institutions shall be consulted in relation to noise mitigation measures. Noise generating construction works in the vicinity of affected educational buildings are not to be time tabled during examination periods, unless other arrangements acceptable to the affected institutions are made at no cost to affected institutions.	CLM	During rock-breaking, sheet piling etc.	On-going	CoA 47
Monitor vibration impacts at sensitive receptors to ensure vibration objectives are not exceeded	CW-PM	All	On-going	CoA 46
Monitor equipment vibration levels at a number of distances and establish minimum working distances from vibration sensitive receivers.	CM	All	When brought to site	CoA 41
Blasting will not be conducted for construction unless otherwise approved by the DECC in an Environmental Protection Licence variation.	CW-PM	All	Ongoing	CoA 50
Vibratory rollers, will where practicable, turn off vibration when manoeuvring for down pass and non-vibratory events	CW-PM	All	Ongoing	n/a
Oscillating vibratory rollers, where practicable and where determined to provide a benefit to received vibration impacts, will be utilised to minimise	CW-PM	All	Ongoing	n/a

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
potential vibration emissions				
Where liable, rectify any property damage caused directly or indirectly by the construction at no cost, or negotiate compensation, with the property owner (s)	CW-PM	All	Ongoing	n/a
Residents at sensitive receivers that are determined to be affected by potential vibration / noise impacts in exceedance of disturbance criteria (where all practicable and feasible mitigation measures have been incorporated) may be considered for temporary relocation on a case by case basis.	EM	All	On-going	n/a
Transport				
Restrict entry and departure of heavy vehicles to the hours 7am to 6pm (Monday to Friday) and 8am to 1pm (Saturday)	CW-PM	All	On-going	n/a
Off-site truck movements only to be carried out during standard hours	CW-PM	All	On-going	n/a
Loading and unloading to be carried out away from sensitive receptors where possible	CW-PM	All	On-going	n/a
Trucks used throughout the works program will have mufflers and any other noise control equipment in good working order	CW-PM	All	On-going	n/a
Truck routes will be restricted to those within the Traffic Management sub-plan. Main roads will be used where possible after passage through the local residential area	CW-PM	All	On-going	n/a
Truck routes where possible should include one-way systems or turning points to minimise reversing and audible reversing alarm requirements	CW-PM	All	On-going	n/a
Use of air brakes in residential areas will be avoided	CW-PM	All	On-going	n/a
Site access points and tracks will be located as far as possible from potentially affected sensitive receivers	CW-PM	All	On-going	n/a
Source controls				
The quietest available plant and equipment that can economically carry out the work will be selected. Where appropriate, silencers and	CW-PM	All	On-going	n/a

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
acoustic screens (or similar ameliorative measures) to be utilised to minimise cumulative noise emissions and reduce total site noise emissions				
Noise emissions will be monitored with controls applied as required, such as the fitting of residential class mufflers to mobile and diesel powered equipment	CW-PM	All	Not less than monthly (or when new equipment located on site)	n/a
Sensitive vibration equipment at Liverpool hospital				
Where practical, vibration producing machinery will be avoided and alternatives used.	CW-PM	All	On-going	n/a
Where the use this machinery is unavoidable, vibration monitoring will be undertaken to establish minimum working distances to vibration sensitive equipment	CW-PM	All	On-going	n/a
Ecological mitigation measures				
Use only bored piles at Cabramatta Creek Bridge to minimise disturbance to roosting Grey-headed Flying-foxes.	CW-PM	Bridge works at Cabramatta Creek	On-going	CoA 60
Restrict noise levels and avoid noisy construction activities associated with pile boring at Cabramatta Creek Bridge between peak breeding season (March-May) and peak birthing time (September –November). Examples of appropriate noise source controls could include selection of quiet equipment, efficient silencers, low noise mufflers and alternatives to reversing alarms.	CW-PM	Bridge works at Cabramatta Creek	Ongoing	n/a
Impact of Noise and Vibration of construction on Grey-headed Flying-fox colony to be assessed in the Noise and Vibration Impact Statement process.	EM	Bridge works at Cabramatta Creek	Before commencement of bridge works at Cabramatta Creek Bridge	n/a
Noise monitoring station to be installed as close as possible to Cabramatta Creek bridge to ensure noise levels during construction do not exceed acceptable levels	CW-PM	Bridge works at Cabramatta Creek	Before commencement of bridge works at Cabramatta Creek Bridge	n/a

Environmental Procedure	Responsibility	Stage	Frequency	Source of requirement
Weekly monitoring of Grey-headed Flying-fox colony movements in consultation with Community representative (Cab. Ck Flying-Fox Com.)/ Council Environmental Officer. Report any shift in roosting locations in response to disturbance from construction noise and/or vibration.	CW-PM	Bridge works at Cabramatta Creek	Ongoing throughout duration of construction	n/a
Post-construction				
Not applicable				

Note: *EMR: Environmental Management Representative*
PD: ARTC Project Director
CM: Construction Manager
DM: Design Manager
EM: Environment Manager
CW-PM: Contractors – Contract Works package Manager
CLM: Community Liaison Manager

6. Monitoring and reporting

Environmental noise and vibration monitoring will be undertaken within one week after commencement of each new stage of the construction works and monthly thereafter. This monitoring programme would be reviewed after six months, subject to the proposed construction activities.

Noise monitoring would be undertaken using a calibrated sound level meter. The measurements would determine the $L_{A10,\ 15min}$ airborne construction noise levels received external to any sensitive receiver. In respect of airborne noise, in many instances, existing ambient noise levels would be high due to traffic. Where required, an estimate of the L_{A10} levels may be made from spot checks of short duration maximum noise level emissions from the site (e.g. during breaks in traffic).

Vibration levels would be monitored using appropriate vibration monitoring equipment when perceptible vibration levels are likely.

Environmental noise and vibration monitoring would be undertaken external to the ground level of any sensitive receiver identified as potentially affected, as works occur in those areas. These locations would be reviewed every month and receiver locations included or excluded as appropriate.

An activity log of construction works at the various work sites will be maintained in the form of site diaries. Noise and vibration monitoring will be undertaken routinely at the sites (as outlined above) with respect to the objectives and findings of the NVIS.

Table 6-1 Recommended noise and vibration monitoring, and reporting requirements

Monitoring and reporting requirements	Responsibility	Source of requirement
Pre-Construction		
▪ Construction Noise and Vibration Impact Statements will be developed for each work package prior to construction.	EM	n/a
Construction		
Noise monitoring will be undertaken in accordance with AS 2659	CW-PM	CoA 41
Vibration monitoring will be undertaken in accordance with the ENMAV technical guide	CW-PM	CoA 41
Noise and Vibration monitoring report to be issued to the EM monthly detailing: ▪ Date and time of monitoring; ▪ Location of monitoring; ▪ Equipment used and method of monitoring; ▪ Results obtained; and ▪ A comparison of the results with the targets. ▪ Indicate whether construction activities are above the targets ▪ Where appropriate, identify additional measures to be implemented to achieve compliance	CW-PM	CoA 41

Monitoring and reporting requirements	Responsibility	Source of requirement
▪ Indicate when these measures will be implemented ▪ Measured impact of additional measures.		
All monitoring reports required under the Noise and Vibration Management Sub Plan are to be prepared within one week of monitoring and are to be filed by the Environmental Manager for the duration of the project construction and kept for four years after project completion. All monitoring reports should indicate: ▪	CW-PM	CoA 41
▪ Further monitoring will be undertaken as a result of an investigation into noise complaints or as detailed in EPL 12971	CW-PM	n/a
Noise monitoring at Cabramatta Creek bridge to ensure noise levels during construction do not exceed acceptable levels	CW-PM	
Weekly monitoring of Grey-headed Flying-fox colony movements in consultation with Community representative (Cabramatta Creek Flying-Fox Community)/ Council Environmental Officer. Report any shift in roosting locations in response to disturbance from construction noise and/or vibration. Identify and implement remedial action if the Flying-Fox colony is impacted.	CW-PM	
Monthly reports detailing monitoring undertaken during construction will be submitted to EPA	EM	EPL 12971
A Construction Compliance Report will be prepared and submitted to Department of Planning every 6 months for the duration of the project.	EM	CoA 10
Post-Construction		
Not applicable		

7. Corrective action

7.1 Non-conformances

Non-conformances may include:

- Excessive exceedance of airborne noise objective.
- Exceedance of vibration criteria for building damage.
- Community complaints relating to noise and vibration.

In the event of a non-conformance, the source and nature of the event will be investigated, the effectiveness of the existing noise and vibration controls reviewed and modified where practical, and necessary strategies will be implemented to minimise further impacts.

Examples include:

- Implementing alternative construction methodologies.
- Replacing excessively noisy equipment.
- Fitting additional acoustic controls to minimise emissions from machinery.

Such actions will be under the direction of the Environment Manager.

Complaints will be managed in accordance with the complaints management procedure detailed below.

7.2 Complaints

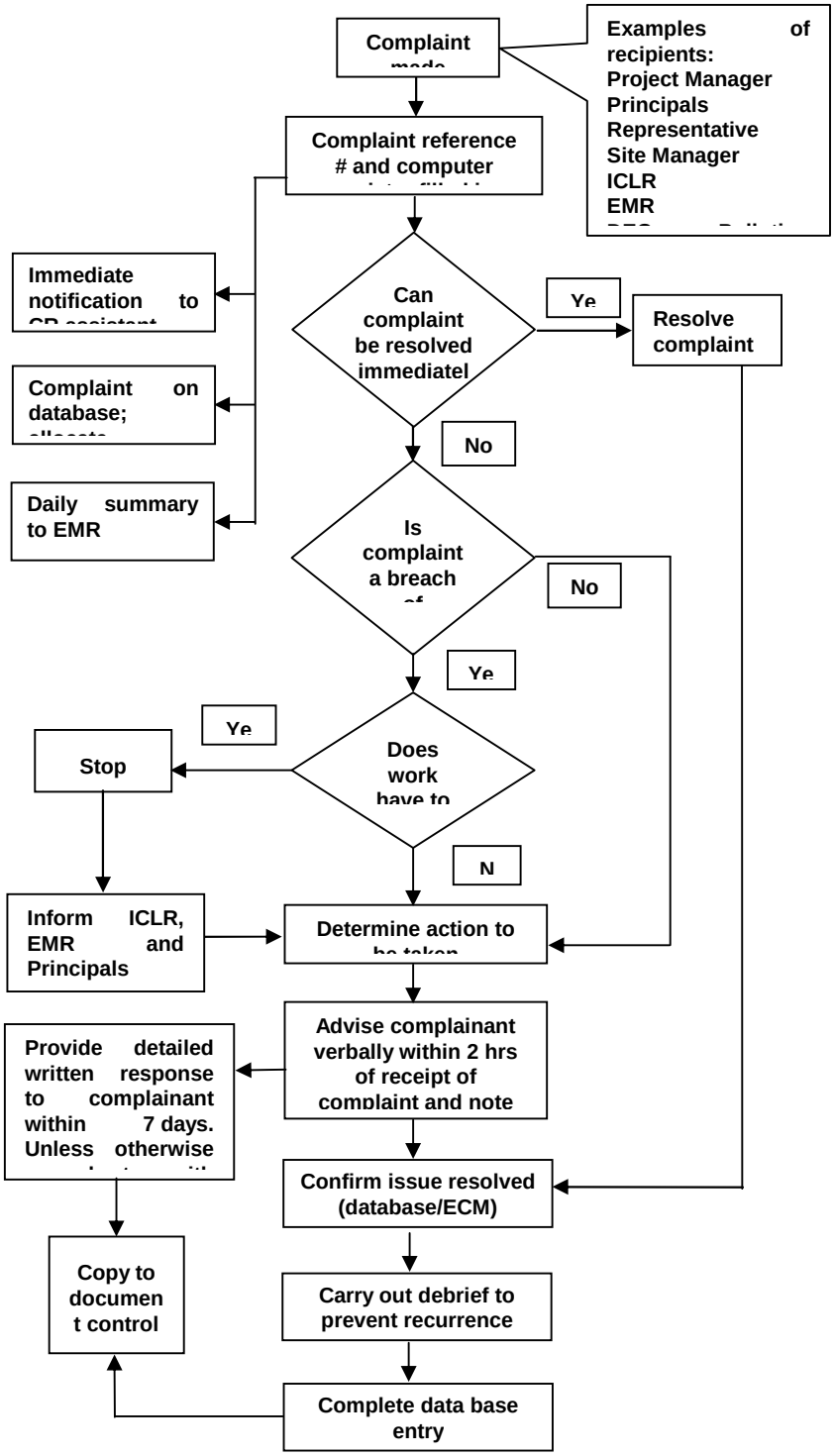
All complaints will be handled in accordance with the Complaints Management System detailed in the Community Involvement Plan (CIP). A summary of the Procedure is provided below.

Should complaints be received regarding the effect of noise or vibration from the construction activities, the complaint is to be investigated by the CW-PM. The investigation shall take the form of:

- Record the complaint.
- Investigate noise and vibration complaints within two hours of receiving the complaint
- Provide offer to complainant of noise monitoring.
- If offer of monitoring accepted, undertake monitoring as soon as possible or at a time agreed with the complainant.
- Compare measured levels with the equivalent targets in Section 3.
- Identify control or management measures to mitigate noise or vibration levels at the complainant location.
- Monitoring after implementation of the control or procedure to establish the level of reduction obtained.
- Notify complainant of actions taken.

- Continue to monitor activity if required.
- Provide report detailing the above including analysis of monitored noise or vibration levels to the Environmental Manager.

Complaints Handling Procedure



8. Document control

This Sub Plan will be reviewed in response to major changes in construction methodologies. Work site specific issues will be addressed by the preparation of construction NVIS. The statements will be requested by the Environmental Officer and issued to all relevant parties.

Appendix A

Glossary of noise terminology

Appendix B

Constraints maps

Appendix C

Summary of EA predicted construction noise source impacts