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AGL ENERGY LIMITED

WAUKIVORY PILOT PROJECT

CONSTRUCTION NOISE COMPLIANCE SURVEY

REPORT J0215-01-R1

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Prepared for:
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1. INTRODUCTION

This report presents results from a construction noise compliance survey at various residences in the vicinity of the Waukivory Pilot Project (the project) which is part of the Gloucester Coal Seam Gas Project being developed by AGL Energy Limited. The project includes construction of the following infrastructure:

- Gas collection equipment fitted to four existing gas wells known as WK11, WK12, WK13 and WK14 located approximately 2 km south of Gloucester, NSW;
- Trenching and installation of gas collection pipelines (gathering lines) between the four wells;
- Trenching and installation of a water transfer pipeline between the southern well (WK13) to two surface dams located approximately 1 km and 2.5 km south of the wells;
- Directional drilling to install gathering lines and the water transfer pipeline under the Avon River, Waukivory Creek and Fairbairns Road;
- Gravel hardstand areas around each well, security fences and other ancillary infrastructure; and
- Fracture stimulation of the coal seam around each well to increase gas flow.

The project is subject to Environment Protection Licence (EPL) 20358 issued by the Environment Protection Authority (EPA).

AGL Energy Limited commissioned the *Waukivory Pilot Project Construction Noise Management Plan* (CNMP) (EMGA Mitchell McLennan, 6 August 2014) in response to Condition G2.2 of the EPL. Section 4.2.3 of the CNMP recommends noise monitoring during activities predicted to generate maximum noise impacts during the construction program, while Section 5.1 of the CNMP recommends a number of responses to noise related complaints including noise monitoring at potentially affected receivers to assess construction noise levels against relevant criteria.

This report has been commissioned by AGL Energy Limited in response to Sections 4.2.3 and 5.1 of the CNMP. Noise measurements were taken during a site visit on Thursday 14 August 2014.

1.1. Glossary

The following acoustical terms are used in this report:

Sound Pressure	Small air pressure variations above and below normal atmospheric pressure that are perceived by human ears as sound.
Frequency	The rate of sound pressure fluctuations per second, expressed as cycles per second or hertz (Hz). Human ears in good condition can typically detect sound in the frequency range 20 Hz to 20,000 Hz (20 kHz), depending on sound level.
Decibels, dB	A noise level unit based on a logarithmic scale of pascals of sound pressure above and below atmospheric pressure. Expressing a sound pressure level in decibels implies root-mean-squared (RMS) sound pressure unless explicitly stated otherwise. Human ears in good condition can typically detect sound pressures from the threshold of perception at 0 dB (20 uPa) to the threshold of pain at 140 dB (200 Pa), depending on frequency. An increase of 10 dB is perceived as an approximate doubling of sound level by a human ear.
dBL	Linear decibels, the same as dB but used to explicitly define a decibel scale in the absence of any frequency weighting.
dBA	A-weighted decibels, where the A weighting means frequencies below 500Hz and above 10kHz are artificially reduced to approximate the frequency response of an average human ear. Most sound monitoring instruments include an A-weighting option, enabling direct measurement of noise levels in dBA.

- LA90 The A-weighted noise level exceeded 90% of the time (which can be thought of as the quietest 10% of the time) over a defined measurement period, usually 15 minutes or one hour, and widely accepted as the background noise level.
- LA90,15min Same as LA90 with the measurement period specifically stated.
- LAeq The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location.
- LAeq,15min Same as LAeq with the measurement period specifically stated.
- Background Level see LA90.

2. RECEIVERS

The CNMP identified 10 residential receivers with the potential to receive significant construction noise. Table 1.2 in the CNMP presents the address and location of each receiver and is reproduced in Table 1.

Table 1: Identified Residential Receivers (from Table 1.2 in the CNMP).

Location	Address	Coordinates (MGA Zone 56)
R1	20 Grantham Road, Forbesdale	402023, 6453041
R2	Intersection of Fairbairns Lane and North Coast Railway	401824, 6452610
R3	176 Fairbairns Road, Forbesdale	402095, 6452080
R4 ¹	237 Fairbairns Road, Forbesdale	402510, 6451653
R5 ¹	197 Fairbairns Road, Forbesdale	403184, 6452184
R6	114 Maslens Lane, Gloucester	402747, 6453425
R7	304 Fairbairns Road, Forbesdale	402282, 6451332
R8	305 Fairbairns Road, Forbesdale	402822, 6450969
R9	Lot 881 Fairbairns Road, Forbesdale	402942, 6450475
R10	384 Fairbairns Road, Forbesdale	403012, 6450236

¹ Receivers R4 and R5 are owned by a neighbouring mining company.

A plan of the area showing the location of each receiver is attached as Appendix A.

3. NOISE CRITERIA

Construction activity associated with the project is subject to noise criteria recommended in the *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change NSW, July 2009). The ICNG recommends two noise assessment levels during standard construction hours, which are 7 am to 6 pm Monday to Friday and 8 am to 1 pm Monday to Saturday excluding public holidays:

- A ‘noise affected’ level set 10 dBA above the background noise level represents the point above which there may be some community reaction to noise and all feasible and reasonable mitigation measures should be implemented; and
- A ‘highly noise affected’ level of 75 dBA above the background noise level represents the point above which there may be a strong community reaction to noise and additional mitigation measures such as respite periods may be appropriate.

Section 2.2 of the CNMP reports a measured background noise level at or below 30 LA90,15min at all receivers which leads to a ‘noise affected’ level of 40 LAeq,15min during normal construction hours at all receivers.

4. METHOD OF ASSESSMENT

Noise measurements were taken on Thursday 14 August 2014 in the vicinity of each potentially affected receiver using a Svan 957 Type 1 sound level analyser which was programmed to measure and store 1-second Leq noise levels in 1/3 octave bands from 20 Hz to 20 kHz for each measurement period. The analyser was fitted with a 12.7mm condenser microphone and a windshield and mounted on a tripod with the microphone located approximately 1.2m above the ground. Noise measurements were taken at each location for a representative period of nominally 15 minutes, however a shorter measurement duration of 5 minutes was used where construction noise was not audible.

Instrument calibration was checked at the beginning and end of the noise survey using an 01dB Cal-01 acoustic calibrator which produces 94 dB at 1kHz. Copies of current calibration certificates for these instruments, from a NATA-accredited laboratory, have not been attached to this report but are available upon request.

The measured 1-second data were subsequently processed to exclude noise produced by extraneous sources to enable the separate noise contribution from construction activity alone to be determined, based on detailed notes taken during each measurement period. Charts showing the total measured noise level and the separate noise contribution from construction activity are attached to this report in Appendix B.

The noise survey complies with the recommendations in Section 5.1 of the CNMP, particularly Section 5.1.1 which discusses noise monitoring equipment and Section 5.1.2 which discusses an appropriate noise survey methodology.

5. RESULTS

Total measured noise levels at each location, and noise levels produced by construction activity alone, are presented for each assessed receiver in the order in which the noise measurements were taken.

Weather conditions were generally acceptable for noise monitoring with an average wind speed of approximately 1 to 2 m/s and gusts to approximately 3 m/s, generally from the south to south west. An air temperature of approximately 20 °C was accompanied by sparse cloud cover averaging 1/8 of the sky area early in the survey and increasing to approximately 4/8 at the end of the survey.

5.1. Receiver R5

Noise measurements were taken at Receiver R5, at a location approximately 30 m south of the residence, from 12:05 pm on Thursday 14 August 2014. Construction activities at the time of the noise measurement, generally in order from the most to the least audible, included:

- Direction drilling under Waukivory Creek to install the gathering pipelines. The directional drilling machine was located on the eastern side of Waukivory Creek approximately 370 m from R5;
- Laying out sections of gathering pipeline between WK13 and WK14 in preparation for trenching, with the pipeline trailer primarily working approximately 270 m west of R5 during the noise monitoring period; and
- Civil works including transport, tipping and spreading of hardstand gravel at WK13 approximately 730 m west of R5.

Other sources of noise that were audible during the survey at R5 included:

- Wind noise, with wind speeds gusting to approximately 3 m/s at the microphone and averaging an estimated 1 to 2 m/s generally from the south during the noise measurement period;

- Farm vehicle movements unrelated to construction activity including a tractor and trailer and a tractor alone;
- Horses adjacent to R5; and
- Intermittent bird calls.

A total noise level of 42.9 LAeq,15min was measured at R5. A construction noise level of approximately 42 LAeq,15min has been determined in the absence of extraneous sources, although some uncertainty remains due to the difficulty of separating noise from simultaneous construction and extraneous sources.

The primary source of construction noise was the directional drilling machine at the Waukivory Creek crossing which produced approximately 42 LAeq,15min at R5, with laying out of the gathering pipeline from a trailer and associated vehicle movements only occasionally audible. Civil work at WK13 was not audible, or could not be separately identified, during the noise measurement period.

The calculated construction noise level of 42 LAeq,15min is 2 decibels above the 'noise affected' level recommended in the ICNG therefore all feasible and reasonable noise mitigation measures should be considered and implemented to minimise construction noise at R5. The following noise reduction measures are considered possible, however may not be feasible or reasonable:

- Use an alternative method to install the gathering pipeline. Given the practical advantages of the directional drilling technique, including minimal disturbance to ecologically sensitive watercourses, any alternative to this technique such as open trenching is likely to cause significant additional environmental impacts. No reasonable alternatives appear to be available with current technology;
- Replace the directional drilling machine with a quieter unit. Directional drilling machines are typically used in field locations and must be self-contained, therefore are typically diesel powered. The unit's diesel engine is the primary source of noise. It may be possible to obtain an electrically powered unit, however this alternative would require installation of a temporary power supply line which would cause additional construction noise and increase the area of land disturbed by the project, or use a diesel powered generator which does not avoid diesel engine noise. While a detailed investigation was not undertaken, noise levels from this unit appeared consistent with noise levels produced by similar capacity units on other construction sites. Practically, no reasonable alternative to the current unit appears to be available;
- Operate the machine at lower speed to reduce noise. This option may lower the noise level produced by the unit but would cause a corresponding increase in the duration of noise at the receiver. The total quantity of noise at the receiver would not change significantly, therefore this option does not appear to offer any noticeable benefit;
- Install a noise wall or other noise barrier on the eastern side of the machine to shield R5. This option is considered practically achievable but is unlikely to be justifiable for the following reasons:
 - A noise level only 2 dBA over the recommended level is considered a mild noise impact, as research completed by the EPA and others indicates an average person has difficulty distinguishing a noise level change of 2 dBA or less;
 - Construction work associated with gathering pipeline installation under Waukivory Creek is expected to take approximately 4 to 5 days. Additional construction noise for a day or two to install a noise barrier is not justifiable considering the short period of construction noise;
 - The occupants of Receiver R5 did not appear to be at home during the noise survey. Construction noise cannot cause a noise impact to a residence that is not occupied at the time the noise occurs. It is not known whether the residence is typically occupied during normal construction hours.

Considering the very short duration of construction noise, minimal potential for noise impact and lack of practical or justifiable noise mitigation measures, no additional noise mitigation measures are recommended to reduce construction noise at R5.

A separate noise measurement to quantify the background noise level at R5 in the absence of construction noise was not required, as the low background noise levels measured at all other receiver locations indicates a background noise level below 30 LA_{90,15min} would have occurred at R5.

Detailed analysis of the results indicates modifying factors as defined in the *NSW Industrial Noise Policy* (INP) (DECC, 1999) such as tonal or low frequency corrections do not apply to construction noise levels at Receiver R5.

5.2. Receiver R6

Receiver R6 includes two residences adjacent to a number of farm related buildings such as storage sheds and workshops. The main residence is located north of the workshop and is effectively shielded from project noise by the large workshop building, while a second residence is located west of the workshop and would have an unobstructed view of the project. At the time of the site visit there were approximately 6 people working in the workshop or on tractors or other mobile plant adjacent to the workshop.

Noise measurements were therefore taken at a location approximately 50 m south of the workshop which is approximately 140 m south of the main residence and approximately 110 m south east of the second residence. This location is not within 30 m of the residence as recommended by relevant policy documents, however is closer to the project and more remote and shielded from workshop noise and is therefore acceptable. The noise measurement was taken from 12:33 pm on Thursday 14 August 2014.

Construction noise was not audible at any time during the noise survey. A noise level of 37.0 LA_{eq,15min}, due entirely to farm-related activity or other extraneous sources such as aircraft, wind or birds, was measured at this location. With construction noise not audible at a measured background noise level of 30.4 LA_{90,15min}, the construction noise level at the time of the survey is estimated at less than 20 LA_{eq,15min}.

5.3. Receiver R4

Noise measurements were taken at Receiver R4, at a location approximately 10 m west of the residence on the side of Fairbairns Road, from 13:00 pm on Thursday 14 August 2014. Construction activity including truck movements was visible at WK13 and on the access road from Fairbairns Road, however no construction noise was audible at any time during the survey.

A noise level of 32.5 LA_{eq,15min}, due entirely to extraneous sources such as wind, birds and domestic activity at another nearby residence, was measured at this location. With construction noise not audible at a measured background noise level of 25.6 LA_{90,15min}, the construction noise level at the time of the survey is estimated at less than 15 LA_{eq,15min}. The southerly breeze, from the receiver to the construction site, that occurred during the survey would have resulted in significantly lower noise levels that would otherwise have occurred in calm conditions.

5.4. Receiver R3

Noise measurements were taken at Receiver R3, at a location approximately 45 m east of the residence on the side of Fairbairns Road, from 13:10 pm on Thursday 14 August 2014. While the noise measurement location was not within 30 m of the residence, the location was selected as it is readily accessible and is considered appropriate as it is slightly closer to the project and is therefore conservative.

Construction activity included truck movements from Fairbairns Road, unloading and spreading hardstand gravel, and unloading fence panels off a light truck, all at WK13 which is approximately 320 m east of R3.

Extraneous noise sources that were audible during the measurement period included passing traffic, wind and birds.

A total noise level of 58.7 LAeq,15min was measured at R3. A construction noise level of approximately 29 LAeq,15min has been determined in the absence of extraneous sources, although some uncertainty remains due to the difficulty of separating wind noise at times of dominant construction noise. Actual construction noise levels in the absence of all wind noise are likely to be lower than this conservatively calculated level.

According to the INP, a low frequency penalty of +5 dBA should be added to the estimated construction noise level to account for the low frequency nature of the construction noise, as identified by the dBC level being more than 15 decibels above the dBA level. It is likely that wind noise, which exists primarily in the low frequency bands, has not been completely removed from the estimated construction noise level. If this is the case then construction noise alone may not require a low frequency correction. The 5 dBA correction factor conservatively added to the estimated construction noise level of 29 LAeq,15min remains below the recommended 40 LAeq,15min construction noise goal, therefore construction noise at Receiver R3 is considered acceptable with or without this correction factor.

5.5. Receiver R2

Noise measurements were taken at Receiver R2, at a location approximately 20 m south of the residence on the side of Fairbairns Road, from 13:30 pm on Thursday 14 August 2014. Construction activity included truck movements from Fairbairns Road and unloading and spreading hardstand gravel at WK13 which is approximately 740 m south-east of R2.

A noise level of 49.6 LAeq,15min, due entirely to extraneous sources such as passing traffic, wind and birds, was measured at this location. With construction noise not audible at a measured background noise level of 26.7 LA90,15min, the construction noise level at the time of the survey is estimated at less than 15 LAeq,15min.

5.6. Receiver R1

Noise measurements were taken at Receiver R1, at a location approximately 45 m west of the residence to avoid shielding from other buildings adjacent to the residence, from 13:45 pm on Thursday 14 August 2014. Construction activity included truck movements from Fairbairns Road and unloading and spreading hardstand gravel at WK13 which is approximately 970 m south of R1.

A noise level of 38.9 LAeq,15min, due entirely to extraneous sources such as a farm tractor, aircraft, wind, distant traffic and birds, was measured at this location. With construction noise not audible at a measured background noise level of 29.0 LA90,15min, the construction noise level at the time of the survey is estimated at less than 20 LAeq,15min.

5.7. Results Summary

Table 2 presents a summary of measured noise levels and estimated or calculated construction noise levels at each monitoring location.

Table 2: Measured Total Noise Levels and Construction Noise Levels, 14 August 2014, dBA.

Noise Survey Location	Total Measured Noise Level					Calculated or Estimated Construction Noise Level	
		LA1	LA10	LAeq	LA90	LAmix	LAeq
R1	54.5	52.2	37.2	38.9	29.0	-	< 20
R2	66.6	63.9	46.0	49.6	26.7	-	< 15
R3	79.5	72.2	55.2	58.7	27.8	42	34 ¹
R4	42.5	41.7	35.6	32.5	25.6	-	< 15
R5	51.0	48.5	45.4	42.9	37.6	50 ²	42
R6	50.9	48.8	40.5	37.9	30.4	-	< 20

- 1 The reported construction noise level of 34 LAeq,15min at Receiver R3 includes a 5 dBA low frequency correction factor as recommended in the INP.
- 2 The maximum construction noise level of 50 LAmix reported at R5 may have been caused by, or significantly contributed by, wind noise that was not separately identified or noted.

6. CONCLUSION

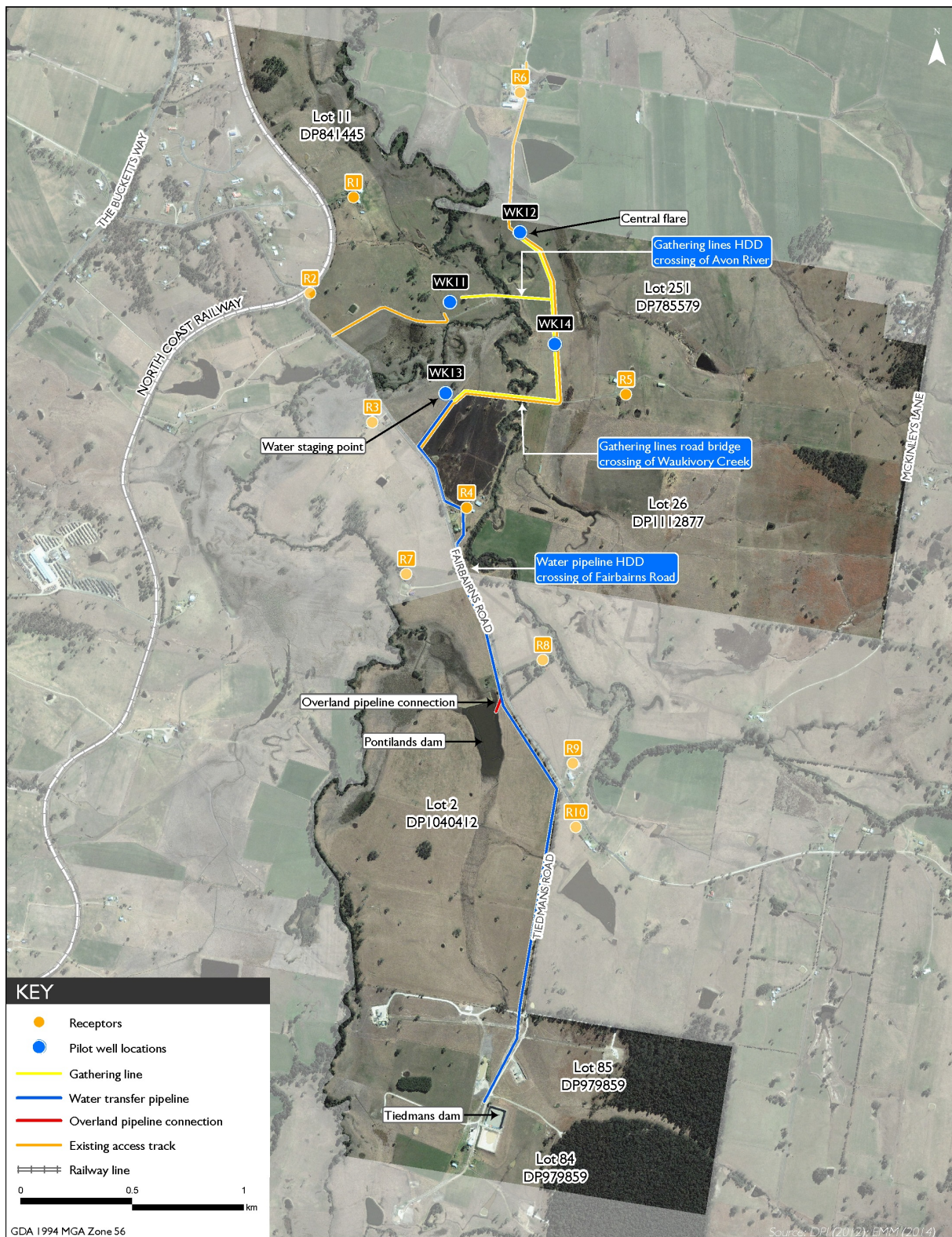
This assessment of noise levels produced by construction work associated with the Waukivory Pilot Project at closest residential receivers indicates construction noise levels are typically well below the recommended guideline value of 40 LAeq,15min in the CNMP and relevant EPA policy.

Construction noise levels reached an estimated 42 LAeq,15min, which is 2 dBA above the recommended level, at Receiver R5 close to a directional drilling work site. This triggered an investigation into feasible and reasonable mitigation measures to minimise noise at that receiver.

A discussion of feasible and reasonable mitigation measures at Receiver R5 is included in Section 5.1 of this report. The discussion indicates no feasible or reasonable mitigation measures can be devised to reduce noise at R5. This does not mean that no mitigation measures exist: it means that available mitigation measures would not result in an appreciable reduction in noise at the receiver when additional noise to set up the mitigation option is considered, or that the mitigation option is unlikely to be effective (including cost effective) considering the minor nature of the noise impact and the very short operating period of less than one week for the primary construction noise source audible at that receiver.

Based on the results of this assessment, no additional construction noise mitigation measures are recommended and no significant noise impacts are occurring at any receiver in relation to construction work for the project.

APPENDIX A – SITE AND AREA PLAN



Proposed work areas
 Construction Noise and Vibration Management Plan
 Waukivory Pilot Project

Figure 1.1

This plan has been reproduced from the plan on page 3 of the CNMP prepared by EMGA Mitchell McLennan.

APPENDIX B – MEASURED NOISE LEVELS

Charts on the following pages show measured noise levels and construction noise levels where construction noise was audible.

Two charts are shown for each receiver location. The first chart shows a ‘noise level trace’ for the duration of the noise measurement in one second intervals in dBA. The red trace shows measured noise levels, while the blue trace shows periods of noise attributed to construction activities where construction noise was audible. If construction noise was not audible then the blue trace representing construction noise is not included in the chart and the noise measurement was typically shortened to five minutes.

Gaps in the blue trace indicate periods of extraneous noise with no significant construction noise at those times, while a difference between the red and blue traces indicates construction noise sources contributed only part of the total noise levels measured at those times.

The second chart for each receiver location shows the measured average (L_{eq}) noise level in 1/3 octave bands from 20 Hz to 20 kHz and total L_{Aeq} , L_{Ceq} and L_{eq} noise levels. The red bars indicate total measured noise levels while the blue bars indicate the noise level attributed to construction sources.

