

Appendix H – Operational mitigation

Issue	Mitigation ID no.	Mitigation measure	Timing	Relevant section
Traffic noise	ONV 1	Architectural treatments would be applied to all identified noise-affected receivers as described in the Working paper – Noise and vibration (Part B). This mitigation measure would require re-assessment at the detailed design stage.	Pre-operation	All sections
Traffic noise	ONV2	Low noise pavement between STN 0.2 to 1.6, subject to confirmation at detailed design stage.	Pre-operation	Section 1
Traffic noise	ONV3	Low-noise pavement would be used between station 66.4 and 68.3, subject to confirmation at detailed design stage.	Pre-operation	Section 3
Traffic noise	ONV4	Low-noise pavement would be used between station 80.5 and 82.5, subject to confirmation at detailed design stage.	Pre-operation	Section 4 Section 5
Traffic noise	ONV5	Low-noise pavement would be used between station 85.9 and 88.0, subject to confirmation at detailed design stage.	Pre-operation	Section 5
Traffic noise	ONV6	Low-noise pavement would be used between station 127.0 and 128.1, subject to confirmation at detailed design stage	Pre-operation	Section 9
Operational traffic noise Traffic noise	ONV7	Low-noise pavement would be used between station 152.1 and 158.1, subject to confirmation at detailed design stage.	Pre-operation	Section 10

Appendix I - Project wide construction mitigation measures

Interim Construction Noise Guideline

The OEH Interim Construction Noise Guideline (ICNG, DECC 2009) provides both a method of assessment of construction noise and practical measures to mitigate and manage noise from construction sites. In addition to the measures identified in this section, further construction noise mitigation methods are contained in Tables 4 to 10 of the *Interim Construction Noise Guideline* (DECC, 2009) and in Australian Standard AS2436-2010 '*Guide to noise & vibration control on construction, demolition and maintenance sites*'. The primary consideration during the consideration an implementation of any control measure is whether they can be classed as 'feasible' and 'reasonable'.

Feasible

In terms of ICNG, a mitigation measure is classed as being 'feasible', where 'it is capable of being put into practice or being engineered and is practical to build given project constraints such as safety and maintenance requirements'

Reasonable

In terms of ICNG, a 'feasible' mitigation measure is classed as being 'reasonable', where the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

A number of exceedances of the noise management levels within this project have been shown as a result of various different construction activities. In addition to this, a number of exceedances of the 'highly noise affected' criteria have been predicted within the project. As a result of these exceedances, and potential exceedances of vibration and blasting criteria, the following generic and receiver specific mitigation measures have been identified. These measures have been based on the guidance outlined in the ICNG and take account of 'feasible' and 'reasonable'.

Section specific summary

Where receivers are predicted to be exposed to construction noise above the 'highly noise affected' criteria of 75dB(A), or where blasting or vibration criteria has been predicted to be exceeded, specific measures and controls have been identified. These are presented in the table below.

Section	Activity	Affected receivers	Mitigation recommendations
1	Earthworks	R522	Substitution of noisy equipment reduced working hours, temporary noise barriers/hoarding, community consultation sympathetic site layout temporary relocation of occupants
	Paving & Asphaltting	R495	
	Ancillary Sites	R575	R575 is located on land proposed for Section 2, Ancillary Site 1a. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
		R386	R386 is located on land proposed for Section 1, Stockpile Site 1a. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
Blasting	R344, R439, R446, R455	Prior to the blasting at Section 1 cut sites, a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest receivers	
2	Ancillary Sites	R581	R581 is located on land proposed for Ancillary Site 3. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
3	Blasting	R729, R742, R747, R760, R764, R793, R813, R11, R818	Prior to the blasting at Section 3 cut sites, a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest receivers. In addition where overpressure is

			exceeded at the closest receivers, consultation should be undertaken to discuss temporary exceedances of the overpressure criteria with residents.
4	Earthworks	R1000	Substitution of noisy equipment reduced working hours, temporary noise barriers/hoarding, community consultation sympathetic site layout temporary relocation of occupants
	Ancillary Sites	R886	R886 is located on land proposed for Ancillary Site 6. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
		R892	R892 is located on land proposed for Ancillary Site 6. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
	Bridge Works - Vibration	R851	Confirm separation distance between Shark Creek Bridge piling works and receiver prior to construction. Where receiver is within 50 metres of a pile location, a detailed assessment should be undertaken, accompanied with possible attended monitoring during works.
	Blasting	R842, R854	Prior to the blasting at STN48.1 to STN48.6, and STN51.6 to STN52.3 a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest receivers.
	5	Earthworks	R1427
R1441			
Paving & Asphaltting		R1441	
Blasting		R1244	

			the closest receivers
6	Ancillary Sites	R1542	R1542 is located on land proposed for Section 6 Ancillary Site 3 Temporary occupant relocation; temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
7	Earthworks	R1561	Substitution of noisy equipment reduced working hours, temporary noise barriers/hoarding, community consultation sympathetic site layout temporary relocation of occupants
		R1616	
		R1620	
		R1552	
		R1621	
	Paving & Asphaltting	R1561	
		R1621	
		R1620	
R1552			
8	Earthworks	R1637	Substitution of noisy equipment reduced working hours, temporary noise barriers/hoarding, community consultation sympathetic site layout temporary relocation of occupants
	Ancillary Sites	R1716	R1716 is located on land proposed for Section 8 Ancillary Site2b. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
		R1721	R1721 is located on land proposed for Section 8 Ancillary Site 2c. Temporary occupant relocation, temporary land lease/acquisition should be considered. Noise barriers and respites periods are unlikely to be effective or feasible in the longer term operation of the site. Sympathetic layout i.e. location of noisy plant/equipment at furthest extent from receiver.
Blasting	R1665	Prior to the blasting at STN128.1 – STN128.8, a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest	

			receivers. However this does not necessarily mean that blasting cannot be undertaken, but further assessment should be undertaken prior to blasting along with consultation with the closest affected receivers.
9	Blasting	R1739	Prior to the blasting at STN142.1 to STN142.2 and STN144.8 to STN144.9, a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest receivers.
10	Clearing & Formation	R1817	Substitution of noisy equipment reduced working hours, temporary noise barriers/hoarding, community consultation sympathetic site layout temporary relocation of occupants
		R1815	
		R1900	
	Earthworks	R1817	
		R1815	
		R1900	
		R1895	
		R1894	
	Paving & Asphaltting	R1885	
		R1817	
		R1815	
		R1900	
		R1894	
	Blasting	R1885	
R1853, R1819,R1835		Prior to the blasting at STN146.1 – STN146.3, STN148.3 to STN148.5 and STN152.2 to STN152.5 , a detailed blast assessment should be undertaken to take account of site specific geology, exact blast locations and proposed charges. This would determine the suitability of the site for blasting and quantify the impact on the closest receivers	
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General noise control

Exceedances of the project NMLs have been predicted to occur at a number of residential properties in the vicinity of different construction activities. Where these exceedances are predicted to occur, construction noise would be mitigated through management of the proposed

works. Prior to commencing construction, a Construction Noise and Vibration Management Plan (CNVMP) and Blast Management Plan should be prepared. These documents would detail how work is to be carried out to minimise the impacts of noise and vibration on adjacent properties. In addition to these, the following measures would be considered and adopted where they are shown to be feasible and reasonable.

Noise management & administrative measures

Construction noise and vibration management plans

To ensure the construction works are undertaken within appropriate project criteria and with noise and vibration in mind, a detailed Construction Noise and Vibration Management Plan (CNVMP) will be developed. The plan will be developed to detail the process of noise and vibration management as a result of construction activities. The information incorporated into the CNVMP will include the assessment undertaken for the EIS and additional noise impact statements undertaken for the detailed design of the construction phase. The CNVMP would be produced prior to the commencement of works and in consultation with the Department of Planning & Infrastructure.

The CNVMP will include and outline the following:

- Description & identification of all construction activities, including work areas, plan and activity duration
- Identification of associated construction impacts in terms of noise and vibration for each activity
- Generic noise and vibration control measures to be implemented during works
- Works specific or receiver specific mitigation or management measures that are to be implemented for the duration of the works.
- A complaints handling & investigations procedure (for noise, vibration and blasting)
- Noise monitoring procedure, both periodic and in response to complaints
- Vibration monitoring procedure, both periodic and in response to complaints
- Blasting monitoring procedure, both periodic and in response to complaints
- Blasting management plan
- Process for applying for out of hours works (including production of Noise Impact Statements)
- Overview of community consultation required for identified and high impact works

Community consultation

Where exceedances in the NML are predicted or where out of hours works are required, a community consultation exercise will be required. In addition to this consultation will also be required with Office of Environment and Heritage, and Department of Planning and Infrastructure. The consultation strategy would follow a format similar to the method outlined below; however more detail of this process is presented in Section 7 of the Community Consultation report Working Paper number 13.

The community consultation would include the following aspects:

- Receivers potentially impacted up on by construction activities to be identified through EIS construction noise assessment or additional detailed noise assessments. These will be based on the impact predicted as a result of the adopted hours.
- Identified receivers to be notified by letter of the proposed works and asked for comment and feedback. This should include justification for the proposed works along with the benefits to which the community can expect.
- Where the community or individual residents wish to receiver further clarification on the proposed works, individual interviews or public meetings should be organised to address any further issues. Discussions should be sufficiently detailed to provide a general summary of the expected impacts but also how this relates to individual receivers. .
- Property owners should also be provided with the complaints management procedures that will be in place during the works
- Collation of feedback should assist with determining the final approach to specific construction works
- Notifying the nearest noise receptors of the works plan and expected levels of noise well in advance of the works occurring, and responding to residents comments when planning construction timetables.

Construction hours

Compliance with proposed construction hours: 6am – 7pm (Monday-Friday), 8am-5pm (Saturday) and at no time Sundays and public holidays, unless otherwise approved through a CNVMP approved by the Department of Planning and Infrastructure.

In addition noisy plant should be scheduled for non-sensitive periods. For example the highest noise levels during construction works, is likely to result from plant such as impact piling rigs, road & concrete saws, rockbreakers and jackhammers. The impacts associated with these activities can be reduced by limiting these to less sensitive hours, such as daytime and early evening periods.

Construction timetabling to minimise noise impacts - this may include time and duration restrictions and respite periods, and should be considered after consultation with affected receivers.

Machinery would not be turned on prior to the work hours outlined above. This would include the daily maintenance activities and/or 'warming up' of engines.

Construction traffic noise

The movement of construction traffic on existing road networks is likely to blend in with existing road traffic noise; however the movement of traffic on new access roads and along the proposed upgrade has the potential to impact on the closest receivers. The following measures should be adopted to reduce impacts:

- Where practical, schedule all plant and materials deliveries for proposed hours only
- No truck idling
- Where practical schedule deliveries and spoil removals
- Enforce speed limits
- Limit compression braking
- Where practical, locating haulage routes as far away as possible from residential receivers.
- Truck movements would be restricted to identified haulage routes and the routes outlined in the Construction Traffic Management Plan.

Ancillary sites

The noise associated with ancillary sites will primarily result from operation of plant within the site and the movement of trucks to and from the site. Where an ancillary site comprises of fixed plant such as concrete batch plants, the locations of these within the site layout will have a significant bearing on the overall emission of noise from the site. This will be of greatest significance where receivers are located in close proximity to an ancillary site.

The operating hours of ancillary sites will mostly mimic the hours of construction. Therefore where out of hours works are required, an assessment and approval will also be required for the operation of ancillary sites. This process should again be defined in the CNVMP.

Truck movements to and from the ancillary sites should follow the same measures outlined for construction traffic noise, see above.

Temporary relocations

Where short term works are predicted to have a significant impact upon a small number of receivers, temporary relocation of residents will form part of the measures considered for noise control.

Engineering principles

The fundamental principle of noise control begins with control at source, followed by control through the transmission path and finally, and least desired, control at receiver. Where considered feasible and reasonable, noise control measures should be implemented at source. This is not always practical and therefore other measures will be required.

Equipment selection

The careful selection of plant, in terms of noise emissions, can have a significant bearing on the noise associated with construction activities. Where alternate plant is available to undertake the same activity to the same degree of ease, the plant emitting the lowest noise levels should be used. In a similar way, where an alternate method for undertaking a process or activity is available, in which noise emissions are lower, the alternative should be implemented. For example: where the process of impact piling can be replaced with bored or hydraulic piling, noise emissions can be

reduced. This may also include grinding, rock splitting or terrain levelling instead of hydraulic rock breaking where it is reasonable and feasible.

Distance

Throughout each construction activity, plant items should be located as far from receivers as practical. This will increase the noise reduction as a result of distance and therefore reduce noise exposure at receivers. In a linear project such as this, the separation distance and the available areas to move plant is restricted by the size of the project boundary and work area.

Screening

The erection of temporary hoarding/screens may prove to be suitable for longer term works and ancillary sites. Such screens could potentially reduce construction noise at receivers by between 5 and 15dB(A), depending on type, location and design. These would be primarily aimed at receivers who are exposed to noise levels above the 'highly noise affected' criteria but should also be considered, where feasible and reasonable, for receivers exposed to levels above noise management levels. The exact areas suitable for such screens would be determined through detailed acoustic assessment at longer term construction sites such as the ancillary sites.

Enclosures

Enclosures can form a successful method for reducing noise at source, however enclosures are only suitable for certain types of plant. Enclosures do not work for plant items that are mobile, such as excavators, dozers etc. Within construction, enclosures are most commonly used to attenuate noise from generators. Therefore where generators or lighting towers are used, quiet models or ones located within enclosures should be chosen as priority.

Engine silencers

Mobile plant and equipment should be chosen to include exhaust silencers or be suitable for fitting mufflers.

Plant maintenance

Plant should be regularly maintained to reduce the risk of excess noise being emitted from poorly functioning plant. In addition where plant maintenance is required, this should be undertaken in non-sensitive hours.

Reversing alarms

Where acceptable from an Occupational Health and Safety perspective, quieter alternatives to reversing alarms (such as spotters, closed circuit television monitors and 'smart' reversing alarms), particularly during night time activities, should be considered.

Vibration and blasting mitigation and management

Vibration measures

Given the proposed construction methodologies and the separation distance between work areas and sensitive receivers, vibration is considered unlikely to impact human comfort levels or building integrity; however where infrastructure, heritage receivers and buried services are located in close proximity to vibration inducing activities, the following mitigation measures would be considered:

- Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any structure (residential or commercial) or utility/service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor.
- Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any heritage structure or potential structurally unsound service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor. A follow up survey would be conducted in response to any vibration complaints.
- Appropriately sized equipment would be selected in order to minimise vibration emissions where required.
- Vibratory compactors would be replaced with normal compactors where vibration issues have been identified, and it is considered feasible and reasonable.
- A management procedure will be implemented in combination with the CNVMP to deal with vibration complaints. Each complaint will be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures will be implemented to mitigate future occurrences
- Carry out vibration testing on high risk plant to determine site specific buffer distances
- Where vibration is found to exceed project criteria, management measures should be implemented to control vibration. In terms of human comfort criteria, measures will include modifications of construction methods and time restrictions. In terms of structural damage criteria, modification of construction methods will be the most suitable method for vibration control
- Building conditions surveys should be undertaken at receivers with specified distances of certain construction activities and plant, as below;
 - Blasting operations - 500 m (charge size dependent)
 - Pile driving – 200 m
 - Vibratory compaction – 25 to 50 m
 - Demolition works – 50 m
 - Excavation works – 10 m

Blasting measures

The impacts of blasting cannot be accurately predicted without detailed blasting plans; including charge size, rock characteristics, spacing and burden thickness. However, based on an indication of blast sites, indications of impact have been provided. This has highlighted a number of cut sites that may potentially impact upon receivers, these sites are presented in **Table 1**. As such further assessment will be required when specific blasting parameters are determined. At this stage a number of general measures to reduce blasting induced vibration and overpressure impacts from blasting are outlined below:

- A Blast Management Plan would be prepared prior to the start of construction to identify exact blasting locations and to determine assessment procedures
- Blasting must be avoided to the maximum extent possible.
- Where sensitive receivers are located in close vicinity to the blast site, a series of trials would be undertaken at a reduced scale to determine site specific blast response characteristics, in order to define allowable blast sizes to occur within the project criteria.
- Blasting would only be undertaken between the hours of:
 - 10am to 3pm Monday to Friday
 - 10am and 1pm Saturday
- A minimum of 48 hours notice would be provided to all residences locate within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number. The advice would be provided at least five days prior to any potential blast.
- Monitoring of overpressure and vibration levels would be undertaken for each blast at potentially affected receivers.
- Buildings conditions surveys would be undertaken for all buildings located within 500 metres of the blast site prior to, and following, blasting. The proponent would be responsible for rectifying any damages occurring as a result of the construction with the cost to be borne by the proponent.
- The maximum instantaneous charge (MIC) would be reduced to the lowest possible level by use of delays, reduced hole diameter, and/or deck loading.
- Adequate stemming would be provided and exposed detonating cord would be eliminated (by covering with at least 300 millimetres of quarry dust or road base)
- Secondary blasting would be eliminated. (A rock breaker or drop hammer would be used instead of popping). Effort would be made to eliminate need for toe shots (eg by better control of drill patterns).
- Weather conditions at the time of the blast would be assessed. Blasting would be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion would be avoided where possible, or (if not possible) blasting would occur between 11 am and 1 pm.
- Strict control would be exercised over the spacing and orientation of all blast drill holes. Holes would be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size.
- Blasting times would be determined in consideration of site-specific conditions and in consultation with affected residences and would take place, where possible, when impacts are likely to be the least intrusive (eg fire all blasts at a set time acceptable to residents and preferably when background noise is highest).

- Overpressure will be controlled by the cut itself and in addition to these blast shields may be effective at reducing overpressure. This may also allow larger blast charges to be used as the cut deepens