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Vipac Engineers & Scientists

BORG Manufacturing

Gas Fired Co-Generators

Noise Impact Assessment

29N-15-0064-TRP-472771-3

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EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd (Vipac) was engaged by BORG Manufacturing to carry out a Noise Impact Assessment to assess potential noise impacts associated with two proposed Gas Fired Co-Generator units at the BORG Panel Facility in Oberon, NSW.

The Noise Impact Assessment has been undertaken in accordance with the requirements of the following documents:

- Environmental Protection Authority (EPA) NSW *Industrial Noise Policy* (INP),
- EPA NSW Environment Protection Licence(EPL), *Licence number 3035 dated 15 May 2013*

A Noise Impact Assessment has been undertaken to determine the potential Noise Impact of the proposed Gas Fired Co-Generator operations at the BORG Panels Facility in Oberon, on noise sensitive receptors in the surrounding area.

Noise prediction modelling has been undertaken taking into consideration two scenarios considering both the neutral and worst-case conditions during daytime and night-time. The predicted noise impact from the proposed Gas Fired Co-Generators plant on the noise sensitive receivers in the surrounding area are in the range from 16 to 35 dB(A) during the day and evening/night periods, (refer to **Table *12*** and **Table *13***), which are well below the applicable criteria during day, evening and night time.

It should be noted that these predicted noise levels are associated with operation of the Gas Fired Co-Generators alone, and do not include cumulative noise emissions associated with operations at the existing Borg Oberon Facility. It is highly likely that existing plant and equipment operating at the Borg Oberon Facility would mask noise emissions from the proposed Gas Fired Co-Generators.

During a recent compliance noise monitoring survey conducted in November 2014 (Vipac Report Ref: 29N-14-0100-TRP-472593-2), the noise emanating from combined industrial operations at a number of industrial facilities was audible at the majority of the noise monitoring locations as a background noise source but it was not audible on some occasions due to the masking effects of other noise sources in the area such as road traffic noise. It was not possible to determine the noise contribution from operational sources at the Borg Facility alone, due to the effect of noise emissions from a number of additional industrial facilities in the surrounding area. The audible plant noise hum noted at a number of the monitoring locations was attributed from a combination of emissions from all of the industrial facilities in the area, which included Carter Holt Harvey (CHH), Australia Pine Products and also the Borg Panel Facility.

In order to predict the cumulative noise levels from the existing operations and the proposed Gas Fired Co-Generators, Vipac has assumed that the existing noise contribution from the Borg Oberon Facility is representative of the L_{A90} noise level measured during the November 2014 Noise Compliance Assessment. It should be noted that this assumption is slightly conservative as the measured noise levels at the monitoring locations were also influenced by noise emission contributions from the Carter Holt Harvey (CHH) and Australia Pine Products facilities.

The potential cumulative noise impact from the proposed Gas Fired Co-Generator units is likely to be negligible at each of the noise sensitive receptors (no increase in cumulative noise levels at each of the monitoring locations, except R3 and R4, where there is a predicted increase of 1dB) as noise emissions associated with the existing Borg operations, in addition to noise emissions associated with the other industrial facilities located in the area would mask the noise emissions from the proposed Gas Fired Co-Generators, (i.e. the level of noise associated with the proposed Co-Generators would not be significant in the context of the existing ambient and background noise levels in the area).

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1 INTRODUCTION

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- Environmental Protection Authority (EPA) NSW *Industrial Noise Policy* (INP),
- EPA NSW Environment Protection Licence(EPL), *Licence number 3035 dated 15 May 2013*

2 GLOSSARY OF TERMS

A list of commonly used acoustical terms (and their definition) used in this report is provided below in ***Appendix A*** as an aid to readers of this report.

Table 1: Definition of Acoustical Terms

Term	Definition
$L_{eq,1hr}$	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event, has the same amount of acoustic energy as the given event for the period of one hour.
$L_{A10,1\ hr}$	The noise level, which is equalled or exceeded for 10% of the measurement period of one hour.
$L_{A90,T}$	The noise level, which is equalled or exceeded for 90% of a given measurement period, T. $L_{A90,T}$ is used in Australia as the descriptor for background noise.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time, for a given time period. It can be considered as the average sound pressure level over the measurement period and is commonly used as a descriptor for ambient noise.
L_n	The Sound Pressure levels that is equalled or exceeded for n% of the interval time period. Commonly used noise intervals are L_1, L_{10}, L_{90} and L_{99}%
$L_{A10,18hrs}$	The L_{10} noise level for the time period extending from 6am to midnight.

3 PROJECT DESCRIPTION

3.1 SITE LOCATION

The Borg Panel Oberon Facility is located to the east of Lowes Mount Road, Oberon, NSW. The Borg Panels Facility is one of the four primary industries that operate in the vicinity of Oberon town, NSW. The other three industries are Highland Pine Products (HPP), Carter Holt Harvey (CHH) and Woodchem (which is part of Borg Panel operations), refer to ***Figure 1***.

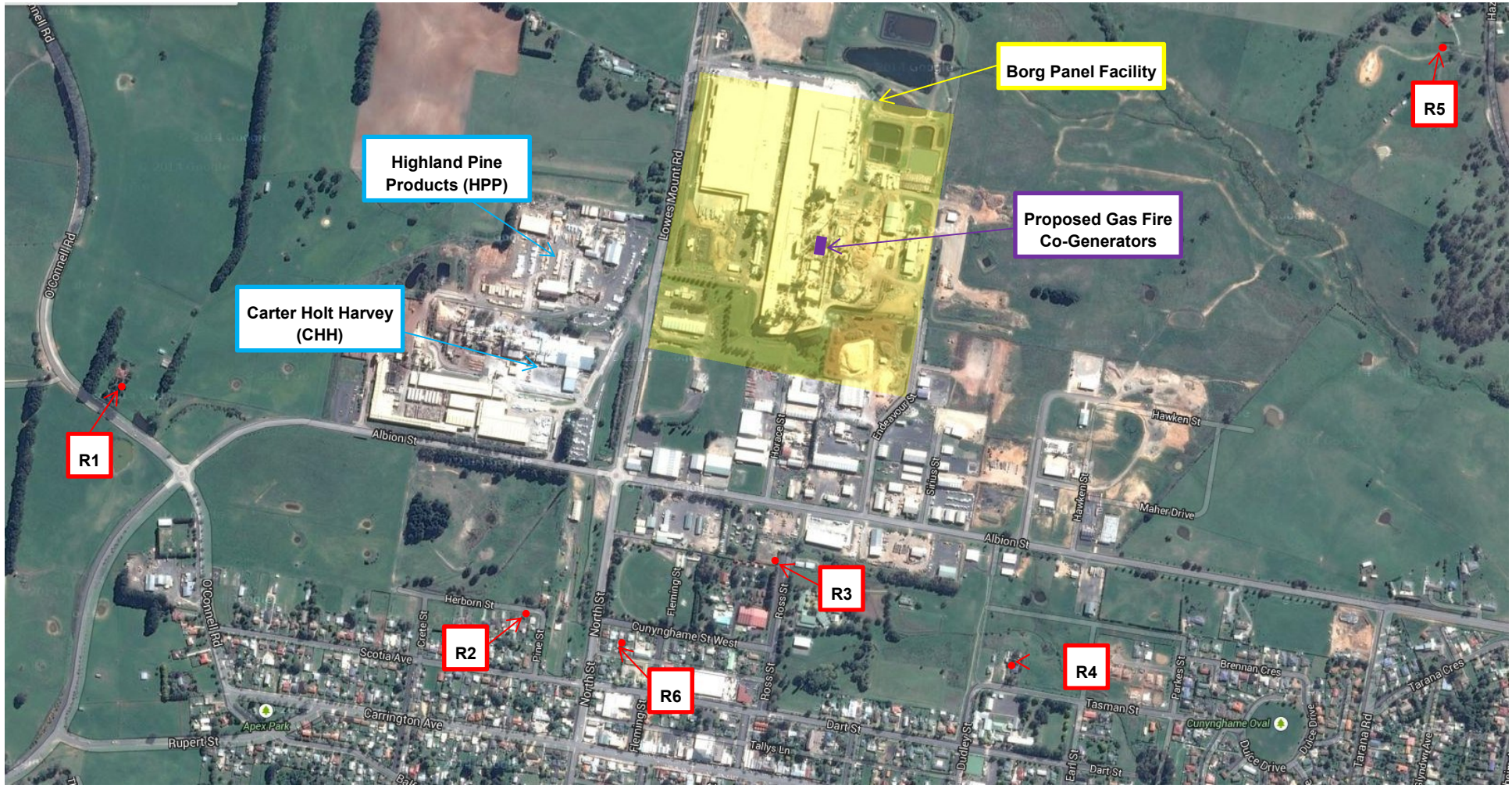

Figure 1: Proposed Gas Fire Co-Generators and Noise Monitoring Locations

3.2 NOISE SENSITIVE RECEIVERS

A list of the nearest potentially affected noise sensitive receivers to the proposed plant is provided below in ***Table 1***. The distance is calculated from the boundary of proposed Gas Fired Co-Generator plant to the property boundary of the noise sensitive receivers.

Table 2: Noise Sensitive Receivers

ID	Property/Address	Approximate Distance (m)	Type of Receivers
R1	Near Albion Street and O'Connell Road	1,500 meters to the west of proposed plant	Residential
R2	6 Herborn Street	940 meters to the south-west of proposed plant	Residential
R3	Ross Street	680 meters to the south of proposed plant	Oberon High School
R4	10 Tasman Street	940 meters to the south-east of proposed plant	Residential
R5	131 Hazelgrove Road	1,400 meters to the north-east of proposed plant	Residential
R6	26 Cunynghame Street West	910 meters to the south-west of proposed plant	Residential

4 CRITERIA

4.1 ENVIRONMENTAL PROTECTION LICENCE (LICENCE NO: 3035) REQUIREMENT

4.1.1 CONDITION L4 – NOISE LIMITS

Noise from the premises must not exceed:

a) 55 dB(A) $L_{Aeq(15mintues)}$ during the day period (7am to 6pm)
b) 50 dB(A) $L_{Aeq(15mintues)}$ during the evening period (6pm to 10pm) and
c) At all other times 45dB(A) $L_{Aeq(15mintues),}$ except as expressly provided by the licence (EPL No. 3035)

The noise emission limits identified in EPL No. 3035 apply under all meteorological conditions except:

a) During rain and wind speeds (at 10m height) greater than 3m/s and
b) Under "non-significant weather conditions"

4.1.2 CONDITION 8 – POLLUTION STUDIES AND REDUCTION PROGRAMS

U1 - Internal Noise – Oberon High School

Where internal classroom noise exceeds the recommended maximum L_{eq} 40 dB(A) as per Industrial Noise Policy Table 2.1, the licensee must develop a works program to achieve an internal noise less than or equal to 40dB(A) $L_{Aeq(15minutes)}$.

When internal noise criteria are specified, the external noise level may be 10dB(A) greater for buildings with no adequate ventilation or 20dB(A) for buildings with fixed external windows and mechanical ventilation. To be conservative, Vipac has utilised a 10dB(A) reduction for the break-in noise through the structure. Therefore, the external noise criteria for classrooms is 50dB(A) $L_{Aeq(15minutes)}$.

4.2 NSW DECC "INTERIM CONSTRUCTION NOISE GUIDELINE"

The NSW Interim Construction Noise Guideline was developed by the NSW Department of Environment & Climate Change (DECC) and outlines detailed procedures for the assessment and management of Construction Noise Impacts.

The Guidelines present two ways of assessing Construction Noise Impacts – the quantitative method, which is generally suited to longer-term construction projects (usually more than 3 weeks), and the qualitative method, which is generally suited to short-term works (usually not more than 3 weeks) such as infrastructure maintenance.

It is anticipated that the overall period for construction works will be approximately 12 weeks and therefore a quantitative method has been used for this assessment.

4.2.1 RESIDENCES AND OTHER SENSITIVE LAND USES

Table 3 and ***Table 4*** set out the management levels for noise at residences and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 3: Noise at residence using Quantitative Assessment

Recommended Hours	Time of Day	Management level [1] $L_{Aeq(15min)}$
Recommended standard hours	Monday to Friday - 7 am to 6pm Saturday - 8am to 1 pm No Work on Sundays or Public holidays	Noise affected RBL [2] + 10dB
		Highly noise affected [3] 75dB
Outside recommended standard hours		Noise affected RBL [2] + 5dB

Table 4: Noise at sensitive land uses (other than residences) using quantitative assessment

Land use	Management Level, $L_{Aeq(15min)}$ Applies when properties are being used
Offices, retail outlets	External Noise Level 70dB
Places of worship	Internal Noise Level 45dB
School	Internal Noise Level 45dB

Where internal noise levels were specified, 10dB was added to approximate an external noise level.

When assessing construction noise it is understood that several types of plant and equipment can be particularly annoying to nearby residents. In those instances a +5dB penalty is applied to the predicted noise level. Examples of the type of machines and operations that typically fit this category are outlined below:

- Use of 'beeper' style reversing or movement alarms, particularly at night time.
- Use of power saws, such as used for cutting timber, masonry, road pavement or steel work.
- Grinding metal, concrete or masonry.
- Rock drilling.
- Line drilling.
- Vibratory rolling.
- Bitumen milling or profiling.
- Jack hammering, rock hammering it rock breaking'.
- Impact piling.

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

2 RBL is the Rating Background Level as defined in the EPA Industrial Noise Policy.

3 $L_{Aeq\ 15\text{-}minute} \geq 75$ dB is highly likely to generate strong community reactions and should be avoided.

5 EXISTING NOISE ENVIRONMENT

5.1 UNATTENDED NOISE MEASUREMENTS

Vipac previously installed six environmental noise loggers at noise sensitive receivers surrounding the Borg Panel Manufacturing Facility in Oberon. The unattended noise measurements were undertaken in November 2014 at the noise sensitive receivers listed in ***Table 1***.

A summary (L_{Aeq}, L_{10}, L_{90} and RBL[1)]) of the unattended noise logger data is presented in ***Table 5*** below for the period Monday 17th to Monday 24th November 2014 inclusive following the removal of weather affected data (where wind-speed is greater than 3 ms^{-1} at 10 metres above ground level and/or rainfall is present), which were extracted from Vipac Report ref: 29N-14-0100-TRP-472593-2.

Table 5: Summary of current ambient noise levels (dBA)

Loc.	Period	L_{Aeq}	L_{A10}	L_{A90}	RBL[1]
N01 (Oorong-Albion Street)	Day	54	56	42	41
	Evening	50	52	38	38
	Night	49	52	42	42
N02 (Herborn Street)	Day	72	68	58	58
	Evening	66	64	58	57
	Night	60	62	54	52
N03 (Oberon High School)	Day	57	56	48	48
	Evening	49	50	47	45
	Night	52	54	48	47
N04 (Tasman Street)	Day	47	50	43	43
	Evening	43	45	40	39
	Night	45	47	43	41
N05 (Hazelgrove Road)	Day	49	50	38	37
	Evening	42	44	38	37
	Night	42	43	37	36
N06 (Cunynghame Street)	Day	49	50	44	44
	Evening	47	49	42	42
	Night	47	48	43	42

5.2 ATTENDED NOISE MEASUREMENTS

Attended noise measurements were also undertaken in November 2014 at the noise sensitive receivers during day, evening and night periods (Noise measurement results were extracted from Vipac Report ref: 29N-14-0100-TRP-472593-2).

Noise from the activities from the industries at Oberon was audible at the majority of the noise monitoring locations as a background noise source but it was not audible on some occasions due to the masking effect of other noise sources in the area such as road traffic noise.

Noise from the industrial sources was predominantly noted as a general plant noise hum and was apparent from the Carter Holt Harvey (CHH) and Australian Pine Products site in addition to the Borg site.

[1] RBL Rating Background Level is the background level used for assessment purposes as determined by the method outlined in OEH INP.

The ambient noise environment during the daytime in particular at the majority of the noise monitoring locations was generally dominated by road traffic noise on public roads in the area. Additional noise sources noted in the area included rustling foliage from breezy conditions blowing in trees near monitoring locations, birds and insects, dog barking, animal noise (horses and sheep) and occasional aircraft passing overhead.

A summary of the noise levels recorded at the noise monitoring locations is presented in ***Table 6*** for the Daytime surveys, **Table 7** for the Evening surveys and ***Table 8*** for the Night-time surveys. Observations regarding the influential noise sources noted at each location during the attended noise surveys are also provided in ***Table 6***, ***Table 7*** and ***Table 8***.

Table 6: Summary of Daytime Noise Survey Results

Locn.	Time	Ambient Noise Levels (dB) 15-mins						BORG Contribution	Ambient Description
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	L_{A95}		
R1	17:01	52.5	66.8	38.7	55.5	42.8	42.0	Nil	Dominant source was traffic on O'Connell Road. Noise from birds in the area influential. Sound of breeze blowing in trees around garden contributory source.
R2	16:37	51.5	73.0	40.9	53.8	43.7	43.1	Nil	Dominant source generally was traffic noise on Albion Street and O'Connell Road. Breeze blowing in trees also noted. Max noise due to utes passing on Herborn Street. Reversing beacon from direction of CHH site was audible at times but not significant.
R3	15:46	37.4	64.2	24.4	32.3	26.4	26.1	Nil	Students were gone but some teachers still in the school. Voices from staff in other rooms was dominant source. Occasional faint traffic noise, person walking on steel stairs in school. No industrial noise audible.
R4	17:25	46.1	68.7	39.2	47.8	41.3	40.8	Slight background plant noise hum.	Noise from sheep in fields near monitoring position influential initially. Noise from forklift at BWG Haulage Yard significant at times, in addition to traffic on Albion Street. General plant noise hum audible from Borg site, individual source not apparent. Jet passing at high altitude and skip truck moving in BWG yard.
R5	17:49	42.2	52.5	36.9	44.5	39.0	38.5	Slight background plant noise hum.	Dominant source generally was sheep in fields around monitoring position. Noise from birds in the area was significant at times. General plant noise hum was audible as low background noise but was masked by sound of breeze blowing in trees and level of noise from sheep and birds nearby. Only occasional traffic noise from cars passing on Hazelgrove Road during survey.
R6	-[2]	---	---	---	---	---	---	---	---
R7	16:15	50.7	68.2	43.9	53.1	46.4	45.8	Nil	Dominant source generally was traffic on Albion Street, engine breaking noise very significant at times. Helicopter noted briefly at 16:20. Noise from chainsaw in use to the south was dominant significant intermittently. Other notable source was turbulence from breezy conditions and wind blowing in trees. Occasional noise from cars in caravan park and children playing in swimming pool.

[2] R6 - Cunynghame Street West was not a regular monitoring location therefore no daytime measurement was conducted at this location, monitoring was instead conducted at the Caravan Park, located off Cunynghame Street.

Table 7: Summary of Evening Noise Survey Results

Locn.	Time	Ambient Noise Levels (dB) 15-mins						BORG Contribution	Ambient Description
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	L_{A95}		
R1	21:11	57.7	76.5	50.3	57.4	52.8	52.4	Nil	Dominant source was occasional cars passing on O'Connell Road. Noise from insects in the area in addition to noise from a bird nearby was significant at times also.
R2	20:19	44.1	56.6	39.5	46.3	41.4	41.1	Slight background plant noise hum.	Traffic on Albion Street, birds in the area and breeze blowing in trees were significant. Reversing beacon from what seemed to be direction of CHH site was further to west than Borg site. General plant noise hum audible from Borg but was not significant due to level of noise from other sources. Car horn and distant airplane influential briefly and masking plant noise. Dog barking towards end of survey.
R3	---[3]	---	---	---	---	---	---	---	---
R4	18:41	46.3	63.9	40.3	48.3	42.8	42.3	Nil	Dominant source overall was traffic on Albion Street. Dog barking at nearby house dominant while prevalent. Additional sources included cockerel crowing, jets passing at high altitude, noise from birds in the area, breeze blowing in trees and horses galloping in field near monitoring position.
R5	18:16	45.1	62.9	34.7	47.6	38.8	38.0	Slight background plant noise hum.	Noise from sheep and birds in the area generally dominant overall. Several cars and utes passed on Hazelgrove Road. Dog barking at nearby house significant occasionally. General plant noise hum audible as low level background noise and seemed to be emanating from tall tower on southern side of Borg site. Two jets passed overhead at high altitude. Plant noise was inaudible at times due to level of noise from other sources.
R6	20:47	49.9	80.0	41.4	46.7	43.6	43.2	Slight background plant noise hum.	Traffic noise on Albion Street dominant, max noise due to car passing on North Street. High pitch noise from bats flying around the area near the SLM. General plant noise hum audible in addition to occasional metal banging noise that seemed to be emanating from the CHH site. Occasional dog barking noted also.
R7	19:28	46.2	61.8	41.3	47.5	43.9	43.5	Slight background plant noise hum.	Traffic on Albion Street dominant overall. Noise from birds in the area and breeze in trees was influential also. General hum of plant noise from Borg site was noted as background noise. Noise from air conditioning unit on roof of caravan was significant at times.

[3] R3 – Oberon High School, monitoring within a classroom in the school was only undertaken during the daytime as the school is not occupied during the evening or night-time monitoring periods.

Table 8: Summary of Night-time Noise Survey Results

Locn.	Time	Ambient Noise Levels (dB) 15-mins						BORG Contribution	Ambient Description
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	L_{A95}		
R1	22:07	55.1	76.8	39.7	54.4	45.3	44.2	Nil	Maximum noise source noted was from occasional traffic passing on O'Connell Road and Albion Street. In absence of traffic, noise from birds and insects in the area was dominant. Noise from frogs noted also. Jet passed overhead at high altitude also.
R2	22:31	47.4	58.9	41.9	49.5	44.9	44.6	Plant noise hum from Borg site and other industrial sites noted.	Dominant source initially was general plant noise hum both from CHH and Borg sites. Only occasional traffic noise due to very little traffic during the survey. Over the full duration of the survey it was apparent that the majority of the plant noise emissions were emanating from the direction of the Australian Pine Products site.
R3	---	---	---	---	---	---	---	---	---
R4	23:43	45.4	60.3	41.6	46.9	43.6	43.1	Slight background plant noise hum.	Dominant source was insects near the monitoring position. Noise from cars passing on Albion Street was significant at times but not dominant overall due to intermittent nature of traffic noise. Background plant noise hum was noted but was not significant due to level of noise from insects in the area.
R5	00:12	43.3	59.2	35.8	45.7	39.0	38.5	Nil	Noise from insects in the area was dominant overall. High pitch noise from bats in the area was influential also. General hum of plant noise noted as background source, not from any individual site but as a general broadband hum. Occasional noise from sheep in fields near monitoring position and birds in the area. Pressure release/air blast noise was faintly audible on occasion. Very little traffic noise during the survey as only a few vehicles passed on Hazelgrove Road during the survey.
R6	22:54	46.3	59.5	42.4	48.2	44.3	43.9	Slight background plant noise hum.	Range of different noise sources noted, all at varying levels during the survey. Noise from bats in the area was significant initially and influential throughout the survey. Occasional traffic on North Street was noted as the maximum noise source. Plant noise hum was audible as background noise but it was not possible to determine the source industrial site. Pressure release/air blast type noise was noted on occasion. Reversing beacon noted intermittently also. Very noisy bird was noted as the dominant source briefly during survey. Occasional metal banging noise noted but not possible to determine from which site.
R7	23:16	47.9	60.6	44.3	49.4	45.9	45.5	Plant noise hum from Borg site and other industrial sites noted.	Generally occasional traffic noise on Albion Street was dominant overall. Plant noise hum from Borg, CHH and Australian Pine Products sites was noted as influential source also. Additional influential sources included insects and bats in the area. Occasional air blast/pressure release noise was noted also. Metal banging noise from CHH site was noted briefly towards the end of the survey.

6 NOISE MODELLING

Noise modelling has been performed using the SoundPLAN® computational noise modelling software package. The use of the SoundPLAN® software and referenced modelling methodology is accepted for use in the state of NSW by the Office of Environment and Heritage (OEH)/Environmental Protection Authority (NSW EPA) for environmental noise modelling purposes. Vipac have undertaken numerous noise modelling and impact assessments previously for a range of projects, including mining and industrial projects using SoundPLAN®.

6.1 GEOGRAPHICAL DATA

Table *9* below lists the drawings/information received and used in the noise model.

Table 9: List of Drawings

Description	Date	Provided by
Site Plan Layout plan	14.04.2015	Borg Manufacturing
Site building dimension	22.05.2014	Borg Manufacturing
Ground elevation of the study area	28.05.2014	Land & Property Information, NSW

6.2 WEATHER CONDITIONS

Four acoustic modelling scenarios were run for the proposed Gas Fired Co-Generator, within the SoundPLAN program using CONCOWE algorithms under both neutral and worst-case weather conditions for the day and night periods. It should be noted that sound will propagate further through the atmosphere under certain weather conditions dependent on air pressure variations, wind speed and direction variations, temperature inversions etc. The 'worst-case' weather conditions chosen were those highly conducive to the propagation of sound. **Table *10*** presents the weather parameters used in the CONCOWE calculations based on annual data from the Bureau of Meteorology (BoM) Weather Station at Oberon (Jenolan Caves Road).

Table 10: Sound Plan Weather Parameters

Parameter	Day		Evening/Night	
	Neutral	Worst-Case	Neutral	Worst-Case
Pasquill Stability Category	B	D	D	F
Wind Speed (m/s)	0	3	0	3
Humidity (%)	58	58	79	79
Temperature (deg Celsius)	15	15	10	10
Met Category	3	5	4	6

6.3 NOISE SOURCES

The generators to be installed at the site will be Deutz TBG 620 K model generators, which have a power generating capacity ranging from 970 – 1400 kW. A copy of the manufacturer's technical specification data sheet for the generators is provided in ***Appendix A***. Details of the noise emission spectrum for the generators is included in the technical specifications (provided in ***Appendix A***), which indicates that the octave frequency band noise emissions from the generators do not contain low frequency characteristic. It should be noted that the generators will be housed within insulated steel enclosures that in-turn are located within a steel awning partially enclosed area, as illustrated in ***Plate 1*** , ***Plate 2*** and ***Plate 3***. The noise emissions data provided on the specifications sheet for the generator (provided in ***Appendix A***) are specifications for noise emissions from the generator as a source "in-the-open-air", i.e. not the noise emissions that will be apparent from the generator when housed in the insulated steel enclosure. The location of the generators at the site is illustrated in ***Figure 2***. The installation of the generators within the insulated steel enclosures has not been proposed as a result of this noise impact assessment for the proposed generators. The installation of the generators within the steel enclosures was a design input to the noise impact assessment at the outset of the assessment as it was a design consideration made by Borg Manufacturing earlier in the design and planning phase for the generator plant investment, prior to commissioning of the Noise Impact Assessment.

Plate 1: Generator's Steel Enclosures and Steel Awning area

Plate 2: Generator's Steel Enclosures and Steel Awning area

Plate 3: Generator's Steel Enclosures, Steel Awning area and Exhaust Mufflers

As outlined above the generators will be enclosed within insulated steel enclosures. The enclosures will have three opening areas (i.e. air intake and discharge vent) and an exhaust pipe that runs from the generator's muffler to the process plant.

Taking into consideration the fact that the generators (i.e. the co-generation gas engines) are contained in insulated steel enclosures and the exhaust pipe termination is located within an enclosed space in the drying and blending chamber (part of process plant at the Borg Oberon site) as part of a heat recovery process, there is negligible potential for breakout noise from the plant to propagate as discernible audible tonal components at the nearest noise sensitive receptors to the site.

The configuration of the generators within the insulated steel enclosures and the recovery of exhaust emissions from the generators into the drying and blending chamber also has the effect of significantly reducing the level of noise emissions at source from the plant installation, as opposed to the level of noise emissions that would otherwise be apparent if the generators were installed "in-the-open" without the steel enclosures and if the exhaust emissions from the generators were emitted to atmosphere, as opposed to being emitted into the drying and blending chamber as part of the heat recover processes utilised at the site.

It should be noted that the nearest noise sensitive receptor (Oberon High School) is located approximately 680 metres from the proposed plant and the next nearest noise sensitive receptors (located on Cunynghame Street West) are situated approximately 910 meters from the proposed plant.

The sound reduction index of the steel enclosures, exhaust pipe and the opening areas have been taken into account in assessing the break-out noise from the generators to the outdoor environment.

In order to calculate the break-out noise from the proposed generators, the following assumptions are made:

- steel enclosure (minimum thickness of 3mm steel) is internally lined with 50mm thick Rockwool (40kg/m^3) and steel enclosure dimension of 3m (Width) x 8 m (Length) x 2.875m (Height).
- Reverberation time of 0.7s.
- Total Intake Area of 1.58m^2 (0.45m x 1.75m for each intake area).
- Discharge Area of 1.2m^2 (2.7m x 0.45m).
- The exhaust pipes extend from the mufflers to an enclosed space (the drying and blending chamber of the process plant). The exhaust pipes are approximately 15m in length and 270mm in diameter of stainless steel construction. Termination of the exhaust pipe is located inside the process plant and therefore, only breakout noise from the steel pipe is considered in the noise model.
- The exhaust pipe is constructed with 4.5mm thick stainless steel and with a discharge air volume of 4m^3/s at each of the generator's exhaust pipes.
- Sound Pressure Level of Deutz Generator Engine type TBG 620 V12K – 102dB(A) at 1 meter distance.
- Sound Pressure Level of Deutz Generator Exhaust - 120dB(A) at 1 meter distance. As outlined above, it should be noted that the exhaust noise emissions from the generators are not emitted directly to atmosphere.

As outlined above the noise emissions data provided in ***Appendix A*** relate to specifications for noise emissions from the generator as a source "in-the-open-air", the noise emissions from the generators will be significantly reduced as a result of being installed within the insulated steel enclosures at the site.

In addition, the exhaust emissions from the generators, which are housed within the insulated steel enclosures, are "plumbed" into the drying and blending chamber (part of process plant at the Borg Oberon site) as part of a heat recovery process. A process flow diagram for operations at the site is provided in ***Appendix B***. The capture of the exhaust emission into the heat recovery process in effect eliminates any external exhaust pipe termination that would otherwise be exposed directly to atmosphere and has the effect of significantly reducing the level of exhaust noise emissions from the generators.

In effect, the generators exhaust noise emissions can only propagate from the 15m length of the exhaust pipes that extend from the mufflers on the generator enclosures to the drying and blending chamber process plant. There is no exposed termination (i.e. open pipe) to the exhaust as it is contained within the drying and blending chamber and this has the effect of significantly reducing the level of exhaust noise emissions at source on-site and reduces the effective noise emission level of the exhaust that can propagate in the atmosphere.

Vipac identified the areas listed in ***Table 11*** as the weakest points within the generator units and therefore, only these areas were considered in the noise model. Each element of the generator associated with the sound pressure level is detailed in ***Table 11***.

Table 11: Sound Pressure Level at 1-metre for each element

Description	Octave Frequency Band (Sound Pressure Level at 1m) dB								Sound Pressure Level at 1m (dBA)
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Generator Intake (Area: 0.79m^2)	91	83	83	84	85	83	84	84	91
Generator Discharge (Area: 1.2m^2)	93	85	85	86	87	85	86	86	93
Generator Exhaust [1]	91	93	86	91	72	71	68	67	83

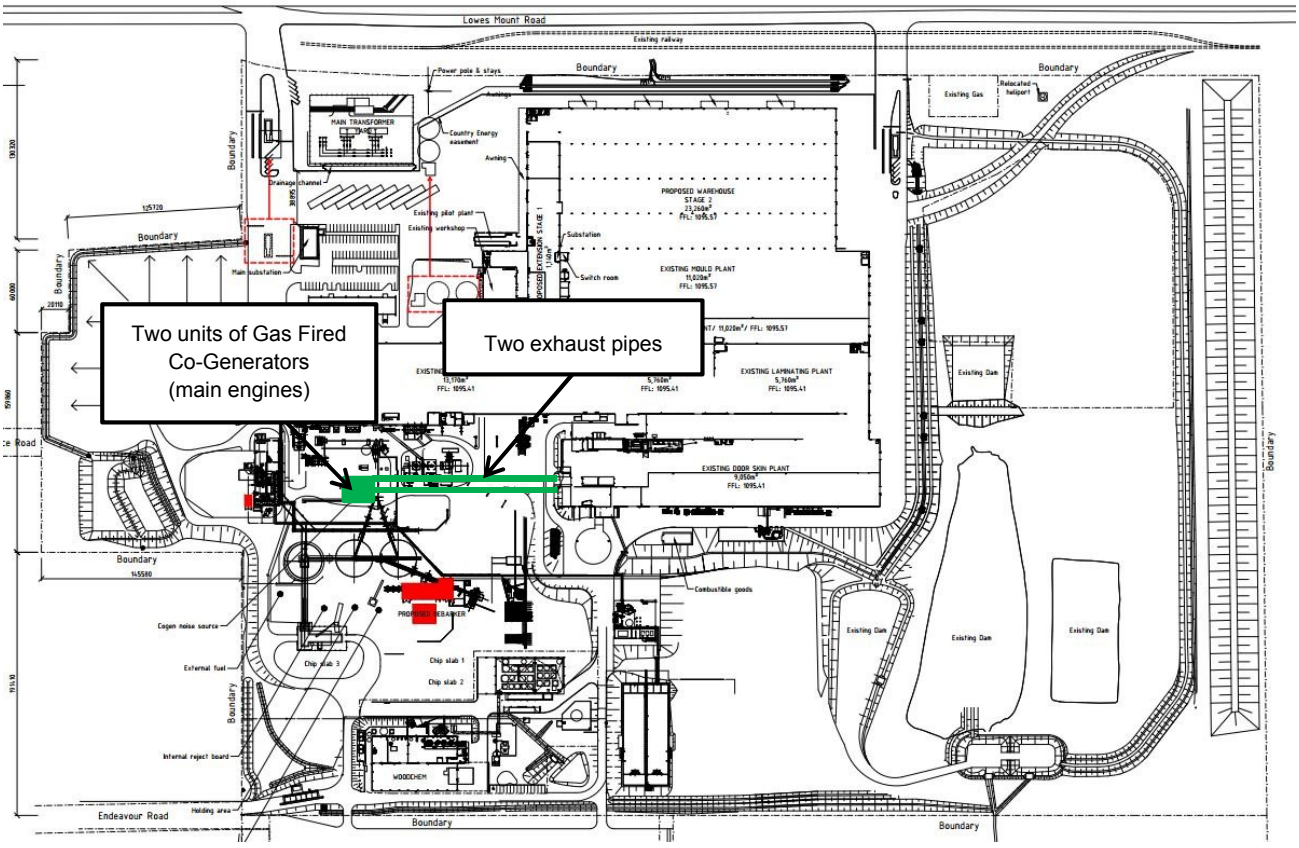

Figure 2: Noise Sources Location

[1] The noise level was calculated by inserting the transmission loss of the 4.5mm steel pipe (equivalent to Rw 38) and also taking into account the air flow at the exhaust pipe (4m^3/s).

7 RESULTS – PREDICTED NOISE LEVELS

Noise prediction modelling has been carried out to assess the potential impact associated with the two proposed Gas Fired Co-Generator units, on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site. The predicted noise levels representative of the operational phase for both neutral conditions and worst-case conditions are presented in **Table *12*** during the day period and **Table *13*** during the evening/night periods.

Table 12: Predicted noise levels for proposed Gas Fired Co-Generators – Day Period

Receiver	Neutral	Worst	Criteria (Day)
R1	16	24	55
R2	23	31	55
R3	24	31	50
R4	26	35	55
R5	21	29	55
R6	21	28	55

Table 13: Predicted noise levels for proposed Gas Fired Co-Generators – Evening/Night Periods

Receiver	Neutral	Worst	Criteria (Evening, Night)
R1	20	25	50/45
R2	26	31	50/45
R3	27	31	50/N/A
R4	30	35	50/45
R5	25	30	50/45
R6	24	29	50/45

Noise prediction modelling has been undertaken for the proposed Gas Fired Co-Generators, taking into consideration two scenarios considering both the neutral and worst-case conditions during daytime and night-time. The predicted noise impact from the proposed Gas Fired Co-Generators on the noise sensitive receivers in the surrounding area are in the range from 16 to 35 dB(A) during the day and evening/night periods, (refer to **Table *12*** and **Table *13***), which are below the applicable criteria during day, evening and night time.

It should be noted that these predicted noise levels are associated with operation of the Gas Fired Co-Generators alone, and do not include cumulative noise emissions associated with operations at the existing Borg Oberon Facility. It is highly likely that existing plant and equipment operating at the Borg Oberon Facility would mask noise emissions from the proposed Gas Fired Co-Generators.

During a recent compliance noise monitoring survey conducted in November 2014 (Vipac Report Ref: 29N-14-0100-TRP-472593-2), the noise emanating from combined industrial operations at a number of industrial facilities was audible at the majority of the noise monitoring locations as a background noise source but it was not audible on some occasions due to the masking effects of other noise sources in the area such as road traffic noise. It was not possible to determine the noise contribution from operational sources at the Borg Facility alone, due to the effect of noise emissions from a number of additional industrial facilities in the surrounding area. The audible plant noise hum noted at a number of the monitoring locations was attributed from a combination of emissions from all of the industrial facilities in the area, which included Carter Holt Harvey (CHH), Australia Pine Products and also the Borg Panel Facility.

In order to predict the cumulative noise levels from the existing Borg operations and the proposed Gas Fired Co-Generators, Vipac has assumed that the existing noise contribution from the Borg Oberon Facility is representative of the L_{A90} noise level measured from the attended noise surveys during the November 2014 Noise Compliance Assessment (refer to results provided in ***Table 6***). It should be noted that this assumption is slightly conservative as the measured noise levels at the monitoring locations were also influenced by noise emission contributions from the Carter Holt Harvey (CHH) and Australia Pine Products facilities.

Cumulative noise levels from the existing operational noise sources in the area, including the existing Borg operations and the proposed Gas Fired Co-Generators were assessed for worst-case scenarios, during worst-case weather conditions. ***Table 14*** presents the cumulative noise levels.

Table 14: Cumulative noise levels (L_{Aeq}) dB

Receiver ID	Day			Evening			Night		
	Existing Operations	Proposed Gas Fired Co-Generator Units	Cumulative Noise Levels	Existing Operations	Proposed Gas Fired Co-Generator Units	Cumulative Noise Levels	Existing Operations	Proposed Gas Fired Co-Generator Units	Cumulative Noise Levels
R1	43	24	43	53	25	53	45	25	45
R2	44	31	44	41	31	41	45	31	45
R3	37*	31	38	N/A	31	N/A	N/A	31	N/A
R4	41	35	42	43	35	44	44	35	45
R5	39	29	39	39	30	39	39	30	39
R6	46	28	46	44	29	44	44	29	44

* Façade adjusted level to convert noise level recorded for attended measurement taken inside classroom of Oberon High School, to exterior level.

Table *14* shows that the potential cumulative noise impact from the proposed Gas Fired Co-Generator units is likely to be negligible at each of the noise sensitive receptors (no increase in cumulative noise levels at each of the monitoring locations, except R3 and R4, where there is a predicted increase of 1dB) as noise emissions associated with the existing Borg operations, in addition to noise emissions associated with the other industrial facilities located in the area would mask the noise emissions from the proposed Gas Fired Co-Generators, (i.e. the level of noise associated with the proposed Co-Generators would not be significant in the context of the existing ambient and background noise levels in the area).

It is reiterated that the cumulative noise levels presented above are indicative levels, based on the results of the Noise Compliance Survey undertaken at a number of noise sensitive receptors located in Oberon, in November 2014.

8 CONSTRUCTION NOISE MANAGEMENT

Typical noise levels representative of construction plant that may be used on-site during the construction/installation of the Gas Fired Co-Generators were sourced from previous measurements conducted by Vipac, equipment suppliers and sound power levels provided in Appendix A of AS2436:2010 – Guide to Noise Control on Construction, Maintenance and Demolition Sites.

From this information, noise impacts were theoretically propagated at varying distances from the construction site. Propagation calculations take into account sound intensity losses due to distance, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to overstate actual received levels by 1 - 2 dB and thus provide a measure of conservatism. Received noise at each assessed distance, produced by each item of plant on the site, can then be added to determine the potential total received noise at that distance from construction activities and compared to the criteria.

Predicted noise levels associated with potential typical construction works, during the construction/installation of the Gas Fired Co-Generators, are shown in **Table *15***, for a variety of distances to a typical receiver, with no noise barriers or acoustic shielding in place and with each item of plant operating at full power.

Table 15: Predicted Plant Item Noise Levels

Plant Item	L_W [dB(A) re: 1pwatt]	Predicted Sound Pressure Level (SPL), dB(A)							
		10m	25m	50m	100m	200m	400m	800m	1500m
Circular Saw (on load)	**113**	85	77	71	65	59	53	47	41
Crane	**105**	77	69	63	57	51	45	39	33
Concrete Mixers 24t	**111**	83	75	69	63	57	51	45	39
Concrete Pump	**108**	80	72	66	60	54	48	42	36
Concrete Saw	**113**	85	77	71	65	59	53	47	41
Excavator (Small)	**108**	80	72	66	60	54	48	42	36
Flat-Bed Truck	**109**	81	73	67	61	55	49	43	37
Generator	**104**	76	68	62	56	50	44	38	32
Semi-Trailer	**112**	84	76	70	64	58	52	46	40
Tip Truck	**108**	80	72	66	60	54	48	42	36

Actual cumulative impacts, from several machines operating simultaneously, may be reduced when some machines are operating in shielded areas not wholly visible to receivers. However, it should be noted that, if two or more machines were to operate simultaneously on the site in an exposed location, received noise levels would be increased.

Table 16 shows the potential construction phase noise impacts on noise sensitive receivers. It should be noted that the noise impacts are expected to fluctuate depending on the machines being used, their number and location on site.

Table 16: Predicted Construction Noise Impact - dBA

Receiver type	Period	Predicted Noise Levels -dBA	Noise Management Limit	Highly affected Noise Level
R1	Day - (RBL+10)	34-49	51	75
	Day (RBL +5) (or outside standard hours)	34-49	46	
	Evening - (RBL+5) (or outside standard hours)	34-49	43	
	Night (RBL+5) (or outside standard hours)	34-49	47	
R2	Day - (RBL+10)	38-53	68	75
	Day (RBL +5) (or outside standard hours)	38-53	63	
	Evening - (RBL+5) (or outside standard hours)	38-53	62	
	Night (RBL+5) (or outside standard hours)	38-53	57	
R3	When in use	40-55	55	75
R4	Day - (RBL+10)	38-53	53	75
	Day (RBL +5) (or outside standard hours)	38-53	48	
	Evening - (RBL+5) (or outside standard hours)	38-53	45	
	Night (RBL+5) (or outside standard hours)	38-53	48	
R5	Day - (RBL+10)	33-48	48	75
	Day (RBL +5) (or outside standard hours)	33-48	43	
	Evening - (RBL+5) (or outside standard hours)	33-48	43	
	Night (RBL+5) (or outside standard hours)	33-48	42	
R6	Day - (RBL+10)	38-53	54	75
	Day (RBL +5) (or outside standard hours)	38-53	49	
	Evening - (RBL+5) (or outside standard hours)	38-53	47	
	Night (RBL+5) (or outside standard hours)	38-53	48	

The noise levels that would be apparent during the construction phase are predicted to be within the Noise Management Levels (for “standard construction hours” and also within the “highly noise affected levels”. However, the construction phase noise levels would be expected to exceed the Noise Management Level (outside construction hours) at the majority of the noise sensitive receivers. Therefore, a Construction Noise Management Plan is detailed in ***Section 9*** to assist with minimising construction noise emissions on-site.

9 CONSTRUCTION NOISE MANAGEMENT PLAN

Construction Noise and Vibration Management Plan		
Component		**Details**
General / Site. Management Issues		All employees, contractors and subcontractors are to receive an environmental induction. The induction should instruct all persons at the site with regard to all relevant project specific and standard noise and vibration mitigation measures detailed herein including permissible hours of work; any limitations on high noise generating activities; location of nearest sensitive receivers; construction employee parking areas; designated loading/unloading areas and procedures; site opening/closing times (including deliveries); and environmental incident procedures.
		A dedicated person will form a point of contact for the dissemination of general information regarding site operations. Contact persons will also be defined to receive comment or complaints from the community – refer to community liaison/complaints handling plan below.
Hours of Work / Respite Periods		Standard Hours for Construction: 07:00 – 18:00 Monday – Friday 08:00 -13:00 Saturday No Work on Sundays or Public holidays.
		Very noisy activities (such as foundation compaction, concrete cutting or surface grinding for example) should be programmed during standard construction hours. If the work cannot be undertaken during the standard construction hours, it should be completed before 11:00 pm.
Source Controls	**General / Work Practices**	Avoid unnecessary revving of engines and turn off plant that is not being used / required.
		Use only non-tonal reverse alarms (broadband alternatives are needed). Where possible organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms.
		Organise and schedule the equipment operations to limit the noisiest machines operating simultaneously.
		Site set up / movement of plant / delivery of materials / waste removal from the site should be undertaken during daytime hours only.

Construction Noise and Vibration Management Plan		
Component		**Details**
		Truck drivers are to be informed of site access routes, acceptable delivery hours and must minimise extended periods of engine idling.
		Ensure there is no unnecessary shouting or loud stereos/radios on-site. There must be no dropping of materials from heights, throwing of metal items, or slamming of doors.
		Equipment must be inspected on a regular basis and maintained as necessary, to ensure it is in good working order. This must include inspections of the condition and performance of mufflers.
	Equipment Selection and / or Substitution	Where reasonable and feasible the quietest equipment suitable for a task should be used instead of noise-intensive equipment.
		Construction equipment with the most effective mufflers, enclosures and low-noise tool bits and blades must be procured and utilised for the project.
		Where possible mains power should be utilised for temporary work area lighting, dewatering pumps or other temporary power requirements. Where this is not feasible silenced generator sets are to be used instead.
		Vipac recommends that all plant and equipment be certified prior to use.
	Use and Siting of Equipment / activities	Where practical fixed plant should be positioned as far away as possible from sensitive receivers.
		For any concrete cutting works, consideration should be given to having all concrete panels either cast-in-situ or pre-cut to the required dimensions and deliver to site, suitable for erection, without the need for cutting on-site.
Complaints management		Provide a complaints hotline number as a contact point for any complaints regarding the construction work.
Monitoring Requirements	**Vibration**	Vibration monitoring should be undertaken for works within ten metres of sensitive receivers. It is Vipac's understanding that there will not be any construction work associated with the proposed Gas Fired Co-Generator units, undertaken within 10m of sensitive receivers.

10 CONCLUSION

A Noise Impact Assessment has been undertaken to determine the potential Noise Impact of the proposed Gas Fired Co-Generator operations at the BORG Panels Facility in Oberon, on noise sensitive receptors in the surrounding area.

Noise prediction modelling has been undertaken taking into consideration two scenarios considering both the neutral and worst-case conditions during daytime and night-time. The predicted noise impact from the proposed Gas Fired Co-Generators plant on the noise sensitive receivers in the surrounding area are in the range from 16 to 35 dB(A) during the day and evening/night periods, (refer to **Table *12*** and **Table *13***), which are below the applicable criteria during day, evening and night time.

It should be noted that these predicted noise levels are associated with operation of the Gas Fired Co-Generators alone, and do not include cumulative noise emissions associated with operations at the existing Borg Oberon Facility. It is highly likely that existing plant and equipment operating at the Borg Oberon Facility would mask noise emissions from the proposed Gas Fired Co-Generators.

During a recent compliance noise monitoring survey conducted in November 2014 (Vipac Report Ref: 29N-14-0100-TRP-472593-2), the noise emanating from combined industrial operations at a number of industrial facilities was audible at the majority of the noise monitoring locations as a background noise source but it was not audible on some occasions due to the masking effects of other noise sources in the area such as road traffic noise. It was not possible to determine the noise contribution from operational sources at the Borg Facility alone, due to the effect of noise emissions from a number of additional industrial facilities in the surrounding area. The audible plant noise hum noted at a number of the monitoring locations was attributed from a combination of emissions from all of the industrial facilities in the area, which included Carter Holt Harvey (CHH), Australia Pine Products and also the Borg Panel Facility.

In order to predict the cumulative noise levels from the existing Borg Operations and the proposed Gas Fired Co-Generators, Vipac has assumed that the existing noise contribution from the Borg Oberon Facility is representative of the L_{A90} noise level measured during the November 2014 Noise Compliance Assessment. It should be noted that this assumption is slightly conservative as the measured noise levels at the monitoring locations were also influenced by noise emission contributions from the Carter Holt Harvey (CHH) and Australia Pine Products facilities.

The potential cumulative noise impact from the proposed Gas Fired Co-Generator units is likely to be negligible at each of the noise sensitive receptors (no increase in cumulative noise levels at each of the monitoring locations, except R3 and R4, where there is a predicted increase of 1dB) as noise emissions associated with the existing Borg operations, in addition to noise emissions associated with the other industrial facilities located in the area would mask the noise emissions from the proposed Gas Fired Co-Generators, (i.e. the level of noise associated with the proposed Co-Generators would not be significant in the context of the existing ambient and background noise levels in the area).

Appendix A NOISE EMISSION DATA OF TBG 620 V12K GENERATOR

▶ Dimensions 50 Hz

Genset		Length	Width	Heigth
TBG 620 V12 K	mm	4700	1800	2650
TBG 620 V16 K	mm	5500	1800	2650

▶ Noise emissions* 50 Hz

Noise frequency band		Hz	63	125	250	500	1000	2000	4000	8000
Engine type TBG 620 V12 K										
Exhaust noise	120 dB (A)	dB (lin)	116	121	120	118	112	111	108	107
Air-borne noise	102 dB (A)	dB (lin)	102	94	94	95	96	94	95	95
Engine type TBG 620 V16 K										
Exhaust noise	122 dB (A)	dB (lin)	119	128	120	117	116	115	112	107
Air-borne noise	104 dB (A)	dB (lin)	92	96	98	97	99	97	96	98

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Exhaust noise at 1 m, ∢ 45°, ± 2.5 dB (A)
Air-borne noise at 1 m from the side, ± 1 dB (A)

* Values apply to natural gas applications, measured as noise pressure level.

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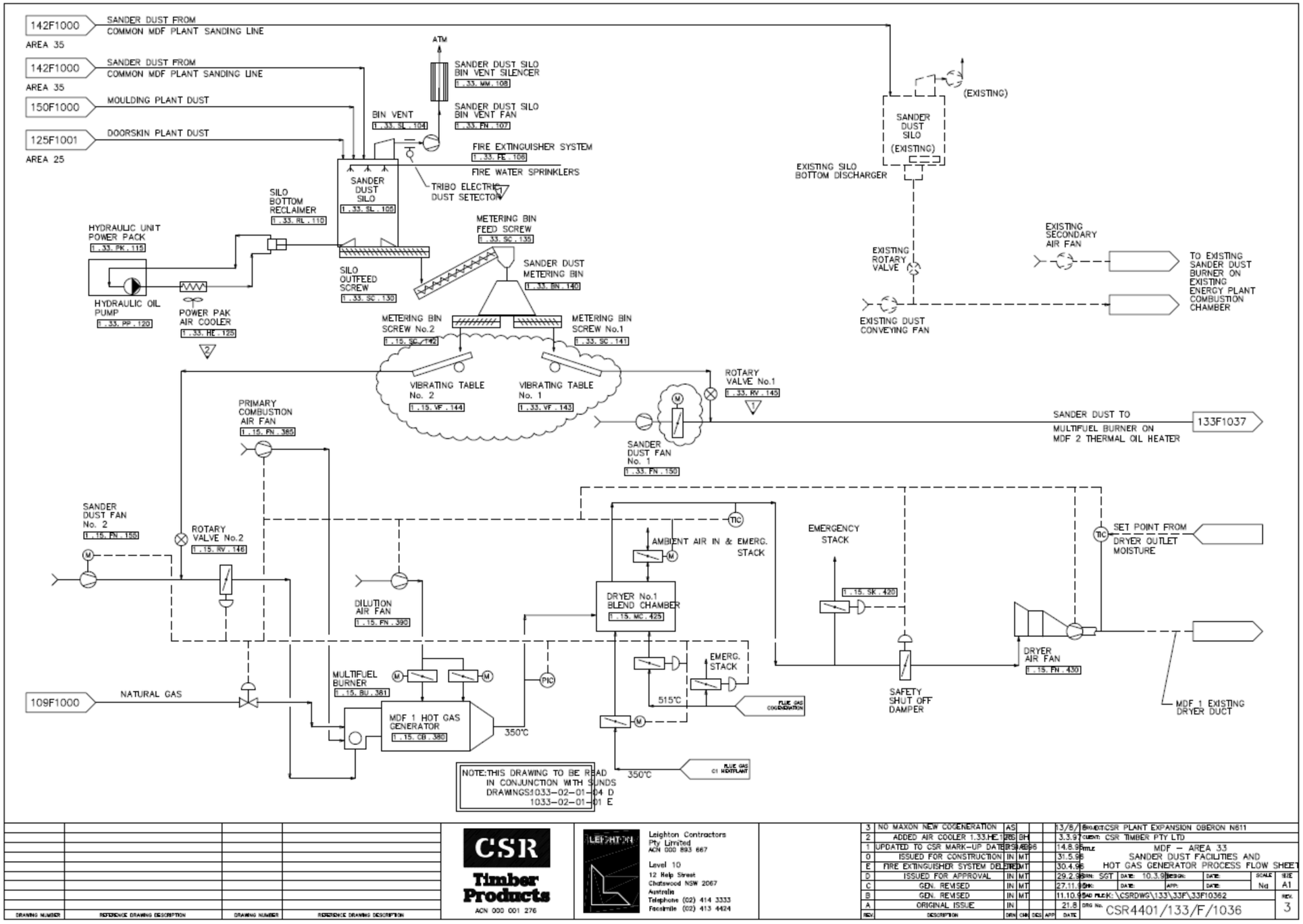
Appendix B BORG PANEL FACILITY OBERON – PROCESS FLOW DIAGRAM



07 Sep 2015