ANNEXURE 16

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Construction Noise
and Vibration Management Plan

prepared by

Day Design Pty Ltd

DAY DESIGN PTY LTD

A.B.N. 73 107 291 494

CONSULTING ACOUSTICAL ENGINEERS

Suite 17, 808 Forest Road
Peakhurst Sydney NSW 2210
Phone: (02) 9584 2639 Fax: (02) 9584 2619
Email: acoustics@daydesign.com.au
www.daydesign.com.au

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

PROPOSED GAS PIPELINE

SHOALHAVEN STARCHES, BOMADERRY, NSW

REPORT NUMBER: **4522 REV B**

PREPARED FOR: Shoalhaven Starches Pty Ltd
C/- Cowman Stoddart Pty Ltd
PO Box 738
Nowra NSW 2541

Attention: Mr Stephen Richardson
Telephone: 02 4421 6198

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1.0 EXECUTIVE SUMMARY

Shoalhaven Starches Pty Ltd proposes to construct a new gas pipeline from the Eastern Gas Pipeline to their ethanol plant, 'Manildra', on Bolong Road, Bomaderry, NSW. The pipeline will extend approximately 5.5 kilometres from Meroo Meadow, east toward the south coast railway line then south to the Manildra factory.

The pipeline route passes various isolated residences and a residential area. The construction phase will last for approximately 10 weeks and involve site preparation, installation of the pipeline, restoration and demobilisation.

The major noise sources associated with the project are the directional drill rig and other mobile plant and equipment used in the installation process. There is also potential for rock hammering to be required at isolated locations along the southern part of the route.

This construction noise and vibration management plan has been prepared in accordance with the Australian Standard AS2436 – 2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"*. Construction noise management levels have been derived from the Office of Environment and Heritage's *Interim Construction Noise Guideline* and are used for a quantitative assessment at each of the residential receiver locations.

There is potential, at least on some occasions, for noise emission from construction works to exceed the noise management level at some residences during various stages of the works.

All feasible and reasonable methods to reduce noise emissions and minimise the noise impact on neighbouring properties have been provided in Section 7 of this report. These include, limiting construction activity to within the prescribed hours, selecting quiet equipment, incorporating periods of respite, maintaining community consultation relations, managing noise complaints and conducting ground-borne vibration monitoring.

Provided the recommendations in Section 7 of this report are implemented and adhered to, the level of noise and vibration from the construction works will be minimised in accordance with the NSW Office of Environment and Heritage's *Interim Construction Noise Guideline 2009* and Australian Standard AS2436 – 2010.

2.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Shoalhaven Starches Pty Ltd to prepare a noise assessment and management plan for the construction of a new 5.5 kilometre gas pipeline to supply their facility on Bolong Road, Bomaderry, NSW.

This commission involves the following:

Scope of Work:

- Inspect the site and environs.
- Measure the background noise levels at critical locations and times
- Establish acceptable noise and vibration level criteria.
- Quantify noise emissions from the proposed construction works.
- Calculate the level of noise emission at potentially affected receiver locations.
- Prepare a site plan identifying the development and nearby noise sensitive locations.
- Provide recommendations for noise control, if necessary.
- Prepare a Noise & Vibration Management Plan.

3.0 SITE AND PROJECT DESCRIPTION

Shoalhaven Starches proposes to construct a new gas pipeline to supply gas directly to their ethanol plant located on Bolong Road, Bomaderry. The pipeline shall tie-in to the Eastern Gas Pipeline at the existing Meter Station on Pestells Lane, Meroo Meadow and follow a pre-determined route to Manildra. The proposed route of the pipeline is shown on the attached Figure 1 and is approximately 5.5 kilometres long.

An overview of the route is as follows:-

- Follow Pestells Lane in a south easterly direction (from the Meter Station);
- Cross the Princes Highway and follow the transmission line easement to Meroo Road;
- Cross Meroo Road and travel south to Fletchers Lane;
- Follow Fletchers Lane east to the South Coast Railway Line;
- Cross the railway tracks and follow the rail easement in a generally southerly direction to Edwards Avenue;
- Cross Edwards Avenue and continue in a southerly direction;
- Turn east past the sewage treatment works and south to Manildra;

Details of the proposed route, construction methods and equipment to be used have been supplied by URS Australia Pty Ltd, Level 3, 116 Miller Street, North Sydney. Information supplied in their draft *"Front End Engineering Design, Bomaderry – Manildra Pipeline Lateral"* report number 43167736/R001/A dated 4 May 2009 and discussions with principal engineer, Mr Alex Horn, have been used in this assessment.

There are residential premises at various locations along the route as shown on the attached Figures 1 to 4 inclusive. These include isolated residences on Pestells Lane and Fletchers Lane with a higher concentration of residential and commercial premises south of Edwards Avenue.

The project duration is approximately 10 weeks and the proposed hours of construction are as follows:-

- 7 am to 5 pm Monday to Friday; and
- 8 am to 2 pm on Saturdays.

The installation of the pipeline is likely to involve directional drilling under roadways and the railway tracks, excavation / mobile trenching, removal of materials, welding pipe, lowering in pipe, backfilling, hydro testing, dewatering and site restoration. A preliminary construction schedule is as follows:-

- Mobilisation, site inductions, third party line locates – Weeks 1 to 2;
- Pipeline installation (stringing, excavating, welding, lowering in, tie-ins, backfill, hydro testing) – Weeks 3 to 7;
- Right-of-way restoration, begin demobilising – Weeks 8 to 9;
- Demobilisation complete – Week 10

The main sources of noise during construction will be the plant and equipment used during the pipeline installation. It is expected that the pipeline installation process will move approximately 500 to 800 metres per day.

There is potential for rock hammering to occur in and to the south of Receptor Area 4, as identified in Coffey Environments Australia Pty Ltd's *"Acid Sulfate Soil, Contamination and Geotechnical Investigation"* report prepared for the Manildra Group in July 2011. The report states that where highly weathered sandstone, Class V, is encountered along the route, rock hammering may be required, however the extent to which this may occur is not yet known.

4.0 MEASURED AMBIENT NOISE LEVELS

4.1 Noise Survey Instrumentation

Noise level measurements and analysis were made with instrumentation as follows in Table 4.1.

Table 4.1 Noise Instrumentation

Description	Model No.	Serial No.
Modular Precision Sound Analyser Condenser Microphone 0.5" diameter Acoustical Calibrator Microphone Windscreen	B&K 2260 B&K 4189 B&K 4231 Acoustically transparent foam	244 3406 244 0653 243 9033
Infobyte Noise Logger Condenser Microphone 0.5" diameter Microphone Windscreen	iM3 MK 250 Acoustically transparent foam	38 3156
Infobyte Noise Logger Condenser Microphone 0.5" diameter Microphone Windscreen	iM4 MK 250 Acoustically transparent foam	105 3357

The **B&K 2260 Sound Analyser** is a real-time precision integrating sound level meter with octave and third octave filters that samples noise at a rate of 10 samples per second. The B&K 2260 provides L_{eq}, L_1, L_{10}, L_{50} and L_{90} statistical data at 15 minute intervals (longer or shorter intervals optional) over the desired monitoring period.

An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitors iM3 and 1M4 are Type 1 precision environmental noise monitors meeting all the applicable requirements of AS1259 for integrating-averaging sound level meters.

The instrument systems had been laboratory calibrated and certified within the last two years as required, using instrumentation traceable to National Standards. The measurement system was field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.3 dB during attended measurements and within 1 dB for long-term measurements. No adjustments for instrument drift during the measurement period were warranted.

4.2 Measured Ambient Noise Levels

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the NSW Office of Environment and Heritage as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for day, evening or night periods, measured over a number of days during the proposed days and times of operation.

The places of worst possible annoyance are the residences located along the route of the proposed pipeline, particularly those near Edwards Avenue where ambient noise levels are lower than those at other residential areas.

Noise monitors were placed at the following locations between the following dates:-

- Location A – 100 Pestells Lane, Meroo Meadow (06/01 – 13/01/2011);
- Location B – 55 Fletchers Lane, Meroo Meadow (06/01 – 13/01/2011); and
- Location C – 65A Edwards Avenue, Bomaderry (21/01 – 28/01/2011)

Background noise levels were measured at each location over a minimum period of 7 days and are presented in the attached Figures 2, 3 and 4 and also in Table 4.2 below.

The measured background noise is representative of the background noise at the nearest residences in the absence of noise from the subject development, as required by the NSW Office of Environment and Heritage in Section 3.1 of the NSW *Industrial Noise Policy.*

Table 4.2 Rating Background Level

Noise Measurement Location	Time Period	Rating Background Level
Location 'A' – 100 Pestells Lane, Meroo Meadow	Day (7 am to 6 pm)	**37 dBA**
Location 'B' – 55 Fletchers Lane, Meroo Meadow	Day (7 am to 6 pm)	**32 dBA**
Location 'C' – 65A Edwards Avenue, Bomaderry	Day (7 am to 6 pm)	**30 dBA**

Meteorological conditions during the testing typically consisted of clear skies and temperatures between approximately 13 to 28 ^{o}C at Locations A & B and 16 to 29 ^{o}C at Location C. Atmospheric conditions at each monitoring location were ideal for noise monitoring.

5.0 ACCEPTABLE NOISE LEVELS

5.1 Department of Planning Director-General's Requirements

The Department of Planning provide Director General's requirements for Shoalhaven Starches Pipeline Project (MP 10_0108) dated 8 November 2010.

'Key Issues', states:-

"Noise and Vibration – including:

- *A noise impact assessment, including an assessment of noise impacts and road traffic noise during both construction and maintenance;*
- *Consideration of potential vibration impacts from excavation works; and*
- *Details of the proposed noise mitigation, monitoring and management measures."*

5.2 Australian Standard AS2436

The Australian Standard AS2436–2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* provides guidance on noise control in respect to construction, demolition and maintenance sites. The Standard also provides guidance for the preparation of noise and vibration management plans.

Section 1.5 'Regulatory Requirements' of the Standard states:-

"Legislation associated with the control of noise and vibration on and from construction, demolition and maintenance sites in Australia is generally the responsibility of the relevant State or Territory government, local council or a designated statutory authority."

Consequently the Standard does not provide specific noise criterion rather sets out practical methods for determining the potential for noise and vibration impact on the community from construction, demolition and maintenance sites.

A qualitative method is described in Section 3.3 of the standard, which is designed to avoid the need for complex noise predictions by following a series of questions relating to, for example, whether the noise is likely to be loud, have annoying characteristics or affect sleep.

In the event that any of these outcomes are likely, a more detailed and quantitative approach should be adopted.

In relation to carrying out detailed noise impact assessments, Section 4 'General' of the standard states:-

"Regulatory authorities may have relevant polices and/or guidelines for the control of noise and vibration on construction sites. These should also be referred to when developing noise and vibration management plans for such projects."

In NSW this is the NSW Office of Environment and Heritage's *Interim Construction Noise Guideline 2009* as outlined in Section 5.3 below.

The Standard further states, in Section 4.6.1, that if noisy processes cannot be avoided, then the amount of noise reaching the receiver should be minimised and goes on to provide advice and recommendations to reduce noise and vibration impacts as far as reasonably practicable.

This report has been prepared in accordance with the guidance provided in AS2436-2010.

5.3 OEH Construction Noise Guideline

The NSW Office of Environment and Heritage published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance, the quantitative method is the most appropriate and has been used in this assessment. Details of the quantitative method are given in Section 4 of the Guideline..

Normal construction hours are defined by the OEH as follows:

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Based on the varying RBL levels at residential receiver locations, the recommended noise management levels during all aspects of the construction phase are summarised in Table 5.1 below.

Table 5.1 L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
Residential (Location A) (Location B) (Location C)	**47 (= 37 + 10) dBA** **42 (= 32 + 10) dBA** **40 (= 30 + 10) dBA**	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Section 6, "work practices" of The *Interim Construction Noise Guideline*, states:- *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts.*

This approach gives construction site managers and construction workers the greatest flexibility to manage noise". Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

5.4 OEH Vibration Guideline

The NSW Office of Environment and Heritage published the *Assessing Vibration: a technical guideline* in February 2006. This guideline is based on the British Standard BS 6472:1992 *"Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)."*

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The guideline considers vibration from construction activities as Intermittent Vibration. Table 2.4 of the guideline sets out limits for Vibration Dose Values to assess intermittent vibration and is replicated in Table 5.2 below for residential receptor locations.

Table 5.2 Vibration Dose Values (VDV) from Construction Activities

Receptor Location	Daytime	
	Preferred value ($m/s^{1.75}$)	Maximum value ($m/s^{1.75}$)
All Residences	0.20	0.40

The British Standard BS 7385-2:1993 *"Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration"* provides guide values for transient vibration relating to cosmetic damage, replicated in Table 5.3 below for residential buildings.

Table 5.3 Transient vibration guide values for cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Residential	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

In our opinion, an overall peak particle velocity of **15 mm/s** at the boundaries will comply with the recommended values in Table 5.3 and is an acceptable criterion for intermittent vibration to prevent cosmetic damage to the adjacent residential buildings.

6.0 CONSTRUCTION NOISE EMISSION

The main sources of noise on the site during construction will be during the directional drilling works lasting up to approximately 3 weeks, potential rock hammering where required for short periods and the pipe installation works lasting approximately 5 weeks.

The noise emission has been calculated to the following residential areas and uses the relevant measured background noise levels from Section 4.2 to establish noise management levels in those areas (see Figure 2):

- Receptor Area 1 – Pestells Lane residences (background noise - Location A;)
- Receptor Area 2 – Flecthers Lane residences and Meroo Road residences north of Fletchers Lane (background noise – Location B);
- Receptor Area 3 – Residences located on Meroo Road to the south of Fletchers lane (background noise – Location B);
- Receptor Area 4 – Residences located on Edwards Avenue and to the south in Alfred Street and Lillian Place (background noise - Location C)

6.1 Construction Plant Noise Emission

The installation of the pipeline will be continuous during the hours of construction with various items of plant operating in different locations along the route. For example, the trenchers will be operating ahead of the welders, pipe laying and backhoes, over a distance of up to 800 metres, depending on the section of the route being worked on at the time. The drilling rig will be located at various locations temporarily, i.e. the Princes Highway, Meroo Road, the railway line crossing and Edwards Avenue, for approximately 3 or 4 days at each location.

Rock hammering may potentially occur on the southern side of Edwards Avenue and further to the south along Railway Street where there are isolated sections of heavily weathered sandstone.

Table 6.1 below shows examples of the type of plant and equipment to be used during the construction phase with indicative overall sound power levels (L_w) in decibels re: 1 pW.

Schedules of the sound power levels for the main construction equipment were extracted from the Day Design database of Sound Power Levels and the Australian Standard AS2436–2010 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites"*.

Table 6.1 Pipeline Installation - Plant and Equipment - Sound Power Levels

Description	Sound Power Level (dBA)
Directional Drilling Rig	106
Backhoe	94
Trencher	110
Loader	105
Welding Rig (Diesel)	95
Dewatering Pump	90
Truck	107
Staff Car / 4WD	70
Hydraulic Rock Breaker	118

6.2 Predicted Construction Noise Emission

Knowing the sound power level of a noise source (see Table 6.1 above), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, atmospheric effects, etc.

The level of noise from the construction activities is calculated (using computer modelling) to be as shown in Tables 6.2, 6.3, 6.4 and 6.5 below.

Table 6.2 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 1
(Without Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 1 (Pestells Lane)	Drilling (Princes Highway crossing)	**49**	**47**	**No** + 2dB
	Backhoe	37	**47**	Yes
	Trencher	**53**	**47**	**No** + 6 dB
	Loader	**49**	**47**	**No** + 2 dB
	Welding Rig (Diesel)	38	**47**	Yes
	Dewatering Pump	34	**47**	Yes
	Truck	**51**	**47**	**No** + 4 dB
	Combined	**57**	**47**	**No** + 10 dB *

* See Section 8

Table 6.3 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 2
(Without Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 2 (Fletchers Lane)	Drilling (Meroo Road crossing)	**55**	**42**	**No** + 13 dB
	Drilling (at Railway Line)	**59**	**42**	**No** + 17 dB
	Backhoe	**60**	**42**	**No** + 18 dB
	Trencher	**75**	**42**	**No** + 33 dB
	Loader	**71**	**42**	**No** + 29 dB
	Welding Rig (Diesel)	**61**	**42**	**No** + 19 dB
	Dewatering Pump	**56**	**42**	**No** + 14 dB
	Truck	**73**	**42**	**No** + 31 dB
	Combined	**78**	**42**	**No** + 36 dB *

* See Section 8

Table 6.4 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 3
(Without Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 3 (residences on the eastern side of Meroo Road, south of Fletchers Lane)	Drilling (Meroo Road crossing)	**45**	**42**	**No** + 3 dB
	Drilling (at Railway Line)	**46**	**42**	**No** + 4 dB
	Backhoe	38	**42**	Yes
	Trencher	**55**	**42**	**No** + 13 dB
	Loader	**49**	**42**	**No** + 7 dB
	Welding Rig (Diesel)	39	**42**	Yes
	Dewatering Pump	34	**42**	Yes
	Truck	**51**	**42**	**No** + 9 dB
	Combined	**58**	**42**	**No** + 16 dB *

* See Section 8

Table 6.5 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 4 (Without Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 4 (residences in Edwards Avenue and south e.g. Alfred Street and Lillian Place)	Drilling (Edwards Avenue Crossing)	**61 to 72**	**40**	**No** + 21 to 32 dB
	Backhoe	**60**	**40**	**No** + 20 dB
	Trencher	**75**	**40**	**No** + 35 dB
	Loader	**71**	**40**	**No** + 31 dB
	Welding Rig (Diesel)	**61**	**40**	**No** + 21 dB
	Dewatering Pump	**56**	**40**	**No** + 16 dB
	Truck	**73**	**40**	**No** + 33 dB
	Rock Hammering (if required)	**75**	**40**	**No** + 35 dB
	Combined	**80**	**40**	**No** + 40 dB *

* See Section 8

All calculations and predictions consider attenuation from geometric divergence (distance attenuation) only and are based on the nearest potentially affected residences in the vicinity of the work at any given location.

For instance, directional drilling at the railway line will affect the residence at 130 Fletchers Lane more so than those at 55 and 79 Flecthers Lane (see Figure 3). Similarly trenching and backfilling operations, for example, will affect the residences at 55 and 79 Fletchers Lane more so than at 130 Fletchers Lane.

Further south, drilling at the Edwards Avenue intersection will affect the residence at 65A Edwards Avenue more so than those to the west of the railway line in Alfred Street (see Figure 4). However as works progress south, Alfred Street and Lillian Place residences will be exposed to noise emission from excavation works. Similarly if rock hammering is required in this area the residents in Alfred Street and Lillian Place will be the most potentially affected.

In every case Tables 6.2 to 6.5 inclusive show the highest predicted noise level at the most affected residence in each residential area, for each individual construction activity, at any given time. Residential areas are shown in the attached Figures 2, 3 and 4.

The predicted levels of noise from the construction activities are generally in excess of the noise management levels in Section 5.3 of this report.

To minimise the noise impact from the construction activities we recommend that the noise controls and management plan detailed in Section 7 of this report be implemented.

6.3 Vibration Emission

It is difficult to accurately predict levels of ground borne vibration at remote locations as there are many variables to consider including the surrounding terrain, strata, rock density, etc.

Previous measurements of ground borne vibration from rock hammering show that levels can vary significantly at different distances and locations. Given the distances from neighbouring residences to any potential rock hammering on site, vibration levels are likely to be well under the required maximum levels established in Section 5 of this report. However, we recommend that compliance monitoring of ground borne vibration is carried out along the route, wherever rock hammering is required.

6.4 On Road Traffic Noise

The Director-General's Requirements require an assessment of on road traffic noise generated by the proposal. Motor vehicle movements, for example trucks and staff vehicles, are considered part of the construction works and assessed under the OEH's *Interim Construction Noise Guideline*.

Consideration is given to heavy vehicles as part of the overall construction activities and predicted noise levels for 'trucks' are given in Tables 6.2 to 6.5 inclusive.

With regard to staff vehicles, details have been supplied by Stapleton Transportation & Planning Pty Ltd, in their *"Shoalhaven Starches, Bomaderry Proposed Gas Pipeline Construction Traffic Impact Assessment"* dated December 2010.

Section 2.1.1 of the traffic assessment reports a total of 25 staff vehicle movements per peak arrival or departure hour. Details of designated parking areas along the route have not yet been finalised although it is assumed temporary 'work-zones' will be established along the route as works progress.

Based on the assumption that an average of 8 staff vehicles arrive or leave any particular work-zone in any given 15 minute period, the predicted $L_{eq,\ 15\ minute}$ noise level is **45 dBA** at, for example, a distance of 20 metres. This is based on a 15 minute sound power level ($L_{w,\ 15\ minute}$) for one vehicle as shown in Table 6.1 and the predicted level will vary depending on the distance to residences (e.g. at a distance of 35 metres the predicted level is 40 dBA $L_{eq,\ 15\ minute}$).

A minimum distance of 35 metres from any staff parking area to any residence will ensure the noise management levels are met at all receptor areas from staff vehicle noise emission.

Recommendations to minimise the noise impact from motor vehicles accessing the site during the construction works are provided in Section 7.2 below.

6.5 Fixed Plant Noise Emission

There is no significant noise producing fixed plant associated with the ongoing operation of the gas pipeline. A pressure reduction facility will be located opposite Shoalhaven Starches complex on the northern side of Bolong Road, adjacent to the train line as shown on the attached Figure 1.

An existing pressure reduction facility is located at the Pestells Lane Meter Station and is reported to be indicative of that which is proposed on the Shoalhaven Starches site. Measurements of the existing pressure reduction facility have been used to calculate the L_{10} octave band, and overall 'A' frequency weighted, sound power levels, in decibels re: 1 pW, shown in Table 6.6 below. Measurements were conducted by the author in December 2011 using instrumentation shown in Table 4.1.

Table 6.6 Pressure Reduction Facility L_{10} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	63	125	250	500	1k	2k	4k	8k
Pressure Reduction Facility	**76**	84	80	69	63	63	67	71	71

Shoalhaven Starches operates under Environment Protection Licence 883 issued by the NSW Office of Environment and Heritage. The licence sets acceptable $L_{10,\ 15\ minute}$ noise limits at various receptor locations that are not to be exceeded for the overall, ongoing operation of the entire complex.

In order for any new items of fixed plant not to increase existing levels to beyond acceptable limits, design goals of a minimum 10 dB below the OEH criteria are set. These are as follows:-

- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;*
- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;*
- *32 dBA ($L_{10,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;*
- *30 dBA ($L_{10,\ 15\ minute}$) at other locations in Bomaderry.*

Based on an indicative sound power level, shown in Table 6.6, for the proposed gas pressure reduction facility, the calculated sound pressure level is less than **15 dBA** at the nearest residential receptor location (Meroo Street) and less than **5 dBA** at each of the other locations.

Noise emission from the pressure reduction facility will be inaudible at all residential receptors and as such, no further consideration is given to fixed plant noise emission in this report.

7.0 NOISE CONTROL RECOMMENDATIONS

The predicted level of noise emission from the construction activities is likely to be in excess of the noise management levels established in Section 5.3 of this report, at least on some occasions.

It should be noted however, that individual residences along the route, will only be affected by noise emission for a short period of time compared to the total 10 week construction period. For instance the installation works will move at approximately 500 to 800 metres per day for up to approximately 5 weeks. As such any single residence will be exposed to noise emission from various items of plant for less than one week.

In order to minimise the noise impact from all construction activities at any single residence, we recommend the following engineering and management noise controls be implemented.

7.1 Engineering and Practical Noise Controls

Australian Standard AS2436-2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated in Table 7.1 below.

Table 7.1 Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible, dB
Distance	Approximately 6 dB for each doubling of distance
Screening	Normally 5 dB to 10 dB maximum 15 dB
Enclosure	Normally 5 dB to 25 dB maximum 50 dB
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Generally, erecting temporary sound barrier screens around construction sites is an effective way of reducing noise emission. However, in this instance, given the short duration of works and the short time activities will occur near to any given residences, it is not practicable to construct temporary sound barriers along the construction route to minimise pipe installation works. The time taken to erect and dismantle barriers is likely to be as long as, or longer than individual construction activities passing any given property. However, if rock hammering or drilling is to occur in any one location for more than 3 or 4 days consideration may be given to erecting, for example, timber hoardings around the site.

Engine exhaust silencers may be fitted to the mobile plant such as the loader, trencher, backhoe and the truck and consideration should be given to any plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that not more than one item of plant is operating simultaneously within close proximity of any given residence. This will reduce the combined noise levels shown in Tables 6.2 to 6.5 by a further 3 to 5 dB.

Tables 7.2 to 7.5 below show the predicted levels of noise emission from each item of plant following the implementation of practical noise controls such as screening around fixed plant and fitting silencers or selecting silenced mobile plant.

Table 7.2 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 1 (With Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 1 (Pestells Lane)	Drilling (Princes Highway crossing)	**42**	**47**	Yes
	Backhoe	30	**47**	Yes
	Trencher	**46**	**47**	Yes
	Loader	**42**	**47**	Yes
	Welding Rig (Diesel)	38	**47**	Yes
	Dewatering Pump	27	**47**	Yes
	Truck	**44**	**47**	Yes

Table 7.3 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 2
(With Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 2 (Fletchers Lane)	Drilling (Meroo Road crossing)	**48**	**42**	**No** + 6 dB
	Drilling (at Railway Line)	**52**	**42**	**No** + 10 dB
	Backhoe	**53**	**42**	**No** + 11 dB
	Trencher	**68**	**42**	**No** + 26 dB
	Loader	**64**	**42**	**No** + 22 dB
	Welding Rig (Diesel)	**54**	**42**	**No** + 12 dB
	Dewatering Pump	**49**	**42**	**No** + 7 dB
	Truck	**67**	**42**	**No** + 25 dB

Table 7.4 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 3
(With Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 3 (residences on the eastern side of Meroo Road, south of Fletchers Lane)	Drilling (Meroo Road crossing)	**38**	**42**	Yes
	Drilling (at Railway Line)	**39**	**42**	Yes
	Backhoe	31	**42**	Yes
	Trencher	**48**	**42**	**No** + 6 dB
	Loader	**42**	**42**	Yes
	Welding Rig (Diesel)	32	**42**	Yes
	Dewatering Pump	27	**42**	Yes
	Truck	**44**	**42**	**No** + 2 dB

Table 7.5 Predicted $L_{eq\ 15\ minute}$ Construction Noise Levels – Receptor Area 4 (With Noise Control)

Receptor Locations	Activity	Predicted Sound Level (dBA)	Noise Management Level (dBA)	Compliance (Yes/No)
Receptor Area 4 (residences in Edwards Avenue and south e.g. Alfred Street and Lillian Place)	Drilling (Edwards Avenue Crossing)	**54 to 65**	**40**	**No** + 14 to 25 dB
	Backhoe	**53**	**40**	**No** + 13 dB
	Trencher	**68**	**40**	**No** + 28 dB
	Loader	**64**	**40**	**No** + 24 dB
	Welding Rig (Diesel)	**54**	**40**	**No** + 14 dB
	Dewatering Pump	**49**	**40**	**No** + 9 dB
	Truck	**67**	**40**	**No** + 27 dB
	Rock Hammering (if required)	**68**	**40**	**No** + 28 dB

The above predictions assume a conservative reduction of a maximum 7 dB from either screening around fixed plant or silencing mobile plant. These predictions are an estimate only and greater attenuation may be achieved in practice once full details of all plant and equipment are known.

It can be seen from Tables 7.2 to 7.5 that predicted noise levels are well below the 'highly noise affected' level of 75 dBA above which there may be strong community reaction to noise at all receiver locations.

There is still potential for noise management levels to be exceeded on some occasions and we therefore recommended the following noise management controls to minimise the impact on residential receivers.

7.2 Noise Management Controls

The following noise management controls are derived from or are in accordance with recommendations given in Australian Standard AS2436-2010 and the OEH's *Interim Construction Noise Guideline.*

Periods of Respite

We recommend that noisy construction activities such as rock hammering or drilling at the Edwards Avenue intersection only operate for 2 to 3 hours at a time. This will reduce the noise impact at the nearby residences. Ensure activities in any one location are staggered, for instance, if rock hammering or drilling is occurring at one location, do not operate additional excavators or other noisy plant at the same location until the activity is complete.

Work Practices

We recommend that workers and contractors be trained in work practices to minimise noise emission such as the following:

- Employ the use of broadband audible reversing alarms on all mobile plant.
- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out work only within the recommended hours of operation (see Section 5.3).

Heavy Vehicles and Staff Vehicles

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receiver locations as practicable.
- No motor vehicles should access the site via, or park within, residential areas prior to 7 am in order avoid sleep disturbance. For example whilst works progress through receptor area 4 from north of Roseville Road to south of Alfred Street (see Figure 4).

Community Relations

A Liaison Officer should maintain liaison between the neighbouring community and the contractor and communication lines should be opened early, prior to commencement of any works. Communication should be made with all affected residences via a range of media including, for example, individual contact and letter box drops.

Inform the neighbours about the nature of the construction stages. The neighbours should be notified when the excessively noisy operations (such as the use of the drilling rig) are to be carried out.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

The Liaison Officer should receive and manage noise complaints. All complaints should be treated promptly and with courtesy. Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

7.3 Vibration Monitoring

We recommend that the level of vibration be measured during the rock hammering and trenching in the event that rock hammering is required or complaints arise regarding vibration from any nearby residences.

The vibration measurements can be carried out using either an attended or an unattended vibration monitor. An unattended vibration monitor should be fitted with an alarm in the form of a strobe light or siren to make the plant operator aware immediately when the vibration limit is

exceeded. The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the nearest residential building.

Dilapidation reports may be commissioned for potentially affected residential premises prior to any rock hammering being undertaken. This may be finalised once the extent of rock hammering, if any, is known.

7.4 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only and we make no claim of expertise in other areas.

8.0 DEPARTMENT OF PLANNING AND INFRASTRUCTURE ADEQUACY REVIEW

Following the submission of the original Construction Noise and Vibration Management Plan in August 2011, the NSW Department of Planning and Infrastructure, as part of their Environmental Assessment adequacy review, has requested additional information. Following our review of the Department's comments and discussions with departmental staff, this revised report addresses each of the issues raised, as detailed below:-

1. *The noise assessment predicts the level for each item of plant and equipment to be used during construction individually and compares each noise source to the relevant criteria in OEH's Interim Construction Noise Guideline (ICNG). In order to ensure that the highest potential level of noise is presented, all items of plant and equipment should be added together and remodelled collectively.*

In order to address the Department's request we calculated the combined level of all plant at each receptor location in Tables 6.2 to 6.5 inclusive.

This combined noise impact significantly overstates the potential noise impact as this will never occur in practice.

The works will progress at a rate of approximately 500 to 800 metres per day, consequently different items of plant will be at different locations at any given time, affecting different receptors. The predicted noise level shown in each table, for each individual item of plant is based on that item being as close as possible to the respective receptor at the time. The cumulative impact will therefore not be the acoustic sum of the individual levels predicted for each item of plant. The cumulative level of noise at each receptor will not be significantly greater than the highest individual level represented in each table.

In any event additional recommendations are made in Section 7.1 and 7.2 'periods of respite' in relation to managing the potential for cumulative impacts.

2. *The EA predicts a number of exceedences of the relevant ICNG criteria (and in some cases emissions could be up to a level where there could be strong community reaction). The EA proposes a number of source controls to mitigate these impacts (e.g. exhaust silencers and use low noise machinery) but does not quantify how effective these measures would be at attenuating noise. When the noise emissions are remodelled, it should take into account these measures.*

To address the department's request Tables 7.2 to 7.5 inclusive show estimated noise levels following a conservative reduction from source noise controls. Actual attenuation from these measures or the reasonability and feasibility of implementing them over such a short project should be determined once the contractor and exact items of plant have been selected.

Recommendations made in Section 7.2, under work practices are examples of ways of minimising noise emission from construction activities, where practicable. The objective of the OEH's ICNG is to implement all feasible and reasonable work practices to minimise noise impacts, providing a holistic and pragmatic approach to noise reduction without prescribing specific noise controls.

Selecting quieter, low noise machinery is a good way to reduce noise, for example using a 12 tonne excavator in preference to a 30 tonne excavator if it is capable of doing the task and is economically viable. It is difficult to quantify a reduction like this without knowing the proposed plant however, noise reductions of 10 dB are likely.

Similarly low noise / alternative work practices could reduce the noise impact by, for example, using concrete saws in preference to rock breaking machinery.

The level of attenuation achieved from mobile plant exhaust silencers, can vary considerably, depending on the cost, age of the plant, etc. This project is of relatively short duration and it may not be reasonable to expect a fleet of plant to be fitted with silencers for the sake of the project, however, should any plant already be fitted with silencers this may be a consideration when selecting tenders or individual items of plant from a fleet.

3. *If there are still exceedences of the relevant ICNG criteria once the construction noise levels have been remodelled, the company should consider what other reasonable and feasible noise management and mitigation measures it could implement to further reduce construction noise and/or what community consultation activities it would carry out to reduce these impacts on surrounding receivers.*

Any exceedences of the noise management levels will be for a relatively short duration at any effected residence, specifically less than a total of one week (see Section 7).

Advice is given in Section 7.2 under 'community relations' and 'managing a noise complaint' for examples of carrying out community consultation.

With the potential for rock hammering it is particularly important to inform all potentially affected residences on the southern side of Edwards Avenue, for example between 72B to the east and Samuel Street to west as well as all residences in Lillian Place and on the eastern side

of Alfred Street. This should be confirmed once the location and extent of rock hammering is known.

Consultation should be via letter box drops initially, several weeks prior to commencement, detailing the reason for hammering, the date/s hammering will occur, the duration and between which hours. The letter should contain a contact name and number for queries or complaints and follow up letters should be delivered closer to the time. The company's liaison officer should visit the homes in the immediate vicinity of the rock hammering works and discuss the details with the owners.

If a temporary site office is established on the job, a notice board should be placed prominently outside and updated regularly with details of noisy events and contact details of a liaison officer for members of the community.

If there is potential for rock hammering to continue at one location for more than 3 or 4 days, consideration may be given to temporary noise barriers and a determination may be made once the extent of hammering is known.

4. *The noise assessment indicates that no rock hammering equipment would be used during construction whereas the geotechnical report states that a 20 tonne excavator equipped with rock bucket, rock hammer or ripping tyne would be used to penetrate highly weathered (Class V) sandstone during construction. The revised EA must clarify whether or not rock hammering equipment would be used during construction and, if so, the noise impacts of this must be assessed.*

An assessment of the potential noise impacts associated with potential rock hammering activities has been addressed in this revision. Please see Section 3 page 5, Table 6.5, Section 6.3 and the response to point 3 above.

5. *Finally, the revised EA should clarify whether the proposed pressure reduction facility would generate noise and, if so, the noise impacts of this must be assessed.*

Please refer to Section 6.5.

9.0 CONSTRUCTION NOISE IMPACT STATEMENT

The predicted level of noise emission from the construction activities is likely to be in excess of the noise management levels, at least on some occasions. Provided the recommendations in Section 7 of this report are implemented and adhered to, the level of noise and vibration from the construction works for the Shoalhaven Starches Gas Pipeline Project will be minimised in accordance with the NSW Office of Environment and Heritage's *Interim Construction Noise Guideline* and Australian Standard AS2436 – 2010 as detailed in Section 5 of this report.

Matthew Harwood, MAAS

Senior Acoustical Consultant
for and on behalf of Day Design Pty Ltd.

A.A.A.C. MEMBERSHIP
Day Design Pty Ltd is a member company of the Association of Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:

- Figure 1 – Proposed Pipeline Route
- Figure 2 – Receptor Area 1
- Figure 3 – Receptor Areas 2 and 3
- Figure 4 – Receptor Area 4
- Figure 5 – Ambient Noise Levels – Location A
- Figure 6 – Ambient Noise Levels – Location B
- Figure 7 – Ambient Noise Levels – Location C