APA WOLLERT COMPRESSION STATION NOISE ASSESSMENT

APA GROUP

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Specialist Technical Services
Vibration, dynamics and noise

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EXECUTIVE SUMMARY

APA Group owns and operates a gas compression station located at 365 Summerhill Rd, Wollert, VIC 3750. The APA Wollert site comprises:

- Wollert City Gate: Four regulator runs that reduce the gas pressure from the 7000 kPa country pipeline system to the 2800 kPa metropolitan system, with a 3MW gas fired water bath heater.

- Compressor Station: Two Solar Centaur 50 and three Solar Saturn 10 gas turbine driven compressor units with one fin fan gas cooler and one lube oil cooler per unit, a gas engine generator, an instrument air compressor, a station vent and two pressure regulation valves.

APA are currently progressing the Western Outer Ring Main Project, which includes addition of a Solar Centaur 50 compressor to the site.

There are around 30 noise sensitive receivers close to the compressor station and the current planning scheme allows for additional residential development near the site.

APA has commissioned Wood to assess the noise impact of the proposed facility expansion in accordance with State Environmental Planning Policy N1 (SEPP-N1).

The modelling and analysis undertaken for the assessment show that noise levels for the expanded facility would fall below the SEPP-N1 limits. Modelled receiver noise levels for the facility operating at the maximum operational scenario and under adverse meteorological conditions were up to 36.8dB(A), which is below the most stringent noise limit (39dB(A)).

The modelling assumed that the proposed Unit 6 will have an overall package sound power level of 111dB(A), the same as that of the existing Units 4 and 5. The modelled noise levels for the expanded facility would not meet the requirements of SEPP-N1 if the Unit 6 package sound power level exceeded 116dB(A).

It is recommended that APA procure the proposed Unit 6 compressor with a maximum overall package sound power level of 111dB(A). This would require an acoustic enclosure for the compressor and turbine; and turbine exhaust and combustion air attenuators.

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1 INTRODUCTION

1.1 Facility Description

APA Group owns and operates a gas compression station located at 365 Summerhill Rd, Wollert, VIC 3750. APA are currently progressing the Western Outer Ring Main Project, which includes addition of an additional Solar Centaur 50 compressor to the site.

APA has commissioned Wood to assess the noise impact of the proposed facility expansion in accordance with State Environmental Planning Policy N1 (SEPP-N1).

The APA Wollert site comprises:

- Wollert City Gate: Four regulator runs that reduce the gas pressure from the country pipeline system to the metropolitan system. A gas fired water bath heater preheats the gas entering the valves.
- Compressor Station: Two Solar Centaur 50 (Units 4 and 5) and three Solar Saturn 10 (Units 1, 2 and 3) gas turbine driven compressor units with one gas after cooler and one lube oil cooler per unit, a gas engine generator, an instrument air compressor, flow control valves and two pressure regulation stations.

1.2 Surrounding Land Uses and Sensitive Receivers

The current zoning map of the area surrounding the Wollert Compressor Station is shown in Figure 1-1 overleaf; and the land uses for the area to the east of the facility are shown in Figure 1-2 overleaf. The land uses surrounding the site are primarily Type 1 (noise sensitive), as scheduled in SEPP-N1[1].

[1] Designation of Types of Zones and Reservations in the Metropolitan Region Planning Schemes for the Purposes of State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1

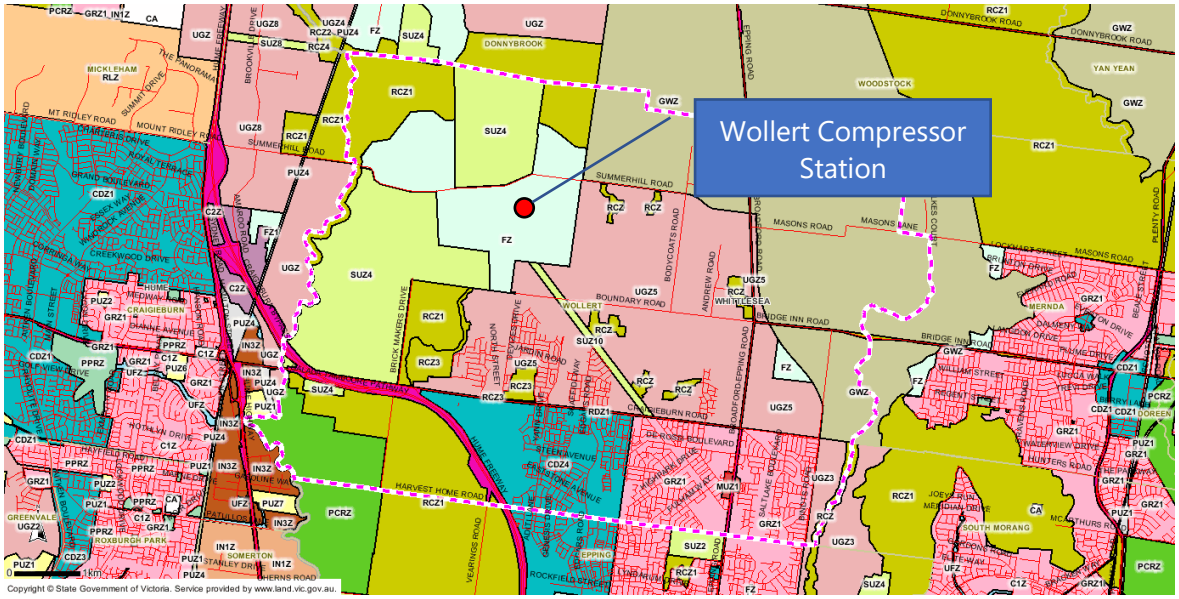


Figure 1-1: Current zoning of surrounding land[2]

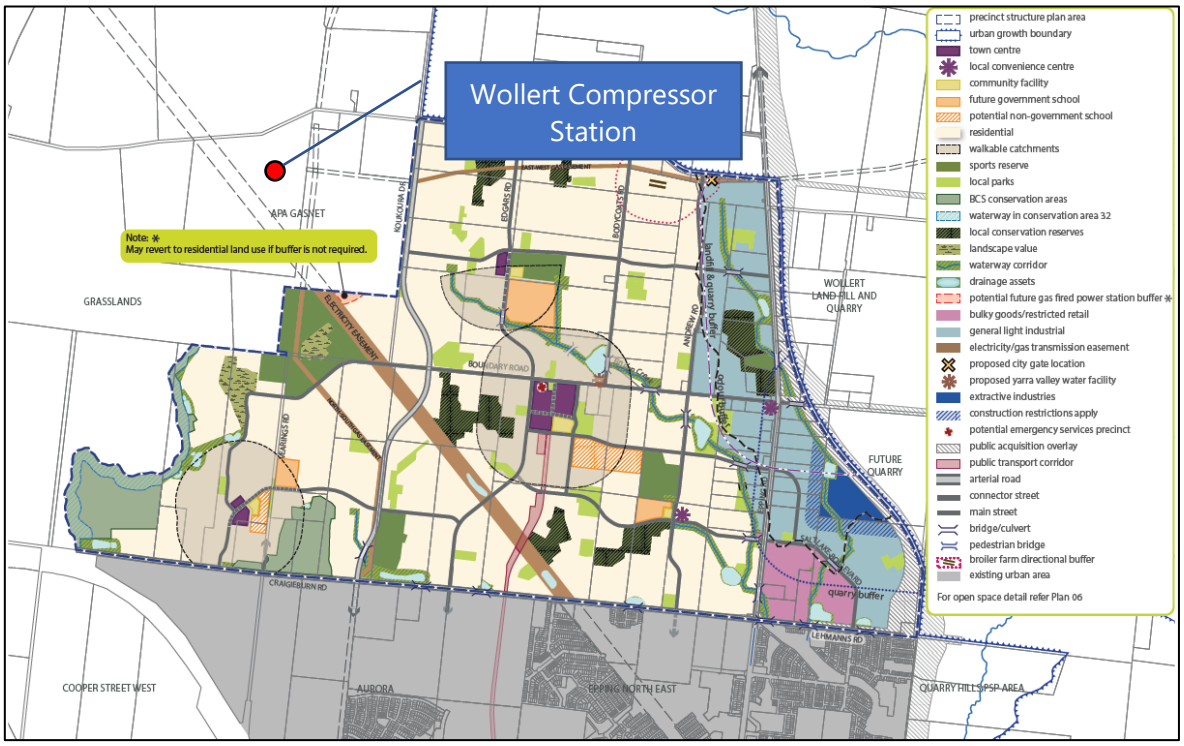


Figure 1-2: Uses of surrounding land in Whittlesea planning scheme[3]

[2] "Planning Maps Online – Wollert, City of Whittlesea Council", Department of Planning & Community Development, Victoria, available at: http://services.land.vic.gov.au/maps/pmo.jsp , accessed 24 March 2019.

[3] "Wollert Precinct Structure Plan – April 2015", Metropolitan Planning Authority and City of Whittlesea Council.

There are around 30 noise sensitive receivers close to the compressor station (refer Figure 1-3 below).

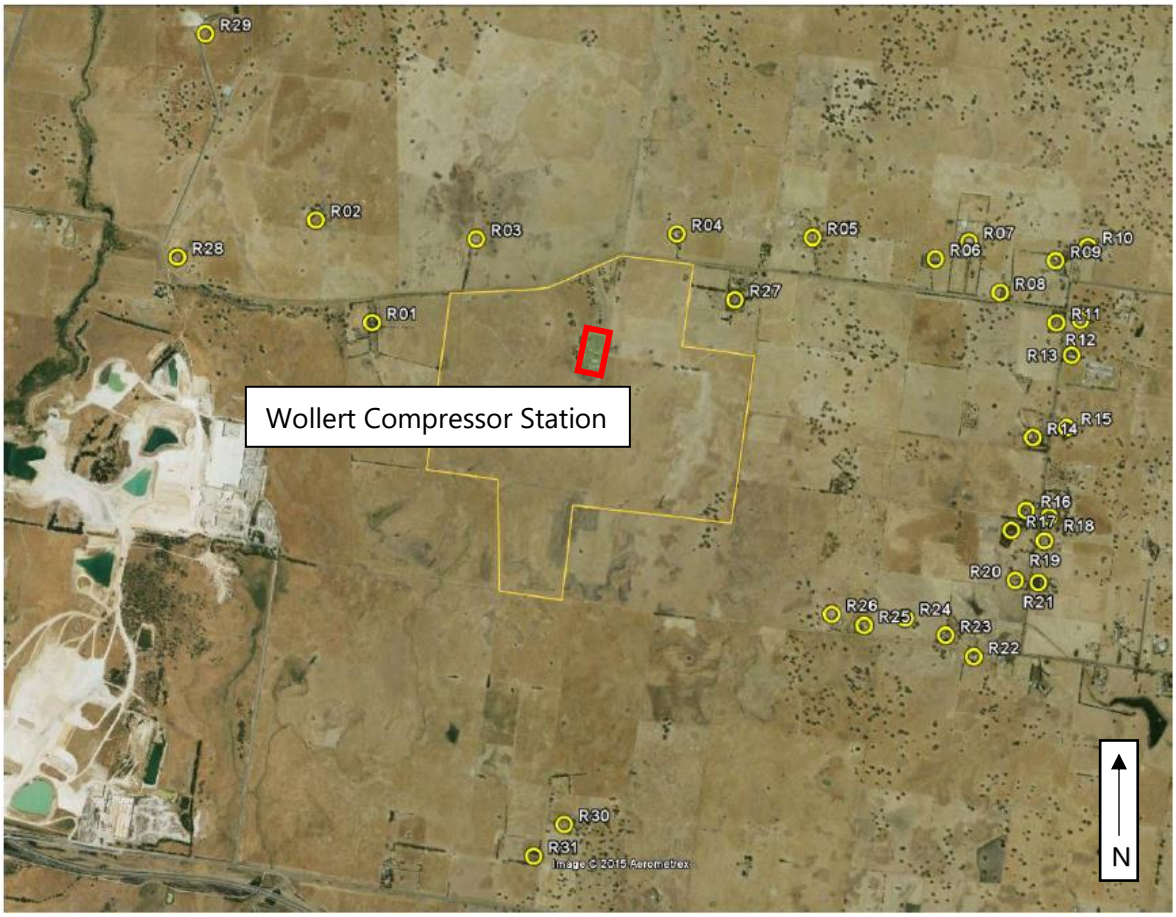


Figure 1-3: Receiver locations

2 NOISE MODELLING

2.1 Modelling Standard

A noise model of the Wollert Compressor station was built using SoundPlan version 8.0 noise modelling software. SoundPlan calculates predicted sound pressure levels at nominated receiver locations or produces noise contours over a designed area of interest around noise sources. SoundPlan can be used to model different sources of environmental noise such as industrial noise, road traffic and rail noise and aircraft noise.

SoundPlan provides a range of published noise propagation prediction algorithms that can be selected by the user. The CONCAWE[4] algorithm, which is accepted by EPA Victoria, was selected for use in this study.

The inputs to the CONCAWE algorithm are noise source sound power data, locations and heights of barriers and screens, ground topographical and absorption type data, meteorological conditions and receiver point locations.

2.2 Model Inputs

The noise model inputs are summarized in Table 2-1 below.

Table 2-1: Summary of noise model inputs

Input	Neutral Conditions	Adverse Conditions
Terrain	Ground elevation data (topography) at 1m intervals supplied by APA Group.	
Ground Absorption Factor	1.0	
Wind Speed (m/s)	0	3.1
Wind Direction	-	Northerly
Pascal-Gifford stability class (Atmospheric Stability)	D	D
Sound Power Levels	Shown in Appendix A	

Terrain and Ground Properties

Ground elevation data (topography) at 1m intervals, was supplied by APA Group.

The acoustic properties of the ground surface influence noise propagation. A ground absorption factor of 1 has been used because the land surrounding the Wollert Compressor Station is

[4] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.

predominantly soil with grass cover. The relatively high openness and porosity of this ground type results in efficient sound absorption

Meteorological conditions

Atmospheric conditions are important factors in noise modelling because temperature and wind shear profiles in the atmosphere can influence the propagation of noise from source to receiver, resulting in deviations in modelled noise level of up to 6dB.

The CONCAWE model defines six meteorological categories (1 to 6). Categories 1 to 3 result in a reduction of received noise, category 4 results in no change and categories 5 and 6 increase received noise. Categories 5 and 6 are defined by the following conditions:

- Category 5: v >3 m/s and A or B; v = 0.5 to 3 m/s and C, D or E; v = -3 m/s to 0.5 m/s and F or G;
- Category 6: v >3 m/s and C, D or E; v = 0.5 to 3 m/s and F or G.

Where v is the averaged wind velocity blowing source to receiver and A to G are Pascal-Gifford stability classes.

The noise guidance published by EPA Victoria does not specify meteorological conditions for noise modelling. However, SEPP-N1 specifies that noise due to sites where the propagation of noise is affected by atmospheric conditions should be measured on three separate occasions over 30 days (i.e. on 10% of the days in the period) and the average of the measurements be used to assess compliance[5]. This approach reduces the significance of infrequent atmospheric conditions on compliance assessment, which implies that conditions occurring much less frequently than 10% of the time can be considered insignificant.

The frequency of noise enhancing conditions at the site has been assessed[6], based on 18 years of data from the BOM weather station at Melbourne airport. The assessment indicates that:

- Calm conditions are rare and averaged wind speed typically exceeds 3m/s.
- The prevailing conditions during winter night time, when maximum facility operation is most likely to occur and when noise limits are most stringent, are winds exceeding 3m/s in a northerly direction (53% of the time) and Pascal-Gifford stability class D or E (85% of the time). This results in the category 6 meteorological condition for receivers directly to the north of the facility.
- Other noise enhancing conditions, as defined in the CONCAWE model, occur for much less than 10% of the time over any 30-day period. While F or G stability class conditions

[5] SEPP-N1 Schedule A, Part A2, Clause 6

[6] Worley Parsons '401010-01412 – AA-REP-0001 Noise Impact Study - 2017 365 Summerhill Rd, Wollert VIC 3750' November 2017

occur for around 10% of the night time, this would almost always be in combination with wind speed exceeding 3m/s, resulting in category 4 or falling outside the CONCAWE meteorological categories. As a result, no other noise enhancing conditions occur frequently enough to justify assessment under SEPP-N1.

Thus, the following 'neutral' (non-enhancing) and 'adverse' (enhancing) meteorological conditions were assumed:

- Neutral Condition (Category 4): Model forced to compute nil enhancement by setting meteorological conditions to Category 4.
- Adverse Condition (Category 6): Pasqual Stability Class D, 3.1m/s northerly wind.

Equipment Sound Power Levels

The sound power levels of equipment operating at the Wollert Compressor Station were measured on the 2nd of April 2019. Sound power levels were determined in accordance with AS 1217.7-1985 Acoustics – Determination of Sound Power Levels of Noise Sources, Part 7 – Survey Method. The sound power levels for the proposed equipment were assumed to be the same as the levels measured for similar existing equipment.

Sound intensity measurements were utilized for situations where multiple noise sources contributed to the noise level at the measurement location. Sound intensity measurement is a technique that uses a device with two opposed microphones to isolate the acoustic energy emanating from a specific point or area.

The sound power levels are presented in APPENDIX B.

2.3 Model Validation

Noise levels were measured at the boundary of the buffer zone surrounding the Wollert Compressor station for validating the noise model predictions on the 2nd April 2019. The measurement locations are shown in Figure 2-1 below. The sound measurement equipment was compliant with IEC 61672, and was check calibrated before and after use with no significant drift identified.

Figure 2-1: Validation Measurement Locations

The noise levels generated by the facility at the validation locations were determined using the 90th percentile (L_{A90}) noise level. The L_{A90} level should exclude the influence of variable extraneous noise present in the measurement (e.g. bird vocalizations, wind gusts) while retaining the contribution of the steady noise that would be generated by the Wollert Compressor station.

The noise model was used to predict noise levels during the facility process conditions at the time of measurement, between 1200 hours and 1330 hours on the 2nd April 2019. The process conditions are shown in Figure 2-2. The weather was generally calm with intermittent wind gusts during the validation measurements. Therefore, neutral (non-enhancing) meteorological conditions were assumed in the model.

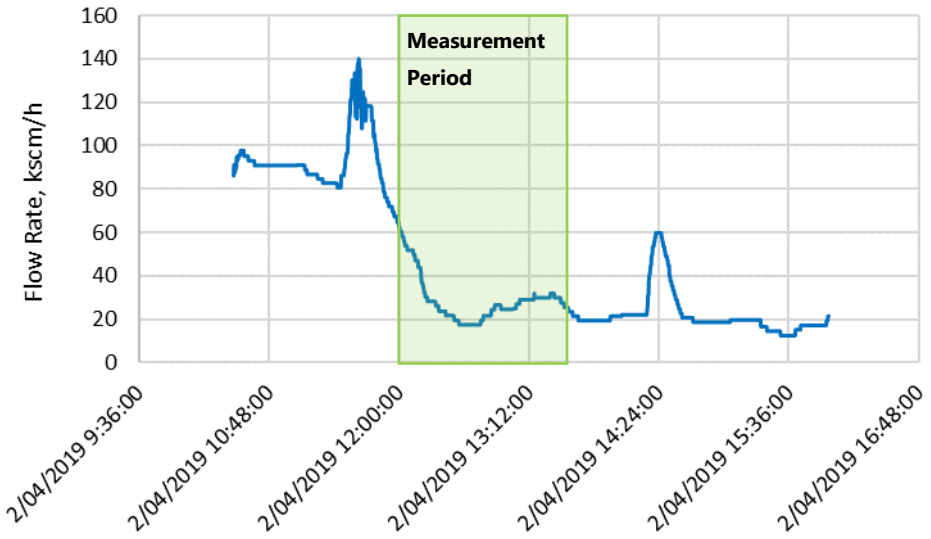


Figure 2-2: Wollert CG Regulator Outlet Flow Rate

During the validation measurements the following equipment was operating:

- Unit 4 Centaur running in recycle; and
- 1 x City Gate value open.

The modelled and measured noise levels are presented in Table 2-2 below.

Table 2-2: Validation Noise Modelling

Receiver	Predicted Levels, dBA	Measured Levels, dBA	Variance, dB
Env 1	40.1	39.1	+1.0
Env 2	37.3	34.3	+3.0
Env 3	44.0	43.5	+0.5

3 NOISE CRITERIA

3.1 State Environmental Planning Policy N1

Noise emissions from commercial, industrial or trade noise sources within the Melbourne Metropolitan region are regulated under State Environmental Planning Policy N1 (SEPP-N1). SEPP-N1 specifies noise level limits at noise sensitive land uses near the activity, within a defined region that encircles the Melbourne metropolitan area. The Wollert Compressor Station falls within the SEPP-N1 area, as shown in Figure 3-1 below.

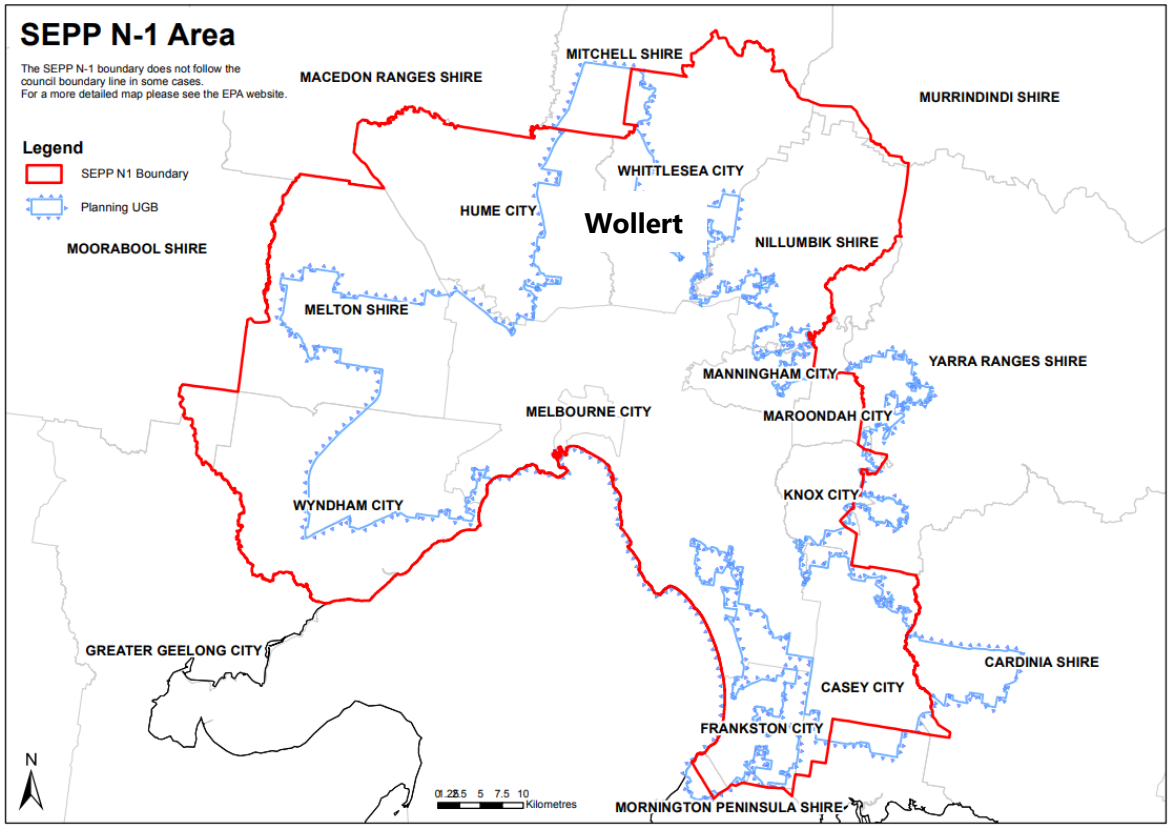


Figure 3-1: Location of Wollert within the SEPP N-1 boundary

The noise limits set by SEPP-N1 are influenced by the zoning of land uses surrounding a noise-sensitive receiver and the existing background noise level. Different limits apply for the day (0700 and 1800 hours), evening (1800 and 2200) and night (2200 to 0700) periods. The noise limit is adjusted (reduced) where non-project industrial noise sources also contribute to industrial noise at a receiver.

The noise limits can be no less than the following values:

- Day Period: 45dB(A)
- Evening Period: 40dB(A)
- Night Period: 35dB(A)

3.2 Noise Limits

The noise limits that apply to the Wollert Compressor Station have been established[7] and these limits were adopted for the study reported here. The night time noise limits, which are the most stringent, range from 39dB(A) to 56dB(A) (refer Table 3-1 below).

Table 3-1: Receiver noise limits

Receiver	Zoning	Influencing Factor	Background Noise Level	Night time zoning Level	Night time noise limit (dB(A))
R01	FZ	0.125	36	41	41
R04, R27	FZ	0	36	39	39
R02	IN2Z	1	36	56	49
R03	SUZ4	1	36	56	49
R05, R06, R07, R08, R09, R10	GWZ	0	36	39	39
R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26	R1Z	0	36	39	39
R28	IN2Z	1	36	56	49
R31	R1Z	0	36	39	39
R29, R30	RCZ	0	36	39	39

An intent of SEPP-N1 is to limit the total industrial noise level at a sensitive receiver. Thus, the SEPP-N1 noise limit is adjusted (reduced) where non-project industrial noise sources also contribute to industrial noise at a receiver. However, the Wollert Compressor Station is the only existing industrial noise source that could contribute to noise levels at the noise sensitive receivers. As a result, this adjustment was not applied.

[7] Worley Parsons '401010-01412 – AA-REP-0001 Noise Impact Study - 2017 365 Summerhill Rd, Wollert VIC 3750' November 2017

4 RESULTS FOR MAXIMUM OPERATING SCENARIO

4.1 Maximum Operating Scenario

Noise levels were modelled for the maximum operating scenarios for the current and expanded facility. APA have advised that the maximum operating scenario involves operation of the following equipment:

Current Facility

Rotating Equipment

- Compressor Units 4 and 5
- Gas engine generator
- Instrument air compressor
- Unit 4 & 5 Gas Cooler fans (2 fans per cooler)
- Unit 4 & 5 Oil Cooler fan (1 fan per cooler)

Valves & Piping

- 4x City gate valves and associated piping, water bath preheater
- T74 PRS (Pressure Reduction Station)
- T119 PRS

Expanded Facility

Rotating Equipment

- Compressor Unit 6
- All rotating equipment sources in the 'current facility' scenario

Valves & Piping

- WORM PRS
- WORM flow control valves
- New T119 Flow control valves
- All valves and piping in the 'current facility' scenario

4.2 Modelled Noise Levels

The receiver noise levels predicted for the current and expanded facility under the maximum operating scenarios and adverse meteorological conditions are presented in Table 4-1 overleaf. Noise level contours for the current and expanded facility maximum operating scenarios under neutral and adverse conditions are presented in APPENDIX A.

Table 4-1: Predicted noise levels for the maximum operating scenario and adverse conditions

Receiver	Limit, dBA	Predicted Noise Level, dBA	
		Current Facility	Expanded Facility
R01	41	30.6	32.5
R02	49	26.1	27.9
R03	49	34.1	36.0
R04	39	30.2	34.1
R05	39	28.6	30.2
R06	39	24.0	25.7
R07	39	22.6	24.2
R08	39	21.9	23.6
R09	39	19.8	21.5
R10	39	18.7	20.4
R11	39	20.1	21.8
R12	39	19.3	21.0
R13	39	19.7	21.3
R14	39	20.8	22.5
R15	39	19.8	21.4
R16	39	20.4	22.0
R17	39	20.6	22.3
R18	39	19.6	21.2
R19	39	19.5	21.2
R20	39	19.9	21.5
R21	39	19.1	20.8
R22	39	19.7	21.4
R23	39	20.9	22.6
R24	39	22.4	24.1
R25	39	23.5	25.2
R26	39	24.8	26.5
R27	39	35.3	36.8
R28	49	21.4	23.2
R29	39	18.8	20.6
R30	39	20.8	22.5
R31	39	19.7	21.3

5 DISCUSSION

The noise levels at nearby noise sensitive receivers due to operation of the current and expanded Wollert Compressor Station at the maximum operating conditions have been modelled. The model was validated against noise levels measured at three locations near the site and found to be accurate within to +3.0 to +0.5dB. Therefore, the modelled noise levels are slightly conservative.

The modelling and analysis undertaken show that for the expanded facility operating at the maximum operational scenario and under adverse meteorological conditions:

- Noise levels would increase by 1.5 to 2dB at most receivers; and
- Modelled noise levels fall below the SEPP-N1 limits. The modelled noise levels were up to 36.8dB(A), which is below the most stringent noise limit (39dB(A)).

The modelling assumed that the proposed Unit 6 will have an overall package sound power level of 111dB(A), inclusive of the gas and lube oil air coolers, the same as that of the existing Units 4 and 5. The modelled noise levels for the expanded facility would not meet the requirements of SEPP-N1 if the Unit 6 package sound power level exceeded 116dB(A).

6 CONCLUSIONS

The noise levels generated at nearby noise sensitive receivers due to the maximum operating conditions for the current and expanded Wollert Compressor Station have been modelled. The model was validated against noise levels measured at three locations near the site and found to be slightly conservative.

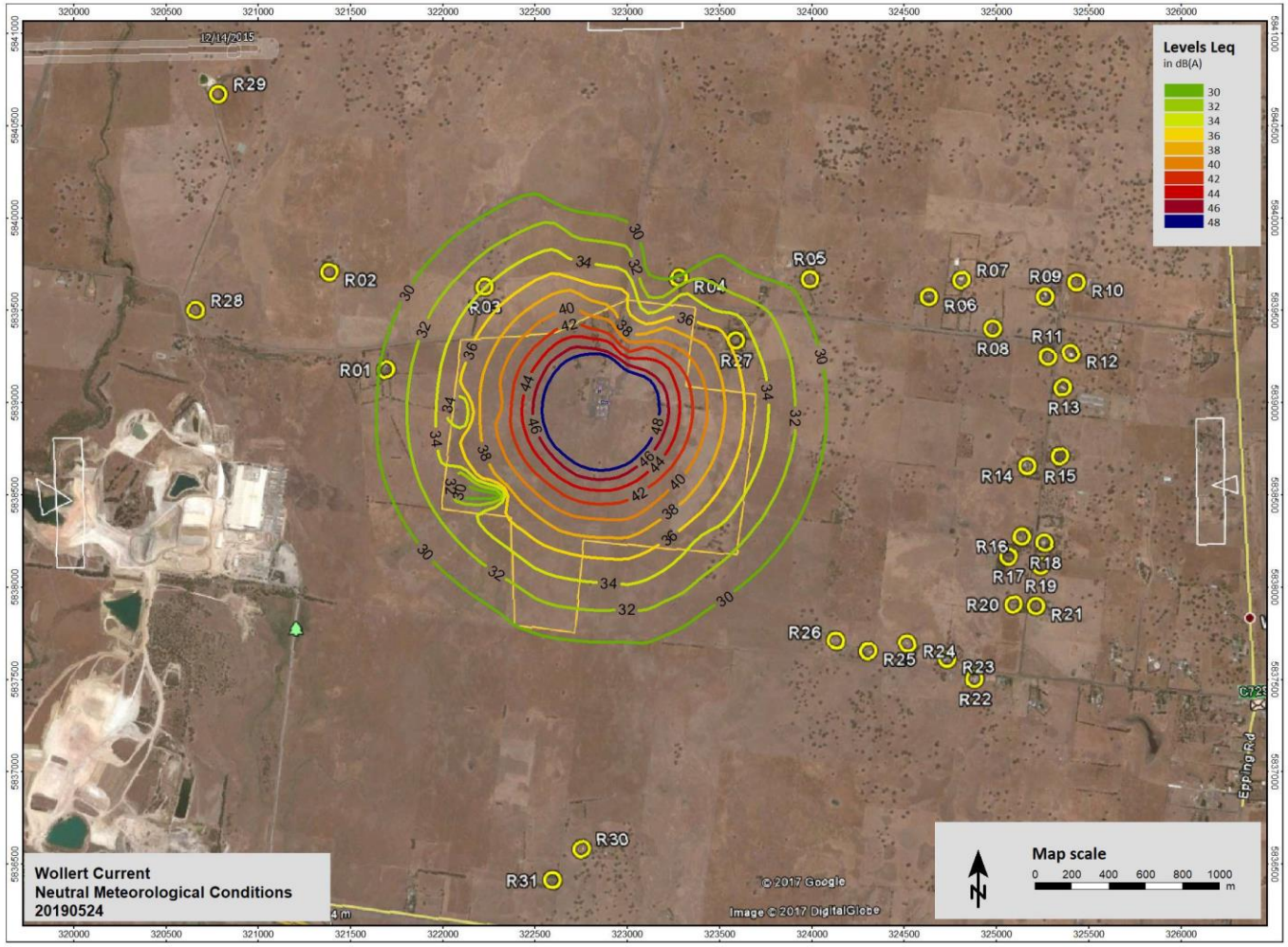
The modelling and analysis undertaken for this assessment show that for the expanded facility operating at the maximum operational scenario:

- Noise levels would increase by 1.5 to 2dB at most receivers; and
- Modelled noise levels fall below the SEPP-N1 limits.

7 RECOMMENDATIONS

It is recommended that APA procure the proposed Unit 6 compressor with a maximum overall package sound power level of 111dB(A), inclusive of the gas and lube oil coolers. This would require an acoustic enclosure for the compressor and turbine; and turbine exhaust and combustion air attenuators.

APPENDIX A NOISE CONTOURS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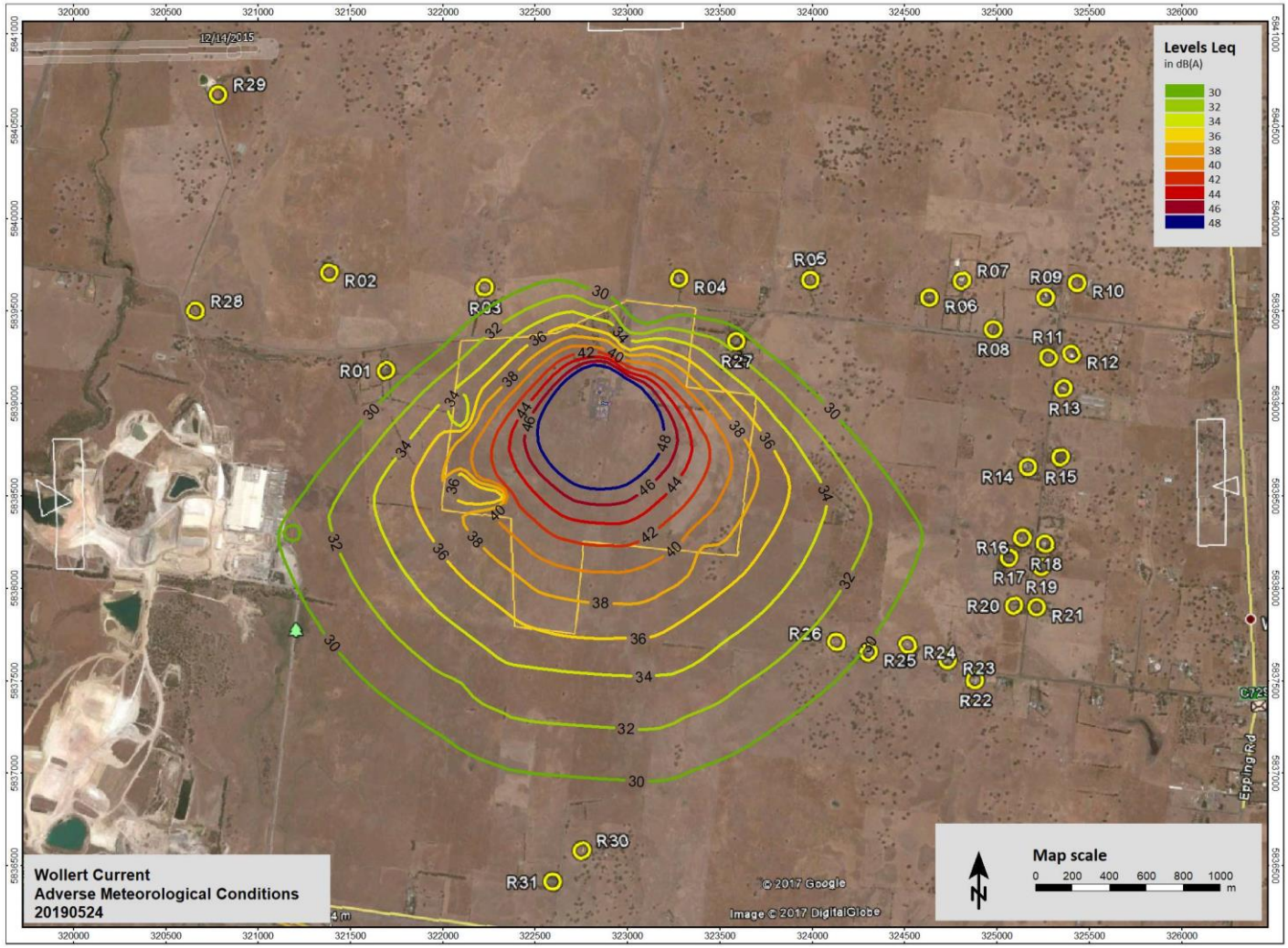
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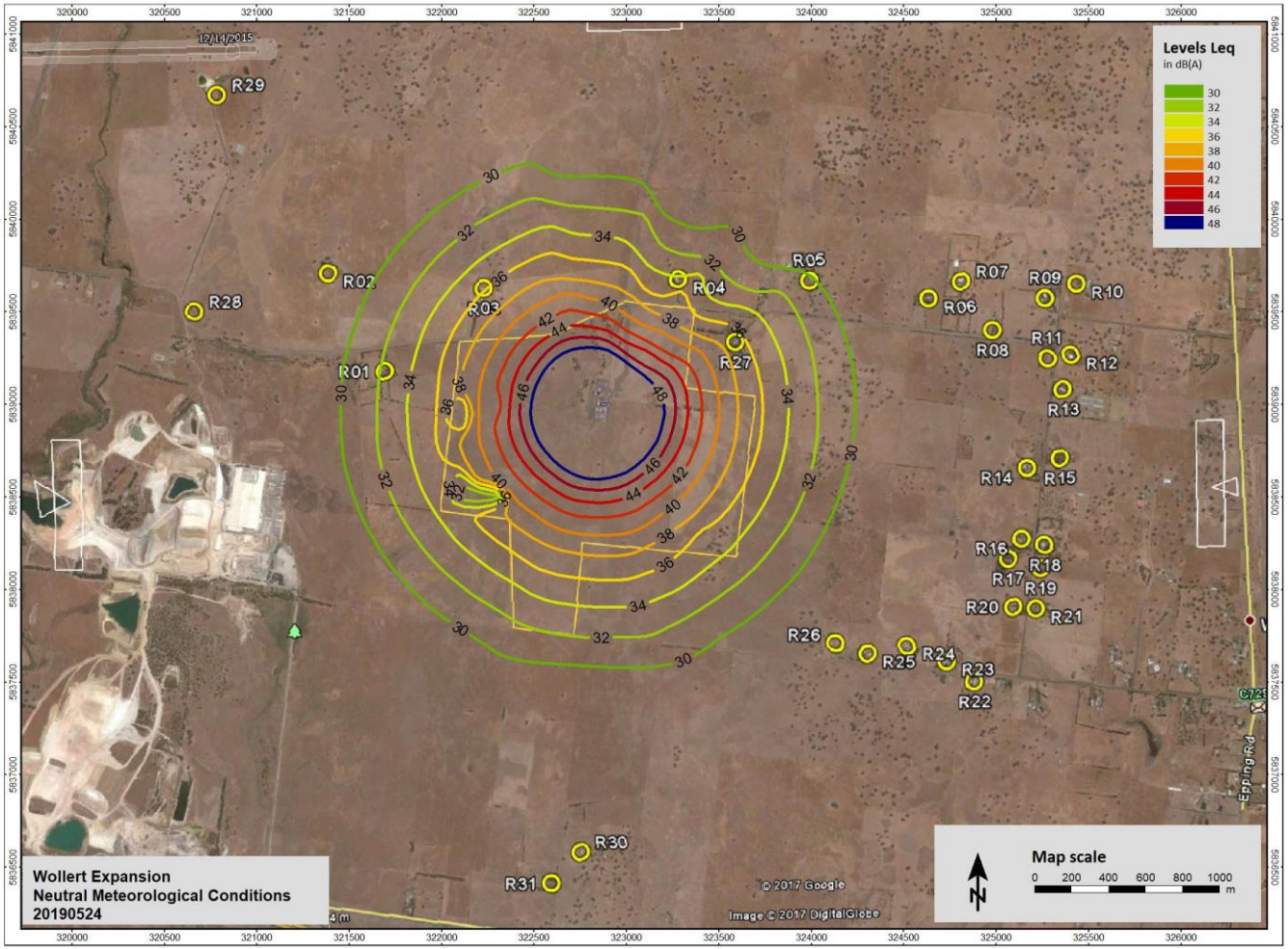
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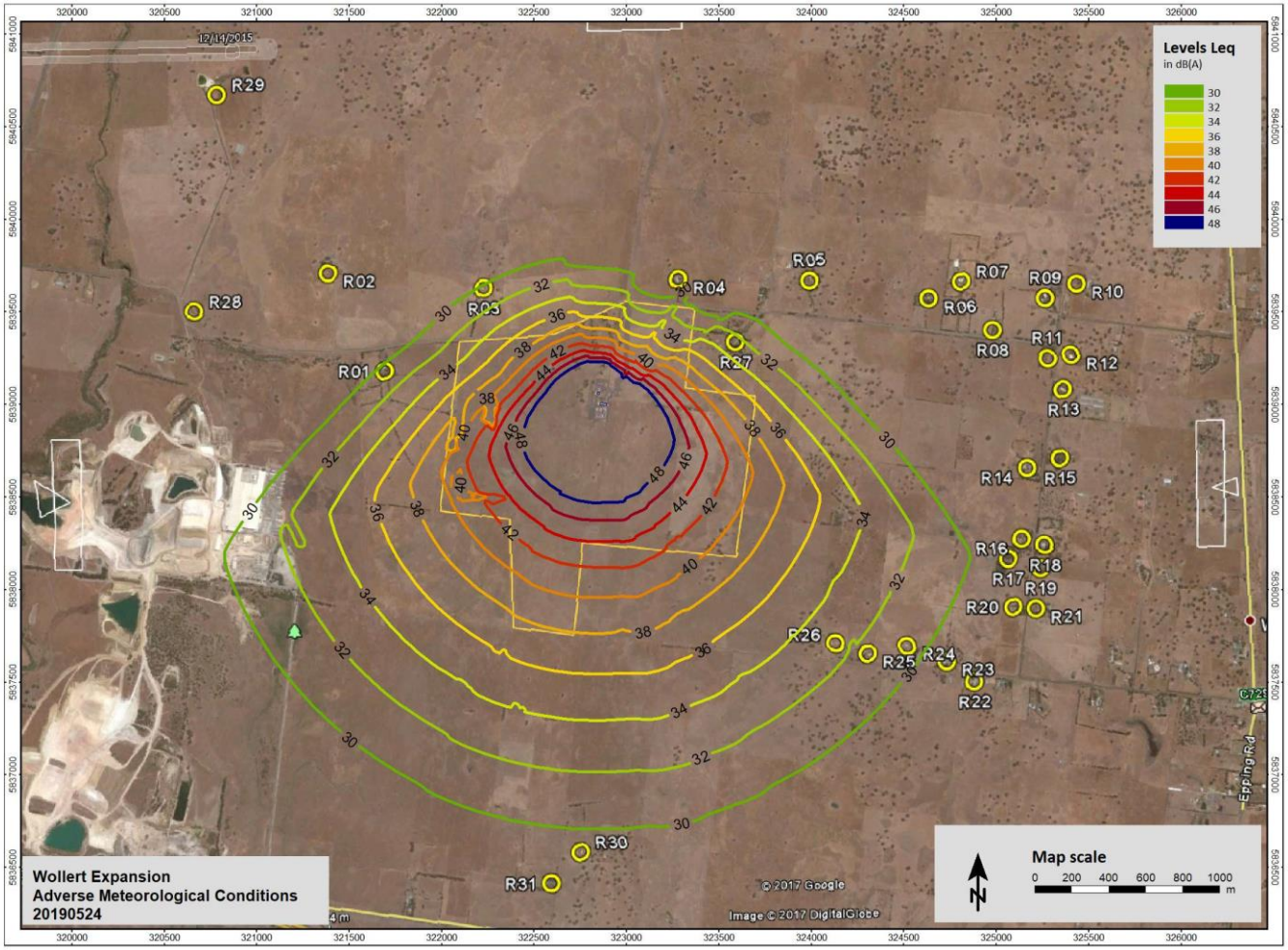
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APPENDIX B SOUND POWER LEVELS

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Compressor Unit 4	104	106	109	107	103	99	103	99	100	106	109	99	98	100	97	95	99	96	96	94	100	111
Unit 4 Compressor - West	90	91	94	93	90	88	93	93	86	89	90	86	87	87	87	89	91	87	87	88	94	101
Unit 4 Compressor - North	92	92	97	97	92	90	89	86	83	85	84	78	81	80	79	81	82	79	80	79	90	94
Unit 4 Compressor - East	101	103	104	103	101	96	95	91	89	91	92	87	88	88	87	88	89	85	87	85	94	100
Unit 4 Compressor Stack	95	98	100	97	93	89	92	91	89	91	93	87	89	88	86	87	88	86	86	86	98	102
Unit 4 Compressor Top - Stack Platform	104	103	105	101	98	95	99	96	94	97	99	92	94	93	91	92	93	90	91	91	102	106
Unit 4 Compressor Top - Compressor Platform	101	102	104	102	100	97	97	95	92	94	96	91	92	92	92	92	93	90	89	91	107	109

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Compressor Unit 4 Aftercooler	100	97	102	98	94	99	103	98	101	109	112	102	100	100	98	98	100	97	99	98	97	113
Recycle Vale	87	86	89	88	83	84	88	82	83	88	89	83	81	80	80	80	80	77	77	77	75	92
Unit 4 Aftercooler	101	97	99	98	95	100	105	99	105	110	112	103	103	101	100	99	98	95	98	98	97	114
Regulator Valve (T119-PRD)	79	78	79	76	71	69	69	64	67	68	70	69	71	72	70	70	70	70	70	70	69	82
Regulator Valve (T74)	78	75	73	71	67	65	63	63	60	59	60	58	58	63	61	62	61	63	61	63	63	73
City Gate - Run 1	76	74	73	84	72	68	68	68	67	71	73	67	71	75	78	87	87	89	90	95	95	102
City Gate - Run 4	79	75	73	85	74	71	70	70	69	70	73	74	71	81	82	91	89	89	91	94	96	104
Compressor Unit 2	105	105	102	95	88	90	84	81	82	83	85	84	86	83	78	77	76	74	70	67	66	92
Lube Oil Fan	90	93	94	96	98	103	99	101	107	103	101	99	98	96	98	98	96	94	88	89	87	108
Compressors Units 1,2,3 Air Intake - North	91	91	86	80	79	76	71	70	83	70	73	71	74	80	83	84	87	90	87	85	88	98

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Compressors Units 1,2,3 Air Intake - East	84	82	79	79	78	77	69	71	84	70	73	73	74	82	81	85	84	85	82	79	78	93
Compressors Units 1,2,3 Air Intake - West	83	80	76	73	73	77	68	67	72	64	66	65	66	72	73	78	79	79	76	74	76	87
Compressors Units 1,2,3 Air Intake - Above	94	94	89	85	84	84	76	76	89	75	78	78	79	87	88	90	91	94	90	88	91	101
Generator Building	94	92	93	101	101	92	94	95	91	89	88	90	90	89	87	86	86	87	83	81	80	99
Compressor Units 1,2 & 3 Aftercoolers	103	103	101	98	95	94	94	93	93	92	95	90	93	92	89	94	94	93	90	85	86	103