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Olive Downs Coking Coal Project

Draft Environmental Impact Statement

Appendix K

Noise and Vibration Assessment

Start Page

RENZO TONIN RON RUMBLE
inspired to achieve

Acoustics
Vibration
Structural Dynamics

OLIVE DOWNS COKING COAL PROJECT - NOISE AND VIBRATION ASSESSMENT

Environmental Noise & Vibration Assessment

23 July 2018

Pembroke Olive Downs Pty Ltd

QB025-01F03 Noise Report (r2)

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Executive Summary

Renzo Tonin Ron Rumble was engaged to prepare a noise and vibration impact assessment as part of an Environmental Impact Statement for the Olive Downs Coking Coal Project (the Project).

The objective of this report is to assess noise and vibration levels from the Project against relevant noise and vibration objectives.

This report identifies and addresses the following items:

- sensitive receptors potentially affected by Project noise and vibration;
- existing noise and vibration environment at the nearest receptors;
- relevant noise and vibration objectives;
- types of mining activities and locations during key stages of Project mining operations;
- types of processing plant activities and locations during key stages of Project processing operations;
- predicted Project noise and vibration levels at the nearest receptors; and
- recommendations for noise control measures, where required.

The Project is located approximately 170 kilometres (km) south-west of Mackay, Queensland, 40 km south-east of Moranbah and 25 km north-east of Dysart.

The site is located within a sparsely populated area where the main land uses are large acreage grazing properties and mining activities. There are few near neighbours with the closest located approximately 12.2 km from the Coal Handling and Preparation Plant (CHPP). A summary of the sensitive receptors relevant to the Project include:

- Vermont Park (12.2 km east of the proposed CHPP);
- Soleh Nolem 1 (19.0 km south-east of the proposed CHPP);
- Soleh Nolem 2 (19.7 km south-east of the proposed CHPP);
- Old Bombandy (41.4 km south-east of the proposed CHPP);
- Willunga (32.2 km south-east of the proposed CHPP); and
- Leichardt (31.4 km south-east of the proposed CHPP).

This noise and vibration assessment has been prepared in accordance with the Department of Environment and Science (DES) (formerly the Department of Environment and Heritage Protection [DEHP]) document *Guideline: Application requirements for activities with noise impacts* (DEHP, 2017b).

Noise and vibration objectives for for the Project were derived from a number of relevant guidelines. The relevant noise and vibration objectives for the Project are provided in Tables ES-1 and ES-2.

Table ES-1: Project Noise Objectives

Noise Issue	Applicable Time Period	Relevant Noise Limit
Operations [1]	Daytime (7 am to 6 pm)	35 dBA $L_{Aeq, adj 15 mins}$
	Evening (6 pm to 10 pm)	35 dBA $L_{Aeq, adj 15 mins}$
	Night time (10 pm to 7 am)	35 dBA $L_{Aeq, adj 15 mins}$
Sleep Disturbance [2]	Night time (10 pm to 7 am)	52 dBA $maxL_{pA}$
Low Frequency [3]	All Periods	50 dBZ

After: [1] Section 10, Environmental Protection (Noise) Policy 2008. [2] Planning for Noise Control Guideline (2016). [3] Assessment of Low Frequency Noise (2004).

dBA = A-weighted decibels. $L_{Aeq, adj 15 mins}$ = Equivalent sound level over a 15 minute period, adjusted for tonal/impulsive noise as required.

$maxL_{pA}$ = maximum instantaneous noise level.

dBZ = Z-weighted decibels. Z-weighting is a flat frequency response and replaces the older "Linear" or "Unweighted" responses.

Table ES-2: Blasting Noise & Vibration Objectives

Blasting Emission	Sensitive or Commercial Blasting Noise & Vibration Objectives	
	7 am to 6 pm	6 pm to 7 am
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm
Ground vibration peak particle velocity	5 millimetres per second (mm/s) peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm

After: Model Mining Conditions Guideline (2017).

dB = decibels.

A computer model was prepared for the Project using Cadna software. Project operational noise levels were predicted for four modelling scenarios at each of these noise sensitive receptors. The operational scenarios modelled (Years 2027, 2043, 2066 and 2085) were selected in consideration of the scale of mining operations in each year of the Project, number of major mobile equipment and proximity of operations to sensitive receptors.

Two weather scenarios were considered in modelling, namely neutral conditions (Stability Class D) and adverse weather conditions (Stability Class F). The following modelling results were determined:

Neutral weather conditions

With the implementation of noise mitigation, including the use of sound suppression on particular mobile fleet and fixed plant operating in proximity to the nearby sensitive receptors, operational noise levels were predicted to comply with the noise objectives at all nearby sensitive receptors including Vermont Park (NSR1), Seloh Nolem 1 (NSR2), Seloh Nolem 2 (NSR3), Old Bombandy (NSR4), Willunga (NSR5) and Leichardt (NSR6) for all modelling scenarios (2027, 2043, 2066 and 2085).

Adverse Weather Conditions

Adverse weather conditions were determined to raise operational noise levels (above predictions for neutral conditions) by up to 7 dBA.

With the implementation of noise mitigation, including the use of sound suppression on particular mobile fleet and fixed plant operating in proximity to the nearby sensitive receptors, operational noise levels were predicted to comply with the noise objectives at all nearby sensitive receptors for all modelling scenarios.

Although noise levels are predicted to comply with the relevant criteria, noise monitoring would be conducted to validate the model predictions and inform the implementation of additional noise mitigation measures, if required. Additional noise mitigation measures could include modification of Project operations or at-receiver mitigation measures.

Low Frequency Noise

Operational noise predictions indicate low frequency noise (<200 Hz) is expected to comply with the noise limits of 55 dBZ (external location) at all receptors.

Sleep Disturbance

Based on predicted noise levels during neutral and adverse weather conditions, compliance with the sleep disturbance criterion is expected.

Blasting

Predicted Project ground vibration and airblast overpressure show that typical explosive charge sizes and practices are expected to be below relevant objectives for the Project.

Operational Management

To reduce noise levels at the nearest sensitive places, Pembroke would implement noise controls on fixed plant and mobile equipment, including the overland conveyor .

Pembroke would also implement proactive and reactive noise control measures. These measures would include the use of weather forecasting and real-time measurement of meteorological conditions and noise levels to modify mining operations as required in order to achieve compliance with applicable noise limits at the nearest sensitive receptors.

Modifying mining operations could include reducing the intensity of particular operations, relocating particular operations or halting particular operations.

Real-time meteorological and noise monitoring would be undertaken at locations representative of the nearest sensitive places to assist in implementing operational controls.

Contents

1 Introduction

Renzo Tonin Ron Rumble was engaged to prepare a noise and vibration impact assessment as part of an Environmental Impact Statement (EIS) for the Olive Downs Coking Coal Project (the Project).

The objective of this report is to assess noise levels from the Project against relevant noise objectives.

This report identifies and addresses the following items:

- sensitive receptors potentially affected by Project noise;
- existing noise environment at sensitive places;
- relevant noise objectives;
- types of mining activities and locations during key stages of Project mining operations;
- types of processing plant activities and locations during key stages of Project processing operations;
- predicted Project noise objectives at sensitive places; and
- recommendations for noise control measures, where required.

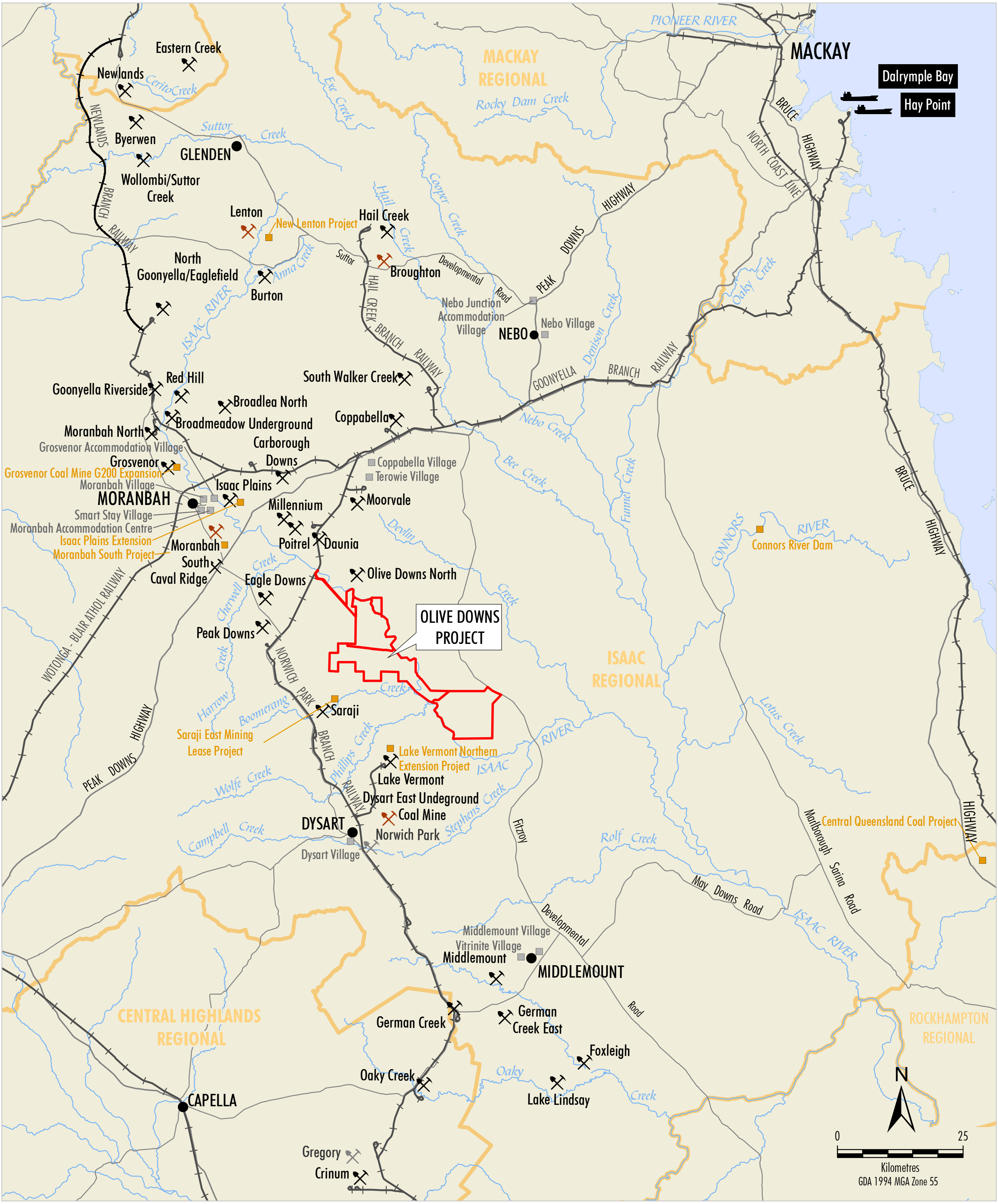
The work documented in this report was carried out in accordance with the Renzo Tonin Ron Rumble's Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Overview of the Project

2.1 Site Location

Pembroke Olive Downs Pty Ltd (Pembroke) proposes to develop the Project, a metallurgical coal mine and associated infrastructure within the Bowen Basin, located approximately 40 kilometres (km) south-east of Moranbah, Queensland (Figure 1). The Project provides an opportunity to develop an open cut metallurgical coal resource within the Bowen Basin mining precinct that can deliver up to 14 million tonnes per annum (Mtpa) of product coal.

The tenements relevant to the Project include Mining Lease Application (MLA) 700032, MLA 700033, MLA 700034, MLA 700035 and MLA 700036.



PRN-16-02_EIS_App NA_209D

LEGEND

- Mining Lease Application Boundary
- Local Government Area
- Major Road
- Railway
- Port
- Approved/Operating Coal Mine
- Proposed Coal Mine
- Under Care and Maintenance
- Workforce Accommodation Facility
- Coordinated, Major and Other Relevant Project

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources and Mines (2016)

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OLIVE DOWNS COKING COAL PROJECT

Regional Location

Figure 1

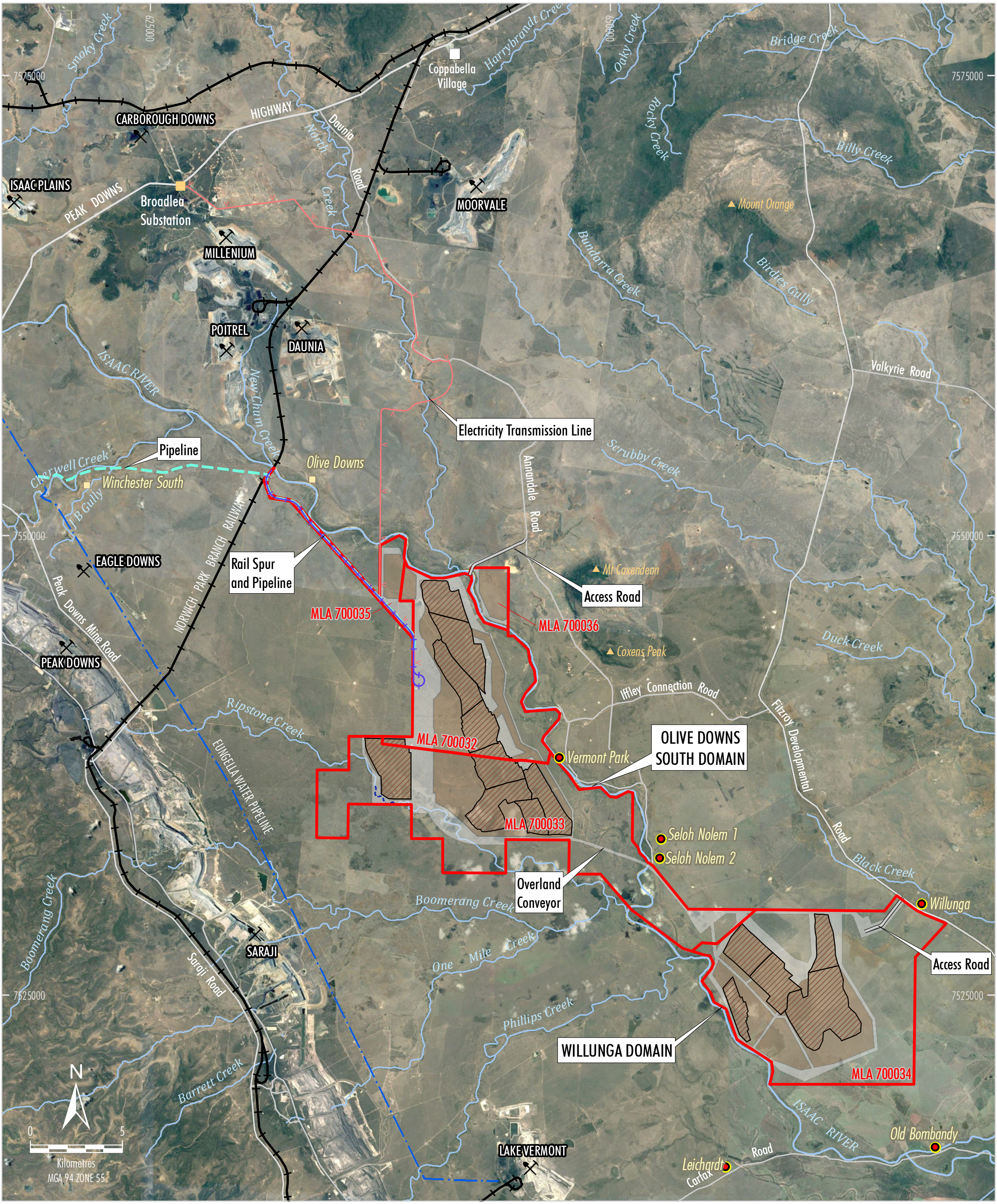
2.2 Brief Project Description

The Project comprises the Olive Downs South and Willunga domains and associated linear infrastructure corridors, including a rail spur connecting to the Norwich Park Branch Railway, a water pipeline connecting to the Eungella pipeline network, an electricity transmission line (ETL) and access roads (Figure 2). The coal resource would be mined by conventional open cut mining methods, with product coal to be transported by rail to the Dalrymple Bay Coal Terminal. Up to 20 Mtpa of run-of-mine (ROM) coal would be extracted over the anticipated Project operational life of approximately 79 years.

The mine will to utilise shovels/excavators and trucks for the removal of overburden and interburden. In general, the mining operation will involve:

- vegetation clearing of selected mining operation areas;
- topsoil stripping;
- stripping of some overburden;
- blasting of overburden and interburden;
- removal of overburden and interburden using loading equipment and trucks;
- ROM coal mining;
- ROM coal transport;
- coal handling and processing, and;
- site rehabilitation.

A detailed description of the Project is provided in the main text of the EIS.



LEGEND

- Mining Lease Application Boundary
- Noise Receptor
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

PRN-16-02_EIS_App NA_210A

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OLIVE DOWNS COKING COAL PROJECT

Project General Arrangement

Figure 2

2.3 Hours of Operation

The proposed hours of operation are 24 hours per day, seven days per week. It is noted that mining operations in Pits ODS7 and ODS8 in the Olive Downs South domain would be restricted to daytime only.

2.4 Noise Sensitive Receptors

The Project is located approximately 40 km south-east of Moranbah and 25 km north-east of Dysart, in a sparsely populated area where the main land uses are large acreage grazing properties and mining activities. There are few near neighbours with the closest located approximately 12.2 km from the Coal Handling and Preparation Plant (CHPP). A summary of the sensitive receptors relevant to the Project include:

- Vermont Park (12.2 km east of the proposed CHPP);
- Soleh Nolem 1 (19.0 km south-east of the proposed CHPP);
- Soleh Nolem 2 (19.7 km south-east of the proposed CHPP);
- Old Bombandy (41.4 km south-east of the proposed CHPP);
- Willunga (32.2 km south-east of the proposed CHPP); and
- Leichardt (31.4 km south-east of the proposed CHPP).

The nearest noise sensitive receptors potentially affected by operational noise emissions from the Project are listed in Table 1.

Table 1: Nearest Noise Sensitive Receptors

Receptor ID	Receptor Address	Coordinates in Universal Transverse Mercator (UTM)	
		Easting (metres [m])	Northing (m)
NSR1	Vermont Park	647231 E	7537824 S
NSR2	Seloh Nolem 1	652770 E	7533482 S
NSR3	Seloh Nolem 2	652715 E	7532465 S
NSR4	Old Bombandy	667546 E	7516686 S
NSR5	Willunga	666958 E	7529954 S
NSR6	Leichardt	656328 E	7515670 S

The locations of the noise sensitive receptors are shown on Figure 2.

3 Terms of Reference

The Terms of Reference for the Project EIS (dated June 2017), relevant to noise and vibration, states the following:

Objective and performance outcomes

The environmental objective to be met under the EP Act is that the activity will be operated in a way that protects the environmental values of the acoustic environment.

The performance outcomes corresponding to this objectives are in Schedule 5, Table 3 of the EP Regulation. The proponent should supply sufficient evidence (including through studies and proposed management measures) that show these outcomes can be achieved.

Information requirements

11.110 The assessment of impacts on noise and vibration will be in accordance with DEHP Application Requirements for Activities with noise impacts (Guideline ESR/2015/1838).

11.111 Fully describe the characteristics of the noise and vibration sources that would be emitted when carrying out the activity (point source and general emissions). Noise and vibration emissions (including fugitive sources) that may occur during construction, commissioning, upset conditions, operation and closure should be described.

11.112 Predict the impacts of the noise emissions from the activity on the environmental values of the receiving environment, with reference to sensitive receptors, using recognised quality assured methods. Taking into account the practices and procedures that would be used to avoid or minimise impacts, the impact prediction must address the:

a) activity's consistency with the objectives
b) cumulative impact of the noise with other known emissions of noise associated with existing development and possible future development (as described by approved plans)
c) potential impacts of any low-frequency (<200 Hz) noise emissions.

11.113 Describe how the proposed activity would be managed to be consistent with best practice environmental management for the activity. Where a government plan is relevant to the activity, or the site where the activity is proposed, describe the activity's consistency with that plan.

11.114 Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed.

4 Existing Acoustic Environment

The existing acoustic environment was measured at four representative locations located near the mine site. The following report sections describe noise measurement methodology, results and meteorology during the monitoring period.

4.1 Noise Measurement Methodology

Long term (unattended) noise monitoring was conducted onsite over 9 days, between Tuesday 8 and Wednesday 16 August, 2017.

The four noise loggers were located onsite as presented in Figure 3:

- Logger L1: Deverill, approx. 2.2 km north-east of the proposed CHPP;
- Logger L2: Vermont Park, approx. 12.2 km east of the proposed CHPP;
- Logger L3: Old Bombandy, approx. 40.6 km south-east of the proposed CHPP; and
- Logger L4: Willunga, approx. 32.2 km south-east of the proposed CHPP.

Table 2 below presents the GPS coordinates of the four long term noise monitoring locations.

Table 2: Long Term Noise Monitoring Locations

Logger	Description	Coordinates in Universal Transverse Mercator (UTM)	
		Easting (m)	Northing (m)
L1	Deverill (2.2 km east of CHPP)	642276 E	7548160 S
L2	Vermont Park (12.2 km south east of CHPP)	647175 E	7537864 S
L3	Old Bombandy (40.6 km south east of CHPP)	668312 E	7518548 S
L4	Willunga (32.2 km south east of CHPP)	666990 E	7529872 S

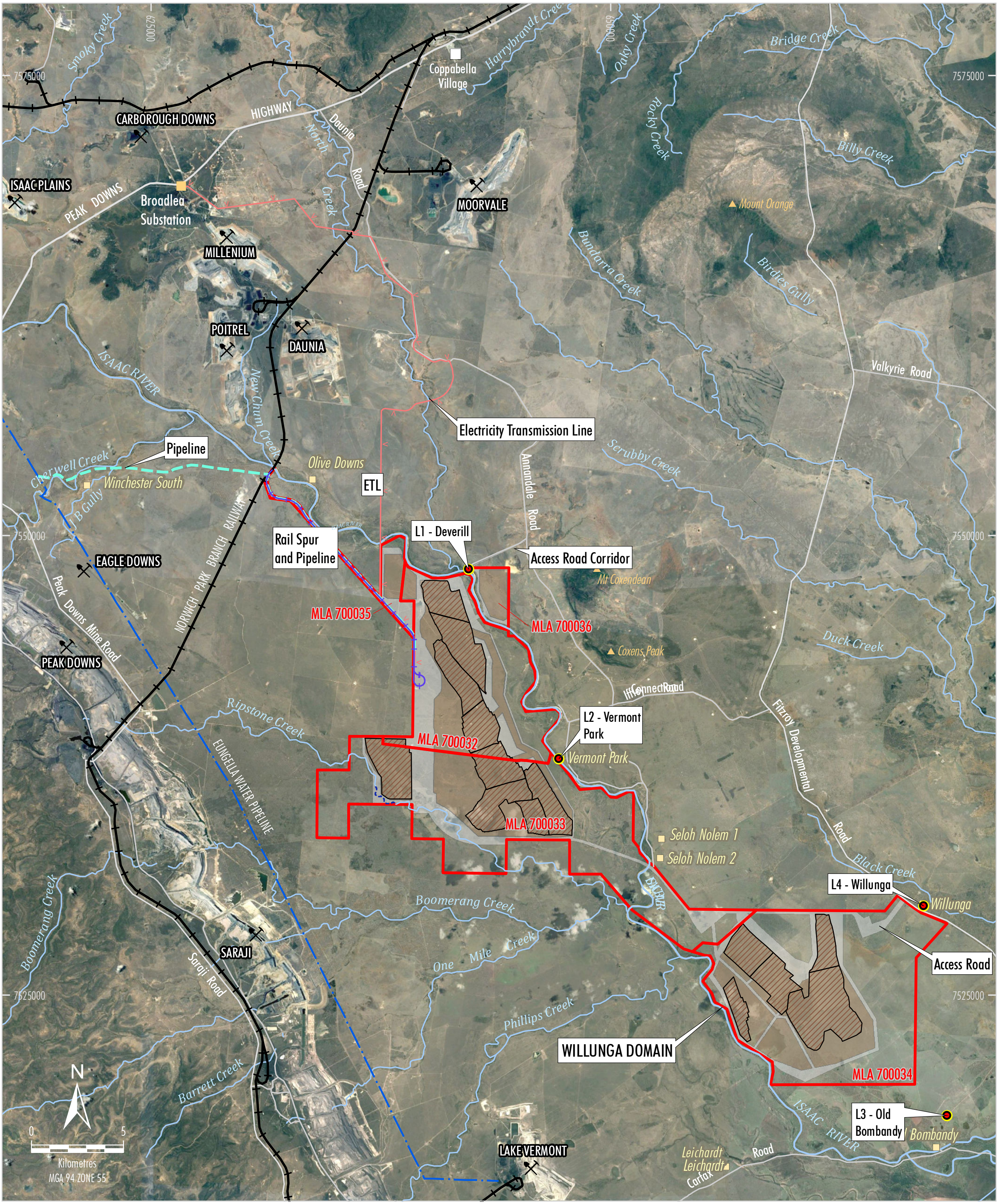
In each instance the logger's microphone was positioned at a height of 1.5 m above the ground and in the free field (well away from buildings and structures).

The test instrumentation consisted of:

- Logger L1 - Portable noise logger NTi XL2 (S/N: A2A-02422-D0);
- Logger L2 - Portable noise logger NTi XL2 (S/N: A2A-03909-D1);
- Logger L3 - Portable noise logger RTA-03 (S/N: 001);
- Logger L4 - Portable noise logger RTA-02 (S/N: 039); and
- Acoustical calibrator Bruel & Kjaer Type 4230 (S/N: 1206747).

A noise logger consists of a sound level meter and a computer housed in a weather resistant enclosure. Ambient noise levels were recorded at a rate of 10 samples per second. Every 15 minutes, the data is processed statistically and stored in memory.

Figures 4 to 7 present the long term noise monitoring locations.



LEGEND

- Mining Lease Application Boundary
- Monitoring Location
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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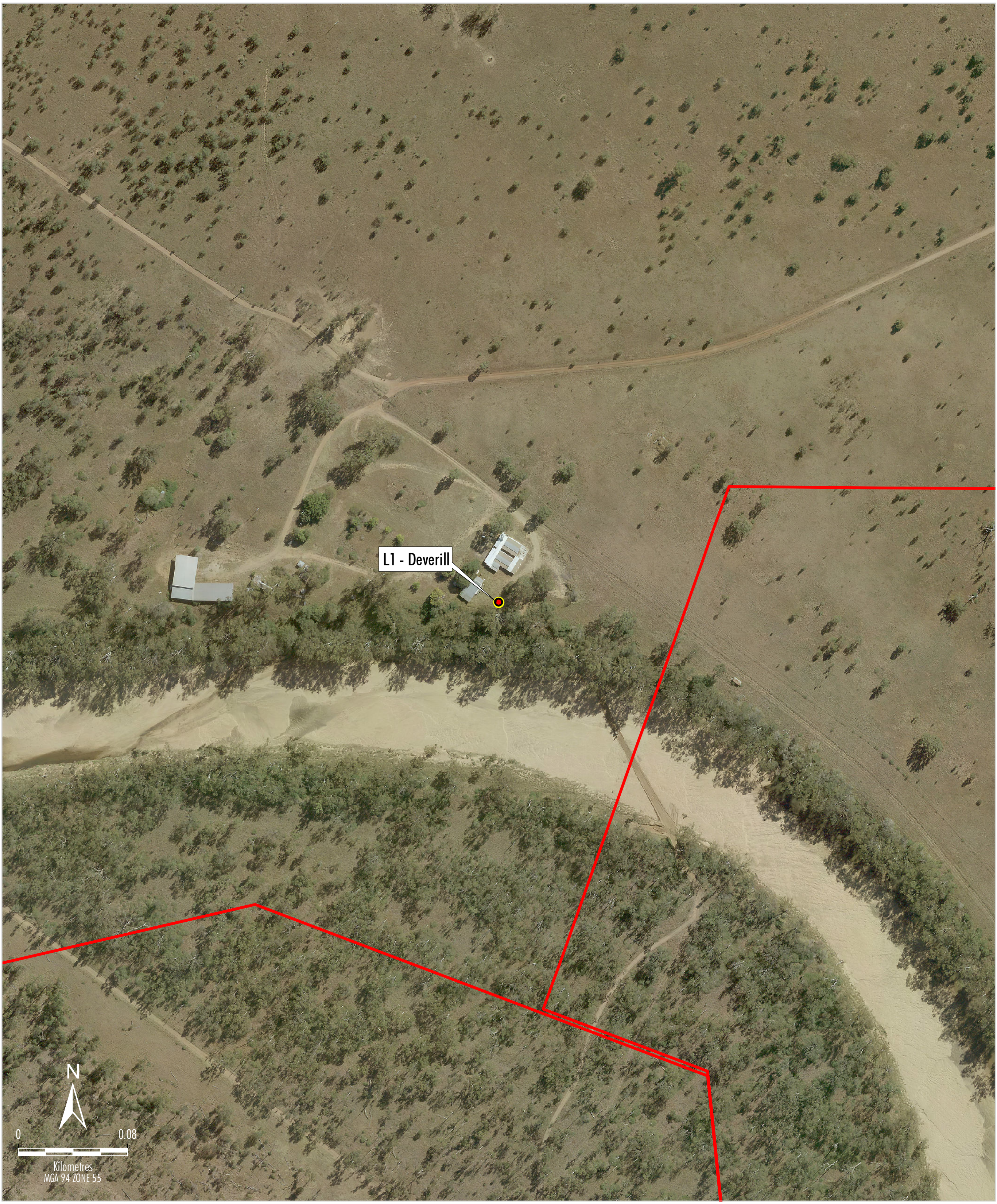
OLIVE DOWNS COKING COAL PROJECT

Noise Monitoring Locations

Figure 3



LEGEND
Mining Lease Application Boundary
Noise Monitoring Location

Orthophotography: Pembroke (2017)

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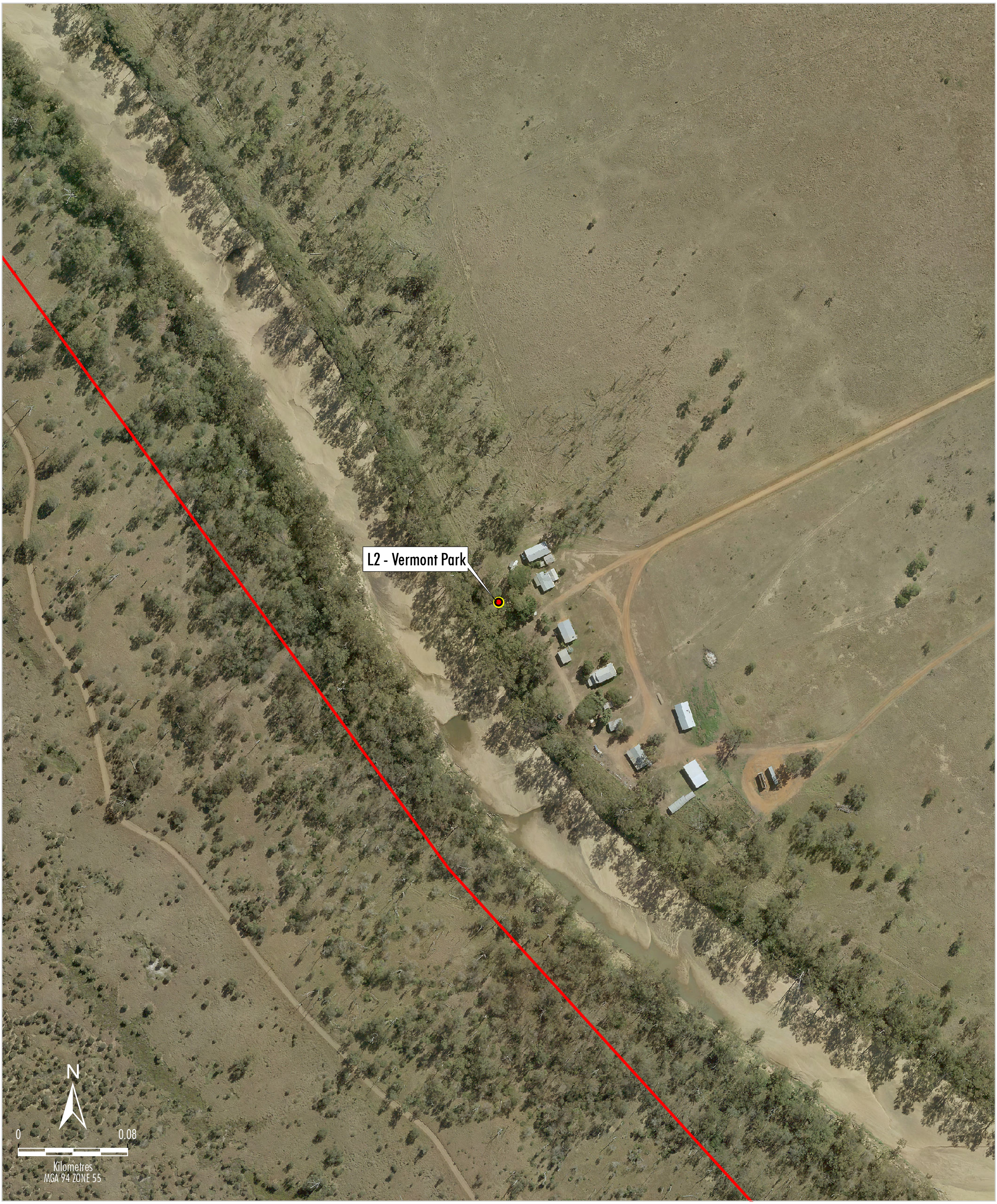
Noise Monitoring Location
L1 - Deverill

Figure 4



LEGEND

Mining Lease Application Boundary

Noise Monitoring Location

Orthophotography: Pembroke (2017)

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Noise Monitoring Location
L2 - Vermont Park

Figure 5

LEGEND

Noise Monitoring Location

Orthophotography: Pembroke (2017)

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Noise Monitoring Location
L3 - Old Bombandy

Figure 6

LEGEND

Mining Lease Application Boundary

Noise Monitoring Location

Orthophotography: Pembroke (2017)

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Noise Monitoring Location
L4 - Willunga

Figure 7

The equipment used for noise measurements was a combination of class 1 and class 2 instruments having accuracy suitable for field and laboratory use.

The instrument was calibrated prior and subsequent to measurements using a Bruel & Kjaer Type 4230 calibrator. No significant drift in calibration was observed. All instrumentation complies with Australian Standard (AS) IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and carries current National Association of Testing Authorities, Australia (NATA) certification (or if less than 2 years old, manufacturers certification).

The unattended loggers were synchronised to each other and configured to capture noise levels over identical 15 minute intervals (T).

4.2 Noise Montoring Results

Tables 3 to 5 present ambient (i.e. all noise sources) noise levels measured over nine days at logger locations L1, L2 and L3, respectively. The data obtained at logger location L4 (Willunga) was corrupt and has therefore not been presented.

Appendix A of this report presents a glossary of acoustical terminology used in this assessment.

Table 3: Summary of Ambient Noise Monitoring Results at Logger Location L1 (Deverill)

Date (Year 2017)	$L_{eq, T}$			$L_{1, T}$			$L_{90, T}$		
	Day[1]	Evening[1]	Night[1]	Day	Evening	Night	Day	Evening	Night
Tuesday 8 August	37	28	37	46	27	31	23	20	20
Wednesday 9 August	41	28	37	48	28	30	25	20	20
Thursday 10 August	45	-	39	50	-	32	28	-	20
Friday 11 August	42	28	39	47	33	33	25	23	20
Saturday 12 August	40	23	41	49	25	32	25	21	20
Sunday 13 August	45	-	42	52	-	30	26	-	20
Monday 14 August	42	-	40	48	-	33	24	-	20
Tuesday 15 August	44	-	36	53	-	32	25	-	20
Wednesday 16 August	43	-	-	51	-	-	26	-	-
Representative Levels	**42**	**27**	**39**	**49**	**28**	**32**	**25**	**20**	**20**

[1] Day = 7 am to 6 pm, Evening = 6 pm to 10 pm, Night = 10 pm to 7 am.

$L_{eq,T}$ = equivalent noise level over selected period of time, T.

$L_{1,T}$ = sound pressure level that is exceeded for 1% of selected period of time, T.

$L_{90,T}$ = sound pressure level that is exceeded for 90% of selected period of time, T.

Table 4: Summary of Ambient Noise Monitoring Results at Logger Location L2 (Vermont Park)

Date (Year 2017)	$L_{eq, T}$			$L_{1, T}$			$L_{90, T}$		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Tuesday 8 August	47	34	39	54	36	32	27	22	19
Wednesday 9 August	50	30	42	54	30	32	28	19	18
Thursday 10 August	46	42	44	55	45	34	31	30	20
Friday 11 August	45	49	42	54	54	37	30	24	23

Date (Year 2017)	$L_{eq, T}$			$L_{1, T}$			$L_{90, T}$		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Saturday 12 August	45	48	44	55	52	34	31	24	18
Sunday 13 August	47	46	44	57	49	33	31	24	19
Monday 14 August	47	55	45	55	69	33	30	29	20
Tuesday 15 August	45	49	46	55	65	37	30	27	19
Wednesday 16 August	47	-	-	58	-	-	32	-	-
Representative Levels	**47**	**44**	**43**	**55**	**50**	**34**	**30**	**24**	**19**

Table 5: Summary of Ambient Noise Monitoring Results at Logger Location L3 (Old Bombandy)

Date (Year 2017)	$L_{eq, T}$			$L_{1, T}$			$L_{90, T}$		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Wednesday 9 August	47	30	42	57	35	30	28	20	17
Thursday 10 August	48	36	43	57	36	34	32	23	18
Friday 11 August	48	40	46	57	36	38	28	20	18
Saturday 12 August	48	35	49	58	42	36	28	24	18
Sunday 13 August	46	40	40	54	42	34	26	23	18
Monday 14 August	46	-	42	56	-	35	26	-	19
Tuesday 15 August	46	-	40	55	-	34	25	-	20
Wednesday 16 August	47	-	-	56	-	-	30	-	-
Representative Levels	**47**	**38**	**43**	**56**	**40**	**34**	**28**	**22**	**18**

Ambient noise levels at all noise logging locations were considered rural in nature. Observations during our site inspections and playback of audio recordings noted that noise was mainly due to birds, insects and wind (rustling of leaves in trees) .

Analysis of the evening noise data indicates that noise levels were heavily influenced by noise generated by insect activity typically between 6 pm and 10 pm. Noise from insects was removed from data analysis.

Although logger location L4 (Willunga) is located close to Fitzroy Development Road, the lowest background noise levels are expected to be similar to the other sites.

Appendix G of this report presents ambient noise levels measured over 9 days in graphical format.

4.3 Meteorology Effects

Weather information was obtained from the Iffley Weather Station for the 9 day monitoring period. The meteorological conditions were conducive for measuring noise under typical conditions.

No rainfall and some light breezes (less than 5 metres per second [m/s]) were observed during the monitoring period. Noise data acquired during days that may have experienced wind conditions greater than 5m/s conditions were compared to the data acquired during fine periods, and where the data was found to be affected by adverse weather conditions it was discarded from further analysis.

4.4 Operator Attended Noise Monitoring

Operator attended noise measurements were conducted at three locations between 10.00 pm and 11.45 pm on Tuesday 8 August 2017.

The test instrumentation consisted of:

- portable noise logger NTi XL2 (S/N: A2A-05714-E0); and
- acoustical calibrator Bruel & Kjaer Type 4230 (S/N: 1206747).

The instrumentation complies with either AS 1259 "Sound Level Meters" (now superseded) or AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters".

The instrument was calibrated prior and subsequent to measurements using the Bruel & Kjaer Type 4230 calibrator. No significant drift in calibration was observed. All equipment carries current NATA certification (or if less than 2 years old, manufacturers' certification).

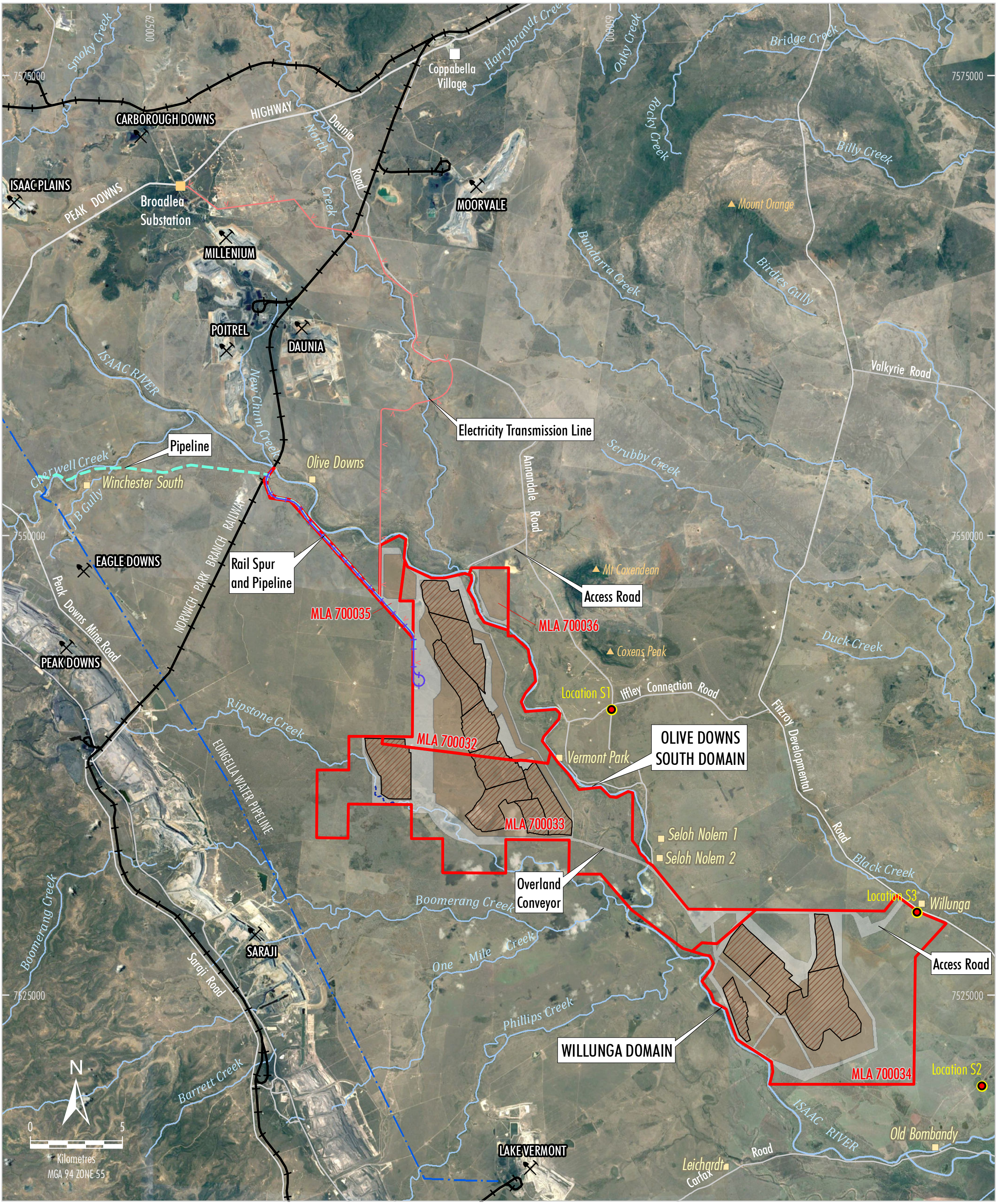
Table 6 presents GPS coordinates for operator attended noise measurements.

Table 6: Operator Attended Noise Monitoring Locations

Logger	Description	Coordinates in UTM	
		Easting (m)	Northing (m)
S1	Intersection Annadale, Iffley Connection and Vermont Park Roads	650104 E	7540655 S
S2	Fitzroy Development Road, unsealed road leading to Old Bombandy	671917 E	7523032 S
S3	Fitzroy Development Road, driveway to Willunga	666712 E	7529620 S

Figure 8 presents a locality map showing operator attended noise monitoring locations.

The operator attended noise monitoring results are provided in Appendix F.



LEGEND

- Mining Lease Application Boundary
- Operator Attended Noise Monitoring Location
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Operator Attended Noise Monitoring Locations

Figure 8

5 Noise & Vibration Objectives

The relevant noise legislation and guidelines for the Project include:

- *Environmental Protection Act 1994;*
- *Environmental Protection Regulation 2008;*
- *Environmental Protection (Noise) Policy 2008* (EPP [Noise]);
- Model Mining Conditions Guideline (Department of Environment and Heritage Protection [DEHP], 2017a);
- EcoAccess Guidelines - Planning for Noise Control Guideline (DEHP, 2016);
- EcoAccess Guideline - Assessment of Low Frequency Noise (Queensland Environmental Protection Agency, 2004); and
- Guideline: Application requirements for activities with noise impacts (DEHP, 2017b).

The *Environmental Protection Act 1994* and subordinate legislation (*Environmental Protection Regulation 2008* and *Environmental Protection [Noise] Policy 2008*) set environmental noise and vibration levels throughout Queensland.

The Department of Environment and Science (DES) (formerly the DEHP) provides the Model Mining Conditions Guideline (DEHP, 2017a) that sets allowable noise emissions from mining operations, commercial premises and industrial premises. The DES also provides other guidelines including EcoAccess Guideline - Planning for Noise Control Guideline (DEHP, 2016) and EcoAccess Guideline - Assessment of Low Frequency Noise (Queensland Environmental Protection Agency, 2004).

5.1 *Environmental Protection Regulation 2008*

The Terms of Reference require that the performance outcomes shown in Schedule 5, Table 1 of the *Environmental Protection Regulation 2008* can be demonstrated through the impact assessment process.

The environmental objective and performance outcomes specified in Schedule 5, Table 1 of the *Environmental Protection Regulation 2008* are presented in Table 7.

Table 7: Operational Assessment as per the *Environmental Protection Regulation 2008*

Noise
Environmental Objective The activity will be operated in a way that protects the environmental values of the acoustic environment
Performance Outcomes 1 Sound from the activity is not audible at a sensitive receptor. 2 The release of sound to the environment from the activity is managed so that adverse effects on environmental values including health and wellbeing and sensitive ecosystems are prevented or minimised.

After: *Environmental Protection Regulation 2008*.

5.2 *Environmental Protection (Noise) Policy 2008*

The statutory requirements for the control of environmental noise are set down in the EPP (Noise), which came into force on January 1, 2009. The EPP (Noise) includes noise limits for both the limiting of *background creep* and sets *acoustic quality objectives* which are *prescribed for enhancing or protecting the environmental value*….

The EPP (Noise) describes one of its primary goals is to preserve or enhance environmental values which are conducive to:

- protecting the health and biodiversity of ecosystems;
- the health and wellbeing of an individual, including the individual's opportunity to have sleep, study or learn, relaxation and conversation without unreasonable interference from intrusive noise; and
- the amenity of the community.

Acoustic quality objectives are nominated as indoor and outdoor goals for day time (7 am to 6 pm) and evening (6 pm to 10 pm) periods. The quality objectives also nominate indoor goals during the quieter night time (10 pm to 7 am) periods to address potential sleep disturbance or awakenings.

Table 8 presents the EPP (Noise) acoustic quality objectives for daytime and evening periods, and the adjusted night time periods for dwellings.

Table 8: Acoustic Quality Objectives (Schedule 1)

Location	Time of Day	Acoustic Quality Objectives (measured at the receptors) dBA			Environmental Value
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$	
Dwelling (for outdoors)	Daytime & evening	50	55	65	Health and wellbeing
Dwelling (for indoors)	Daytime & evening	35	40	45	Health and wellbeing
	Night time	30	35	40	Health and wellbeing in relation to the ability to sleep

After: EPP (Noise).

Notes: Daytime (7 am to 6 pm), evening (6 pm to 10 pm) and night time (10 pm to 7 am).

$L_{Aeq,adj, 1hr}$ = A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time.

$L_{A10 ,adj,1 hr}$ = A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 10% of a 1 hour period when measured using time-weighting 'F'.

$L_{A1 ,adj,1 hr}$ = A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 1% of a 1 hour period when measured using time-weighting 'F'.

For evaluation of noise predictions at the exterior of the building (i.e. outside), indoor objectives for night time periods are adjusted (i.e. increased) by 7 dBA (DEHP, 2016) to allow for the reduction of noise that would occur through the building with the windows open.

Table 9 presents operational noise limits outside a dwelling based on EPP (Noise) Schedule 1.

Table 9: Operational Noise Limits Outside Dwellings

EPP (Noise) Schedule 1	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
$L_{eq, adj, 1 hr}$	35 + 7 = 42dBA	35 + 7 = 42dBA	30 + 7 = 37dBA

As described above, Section 10 of the EPP (Noise) also includes background creep noise criteria:

10 Controlling background creep

To the extent that it is reasonable to do so, noise from an activity must not be—

(a) for noise that is continuous noise measured by $LA_{90,T}$—more than nil dB(A) greater than the existing acoustic environment measured by $LA_{90,T}$; or

(b) for noise that varies over time measured by $LA_{eq,adj,T}$—more than 5dB(A) greater than the existing acoustic environment measured by $LA_{90,T}$.

Tables 3, 4 and 5 show the representative measured background noise levels ($L_{A90, T}$) were lower than 30 dBA during the daytime, evening and night time periods. The Model Mining Conditions Guideline (DEHP, 2017a) (discussed further in Section 5.3) nominates that in the event that measured background ($L_{A90, adj, 15 mins}$) is less than 30 dBA, then 30 dBA can be substituted for the measured background level.

A recent Land Court of Queensland judgement (*New Acland Coal Pty Ltd v Ashman & Ors and Chief Executive, Department of Environment and Heritage Protection (No. 4) [2017] QLC 24*) determined that background creep noise limits should be based upon minimum deemed background noise levels plus 5 dBA for daytime, evening and night time periods.

Table 10 presents background creep noise limits outside a dwelling based on EPP (Noise) Section 10 and the determination of the Land Court judgement (as described above).

Table 10: Background Creep Noise Limits outside Dwellings

EPP Noise Schedule 10	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
$L_{eq, adj, 15 mins}$	30 + 5 = 35dBA	30 + 5 = 35dBA	30 + 5 = 35dBA

5.3 Model Mining Conditions Guideline

Schedule D – Noise of the Model Mining Conditions Guideline (ESR/2016/1936 • Version 6.01 • Effective: 07 MAR 17) (DEHP, 2017a) sets noise limits for mining activities.

Condition D1 nominates that:

The holder of this environmental authority must ensure that noise generated by the mining activities does not cause the criteria in Table D1 – Noise limits to be exceeded at a sensitive place or commercial place.

Table D1, referred to in Condition D1, is reproduced below as Table 11.

Table 11: Noise Limits (Table D1 in Schedule D – Noise)

Sensitive Place						
Noise Level dBA measured as:	**Monday to Saturday**			**Sundays and Public Holidays**		
	7 am to 6 pm	**6 pm to 10 pm**	**10 pm to 7 am**	**7 am to 6 pm**	**6 pm to 10 pm**	**10 pm to 7 am**
$L_{Aeq, adj 15 mins}$	CV = 50 AV = 5	CV = 45 AV = 5	CV = 40 AV = 0	CV = 45 AV = 5	CV = 40 AV = 5	CV = 35 AV = 0
$L_{A1, adj 15 mins}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5
Commercial Place						
Noise Level dBA measured as:	**Monday to Saturday**			**Sundays and Public Holidays**		
	7 am to 6 pm	**6 pm to 10 pm**	**10 pm to 7 am**	**7 am to 6 pm**	**6 pm to 10 pm**	**10 pm to 7 am**
$L_{Aeq, adj 15 mins}$	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5

After: DEHP, 2017a

Note: dBA = A-weighted decibels; L_{Aeq} = A-weighted equivalent noise level.

Table D1 –Noise limits notes:

1. *CV = Critical Value*
2. *AV = Adjustment Value*

3. *To calculate noise limits in Table D1:*

   If bg ≤(CV –AV): *Noise limit = bg + AV*

   If (CV –AV) < bg ≤CV: *Noise limit = CV*

   If bg > CV: *Noise limit = bg + 0*

4. *In the event that measured bg (**$L_{A90, adj, 15 mins}$**) is less than 30 dB(A), then 30 dB(A) can be substituted for the measured background level*
5. *bg = background noise level (**$L_{A90, adj, 15 mins}$**) measured over 3-5 days at the nearest sensitive receptor*
6. *If the project is unable to meet the noise limits as calculated above alternative limits may be calculated using the processes outlined in the "Planning for Noise Control" guideline.*

Monitoring and reporting

Condition D3 nominates that:

Noise monitoring and recording must include the following descriptor characteristics and matters:

a) *$L_{AN,T}$ (where N equals the statistical levels of 1, 10 and 90 and T = 15 mins)*
b) *background noise LA90*
c) *the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels*
d) *atmospheric conditions including temperature, relative humidity and wind speed and directions*
e) *effects due to any extraneous factors such as traffic noise*
f) *location, date and time of monitoring*
g) *if the complaint concerns low frequency noise, Max LpLIN,T and one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range.*

Applicable noise limits

Table 12 presents applicable noise limits based on the Model Mining Conditions Guideline noise limits shown in Table 11 and measured background levels shown in Tables 3 to 5.

Table 12: Applicable Noise Limits (based on Table D1 in Schedule D – Noise)

Sensitive Place						
Noise Level dBA measured as:	**Monday to Saturday**			**Sundays and Public Holidays**		
	7 am to 6 pm	**6 pm to 10 pm**	**10 pm to 7 am**	**7 am to 6 pm**	**6pm to 10 pm**	**10 pm to 7 am**
$L_{Aeq, adj 15 mins}$	CV = 50 AV = 5 CV – AV = 45 Bg = 30 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 35	CV = 45 AV = 5 CV – AV = 40 Bg = 25 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 35	CV = 40 AV = 0 CV – AV = 40 Bg = 19 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 30	CV = 45 AV = 5 CV – AV = 40 Bg = 30 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 35	CV = 40 AV = 5 CV – AV = 35 Bg = 25 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 35	CV = 35 AV = 0 CV – AV = 35 Bg = 19 Take 30 dBA bg ≤(CV –AV) NL = bg + AV NL = 30

Based on the rural land zoning, a noise limit of 35 dBA $L_{eq,\ adj\ 15\ mins}$ would apply for the day and evening periods, and a noise limit of 30 dBA $L_{eq,\ adj\ 15\ mins}$ would apply for the night time period at receptor locations.

5.4 Blasting Noise & Vibration

The Model Mining Conditions Guideline (DEHP, 2017a) includes noise and vibration limits for blasting operations. Table 13 presents an extract from the Model Mining Conditions Guideline showing noise and vibration limits for blasting operations.

Table 13: Blasting Noise & Vibration Limits (Table D2 in Schedule D – Model Mining Conditions Guideline)

Blasting Emission	Sensitive or commercial Blasting noise & vibration limits	
	7 am to 6 pm	6 pm to 7 am
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm
Ground vibration peak particle velocity	5 millimetres per second (mm/s) peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm

After: Model Mining Conditions Guideline (2017a).

5.5 Planning for Noise Control

The Planning for Noise Control Guideline (DEHP, 2016) is older than the Model Mining Conditions Guideline and includes some relevant guidance not included in the Model Mining Conditions Guideline.

Relevant parts of the Planning for Noise Control Guideline have been applied to the Project including use of information regarding meteorological effects, noise adjustment factors and sleep disturbance.

Meteorological Effects

The Planning for Noise Control Guideline (DEHP, 2016) specifies that the prevailing and worst case meteorological conditions (wind, temperature, humidity and temperature inversions) at the planned development and receiver locations must be determined. The Planning for Noise Control Guideline describes that noise levels should be calculated at receiver locations for a range of typical operating scenarios and conditions that are representative of the proposed facility, including worst case meteorological conditions.

Wind effects should be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver winds (at 10 m height) of less than or equal to 3 metres per second (m/s) occur for 30% of the time or more in any assessment period (day, evening, night) in any season.

There are generally two methods to assess wind effects:

- Use available wind data or wind roses to determine the frequency of occurrence and wind speed, taking into account the various components of wind that are relevant.
- Simply assume that wind is a feature of the area (foregoing the need to use wind data or wind roses) and apply a 'maximum impact' scenario by using the default 3 m/s wind at 10 m height.

Where there is 30% or more occurrence of wind speeds below 3 m/s (source-to-receiver component), then the highest wind speed is used (below 3 m/s) instead of the default. Where there is less than a 30% occurrence of wind up to 3 m/s (source-to-receiver component), wind is not included in the noise prediction calculations.

An occurrence of temperature inversions of 30% of the total night time period during winter (June, July and August) is selected by the Planning for Noise Control Guideline as representing a significant noise impact warranting further assessment.

There are two options for determining temperature inversion parameters:

- use default parameters for temperature inversions and drainage flow wind speed where inversions are present for at least 30% of the total night time during winter as specified; or
- use parameters determined by direct measurement. Wind data should be collected at 10 m height.

The default inversion parameters for non-arid areas (annual average rainfall greater than 500 mm), as is the case for the Project, are:

- moderate (F-class stability category) inversions; and
- 3 degrees Celsius per 100 metres (°C/100 m) temperature inversion strength for all receivers plus a 2 m/s source to receiver component drainage flow wind speed for those receivers where applicable.

Noise Adjustment Factors

K_1= Tonal adjustment (noise contains distinguishable, discrete, continuous whine, hiss, screech, hum).

K_2= Impulsive adjustment (noise contains distinct impulses such as bangs, clicks, clatters or thumps).

Subjectively for K1 and K2:

If just detectable:	subtract 2 dBA.
If prominent (clearly audible):	subtract 5 dBA.

These factors are particularly relevant during the noise compliance stage of the Project. If the noise emissions are audible at the nearest receptor noise adjustments may be necessary. If a tonal or impulsive characteristic is just detected at the measurement position then 2 dBA should be added to the measured noise levels. If a tonal or impulsive characteristic is clearly detected at the measurement position then 5 dBA should be added to the measured noise levels.

It is not expected that tonal or impulsive noise characteristics would be detected at the nearest sensitive receptors to the Project. Therefore tonal or impulsive adjustments have not been applied in this assessment.

Sleep Disturbance

The Planning for Noise Control Guideline (DEHP, 2016) recommends that, for good sleep over eight hours, the indoor sound pressure level measured as an instantaneous value should not exceed approximately 45 dBA maxL_{pA} more than 10 – 15 times per night.

The corresponding external noise level, assuming partially closed windows, is 52 dBA maxL_{pA} (maximum instantaneous noise level) measured in the free field (4 m from the façade of a building). This criterion only applies to the night time period between 10 pm and 7 am.

5.6 Low Frequency Noise Criteria

The Assessment of Low Frequency Noise guideline (Queensland Environmental Protection Agency, 2004) is applicable to low frequency noise (frequencies less than 200 Hertz [Hz]) emitted from commercial premises, industrial premises, mining and extractive operations.

Where noise emissions show low frequency, the overall sound pressure level inside residences should not exceed 50 dBZ to avoid complaints of low frequency noise annoyance.

We note 50 dBZ is an internal noise limit. A correction of 5 dBZ (open window) is assumed for outside to inside the building through an open window. For low frequency noise (< 200Hz) the external noise limit should be 55 dBZ measured in the free field (4 m from the façade of a building).

5.7 Road Traffic Noise

The Department of Transport and Main Roads (TMR) *Transport Noise Management Code of Practice* (2013) provides a noise limit of $L_{10\ (18hr)}$ 68 dBA at noise sensitive receptors for existing roads and road upgrades.

5.8 Rail Noise

The Planning Levels for airborne noise from railway activities (train movements) are retained as $L_{eq\ (24hour)}$ 65 dBA and Single Event Maximum 87 dBA maxL_p and are now within Queensland Rail's (QR's) *Safety and Environmental Management System*. Previously the Planning Levels were detailed in QR's Code of Practice for Railway Noise.

5.9 Proposed Noise & Vibration Objectives for the Project

A recent Land Court of Queensland judgement (*New Acland Coal Pty Ltd v Ashman & Ors and Chief Executive, Department of Environment and Heritage Protection (No. 4) [2017] QLC 24*) determined that the most appropriate noise limits are based on background creep noise limits from the EPP (Noise) Section 10, rather than the Model Mining Conditions Guideline (DEHP, 2017a).

Table 14 summarises the operational noise objectives for the Project based on the Land Court of Queensland judgement (as described above).

Table 14: Summary of Relevant Noise Limits (external)

Noise Issue	Applicable Time Period	Relevant Noise Limit
Operations[1]	Daytime (7 am to 6 pm)	35 dBA $L_{Aeq,\ adj\ 15\ mins}$
	Evening (6 pm to 10 pm)	35 dBA $L_{Aeq,\ adj\ 15\ mins}$
	Night time (10 pm to 7 am)	35 dBA $L_{Aeq,\ adj\ 15\ mins}$
Sleep Disturbance[2]	Night time (10pm to 7am)	52 dBA $maxL_p$
Low Frequency[3]	All Periods	55 dBZ
Road Traffic	6am to 12 midnght	68 dBA $L_{eq,\ 18\ hour}$
Rail Traffic	All Periods	65 dBA $L_{Aeq,\ 24\ hours}$ 87 dBA $maxL_p$

After: [1] Section 10, EPP (Noise). [2] Planning for Noise Control Guideline (DEHP, 2016). [3] Assessment of Low Frequency Noise (Queensland Environmental Protection Agency, 2004).

dBA = A-weighted decibels. $L_{Aeq,\ adj\ 15\ mins}$ = Equivalent sound level over a 15 minute period, adjusted for tonal/impulsive noise as required.

$maxL_{pA}$ = maximum instantaneous noise level.

dBZ = Z-weighted decibels.

Table 15 summarises the blasting noise and vibration objectives for the Project.

Table 15: Summary of Blasting Noise & Vibration Objectives

Blasting Emission	Sensitive or Commercial Blasting Noise & Vibration Objectives	
	7 am to 6 pm	6 pm to 7 am
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm
Ground vibration peak particle velocity	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/s peak particle velocity at any time	Either no blasting or limits justified by proponent not less stringent than 7 am – 6 pm

After: Model Mining Conditions Guideline (2017a).

6 Noise Impact Assessment

6.1 Calculation Methodology

Noise levels were predicted by modelling the noise sources, receiver locations and topographical features of the intervening area using the Cadna (version 2018) noise prediction computer program. Cadna is an internationally recognised environmental noise prediction computer program that can be used to model transportation noise, construction noise and general industry noise. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction models takes into account:

- location of noise sources and receiver locations;
- height of sources and receivers;
- separation distances between sources and receivers;
- ground type between sources and receivers;
- attenuation from barriers (natural and purpose built); and
- meteorological effects.

All predictions have been conducted in accordance with ISO 9613 (1996) Acoustics – Attenuation of sound propagation outdoors.

6.2 Meteorological Effects

Certain meteorological conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves will occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

Temperature inversions occurring within the lowest 50 m to 100 m of atmosphere can affect noise levels measured on the ground. Temperature inversions are most commonly caused by radiative cooling of the ground at night leading to the cooling of the air in contact with the ground. This is especially prevalent on cloudless nights with little wind. Air that is somewhat removed from contact with the ground will not cool as much, resulting in warmer air aloft than nearer the ground.

Similarly, when significant wind exists, the conditions can significantly affect noise levels at receptor points downwind of a noise source. This would depend, however, on the particular direction and the velocity of the wind at that time. It should also be noted that although wind can raise noise levels as perceived from a downstream assessment point, background noise also tends to increase as a result of increased wind activity. This often causes masking of potential increases in intrusive noise.

6.2.1 Wind Effects

Gradient wind differs from the drainage-flow wind associated with temperature inversions. Drainage-flow wind is the localised drainage of cold air under the influence of the local topography, and travels in one direction only (direction of decreasing altitude). Gradient wind is the regional wind determined by synoptic factors (high and low-pressure systems), and may originate from any direction.

Unlike temperature inversions, gradient winds may cause impacts during any assessment period, (day, evening, night), and not just the night period.

A review of long term wind effects in the local area was undertaken in order to determine predominant wind directions and flows.

Our analysis of the wind roses (refer to Appendix C) concluded that wind effects were not a particular feature of the area. That is, source to receiver winds (at 10 m height) of equal to or less than 3m/s do not occur for 30% of the time or more in any assessment period (day, evening, night) in any season. For the Project we have therefore not used the default wind effects parameter of 3 m/s.

6.2.2 Temperature Inversions

An occurrence of 30% of the total night time period during winter (June, July and August) is selected by the Planning for Noise Control Guideline (DEHP, 2016) as representing a significant noise impact warranting further assessment.

There is no specific meteorological data available for the Project area to determine if temperature inversions occur for more than 30% of the total night time period during winter (June, July and August). The default inversion parameters have been conservatively adopted for modelling purposes as follows:

Non-arid areas (annual average rainfall greater than 500mm):

- Moderate (F-class stability category) inversions; and
- 3°C/100 m temperature inversion strength for all receivers plus a 2 m/s source to receiver component drainage flow wind speed for those receivers where applicable.

In the absence of specific data for temperature inversion around the site we have adopted the default inversion parameters listed above for assessment purposes. That is, a Moderate (F-class) stability category and a 2 m/s source to receiver component drainage flow wind speed blowing from the north-west (315°) have been adopted.

6.3 Operations Noise

6.3.1 Noise Modelling Scenarios

Four operational scenarios have been selected for noise modelling purposes, years 2027, 2043, 2066 and 2085. These scenarios were selected in consideration of the scale of mining operations in each year of the Project, number of major mobile equipment and proximity of operations to sensitive receivers. Fleet locations showing the haul truck and excavator/shovel locations were provided for the selected years by Pembroke Resources South.

The scenarios are expected to generate the highest noise levels at the nearest receptors based on the number of mining plant and locations. As the mine pit depth increases, noise emissions from some plant sources would decrease due to additional noise shielding from the pit walls. The selected operational scenarios are considered to be representative of the proposed mining operations in terms of noise emissions and therefore suitable for assessment purposes.

A separate construction-only scenario has not been modelled independently of the operational scenarios, however an assessment of potential impacts has been completed. For the following reasons, potential construction noise impacts would be materially less than the operational scenarios assessed:

- noise sources would be concentrated in the vicinity of the mine infrastructure area and CHPP (more than 12 km from the nearest receptor) and hence much further from the nearest receptors than the operational scenarios assessed (where some noise sources are within 5 km from the nearest receptor); and
- the number of major mobile equipment in operation (e.g. less than 20 items of mobile plant) would be significantly less than the operational scenarios assessed (i.e. 53 to 235 items of mobile plant).

6.3.2 Fleet Locations & Numbers

Table 16 presents a summary of the typical Project mining fleet during the selected modelling years.

Table 16: Indicative Fleet Numbers for Selected Years

Fleet/ Infrastructure Item	Indicative Model	Location / Function	Year 2027	Year 2043	Year 2066	Year 2085
Excavators	Leibherr R9800	800 tonne (t) Waste Excavator	4	19	6	3
	Hitachi EX3600	350 t Coal Excavator	1	4	3	2
Haul Trucks	Leibherr T284	Waste Haul Truck	25	114	45	18
	Cat 789	Coal Haul Truck	6	33	25	16
Drill	Sandvik D90KS	Drill	3	11	6	2
Dozers	Caterpillar D11T	Dump Support	3	11	6	2
	Caterpillar D11T	Coal and Partings Preparation	1	5	2	2
	Caterpillar D10T	Drill Preparation and Pit Support	1	5	2	2
	Caterpillar D10T	Excavator Support	3	11	6	2
Grader	Caterpillar 24M	Haul Roads	3	11	6	4
Water Truck	Caterpillar 785D	Haul Roads	3	11	6	4

6.3.3 Indicative Fleet Locations & Haul Routes

Appendix B presents the indicative fleet locations used for modelling Years 2027, 2043, 2066 and 2085.

6.3.4 Sound Power Levels

Noise data for the indicative Project mining equipment (both fixed and mobile) used in the model is presented in Table 17 as octave band frequency data (in dBZ) and overall sound power level (in dBA).

Table 17: Indicative Sound Power Levels for Project Mining Equipment

Plant Item[1]	Octave band centre frequency – Hz (dBZ)								Overall dBA
	63	125	250	500	1k	2k	4k	8k	
Leibherr R9800	110	111	110	107	106	103	98	88	111
Hitachi EX3600	111	105	100	100	111	111	106	98	115
Leibherr T284	112	111	112	114	112	112	106	101	117
Cat 789	125	125	120	116	111	108	102	97	118
Sandvik D90KS	112	114	114	113	113	112	109	104	115
Caterpillar D11T	110	108	110	104	102	100	95	88	116
Caterpillar D10T	111	117	113	114	112	108	102	97	116
Caterpillar 24M	102	118	113	112	110	107	101	95	121
Caterpillar 785D	114	120	115	116	114	113	109	97	119
CHPP	122	122	117	114	111	108	102	95	117
Dump Hopper + Sizers	109	107	107	108	105	100	93	83	109
Overland Conveyor Drive Stations	115	111	105	103	99	93	86	79	105
Overland Conveyor Mid Drive	115	111	105	103	99	93	86	79	105
Overland Conveyor Tail Station	115	111	105	103	99	93	86	79	105
Overland Conveyor (per metre)	80	81	81	83	77	72	63	55	82
Train Loading Bin	107	109	103	99	97	94	92	82	103
Coal Stockpile Bulldozer	111	117	113	114	112	108	102	97	116
Dump Hopper + Crushing	115	116	111	111	107	102	95	88	112
Train on rail spur	108	105	101	100	101	103	100	97	108
Overland Conveyor (per metre) – mitigated by 10dBA	70	71	71	73	67	62	53	45	72
Overland Conveyor (per metre) – mitigated by 20dBA	60	61	61	63	57	52	43	35	62
Cat 789 – mitigated by 5dBA	120	120	115	111	106	103	97	92	113
Cat 789 – mitigated by 7dBA	118	118	113	109	104	101	95	90	111
Caterpillar D10T – mitigated by 5dBA	106	112	108	99	107	103	97	92	111
Sandvik D90KS – mitigated by 5dBA	107	109	109	108	108	107	104	99	110
Leibherr T284 – mitigated by 5dBA	107	106	107	109	107	107	101	96	112
Leibherr T284 – mitigated by 7dBA	105	104	105	107	105	105	99	94	110
Caterpillar 24M – mitigated by 5dBA	97	113	108	107	105	102	96	90	116
Caterpillar 785D – mitigated by 5dBA	109	115	110	111	109	108	104	92	114

[1] - Model numbers are indicative only.

6.3.5 Predicted Operational Noise Levels

Project noise levels for the operational years 2027, 2043, 2066 and 2085 were predicted at the nearest residential receptors previously discussed in Section 2.4.

Noise reductions from the source to receiver typically resulted from distance attenuation, air absorption, ground absorption and shielding afforded by intervening natural and constructed topography. Noise control treatment was also included in the noise modelling.

Appendix E presents noise contour maps for the Year 2027, 2043, 2066 and 2085 modelling scenarios under neutral and adverse weather conditions.

6.3.6 Neutral Weather Conditions

Table 18 presents predicted operational noise levels at each receptor. The $L_{eq,\ adj\ 15\ mins}$ values are A-weighted and correspond to the way the human ear responds to sounds at different frequencies.

Table 18 shows noise levels during neutral weather conditions (i.e. calm conditions) are predicted to be below the day, evening and night noise objectives of 35 dBA $L_{eq,\ adj\ 15\ mins}$ at all receptors with the proposed mitigation measures (refer to Section 7.1 and Appendix D for further details).

Table 18 –Predicted Operational Noise Levels ($L_{eq,\ adj\ 15\ mins}$) at the Nearest Noise Sensitive Receptors (Neutral Weather Conditions) - dBA

Receptor ID	Property Name	Operational Noise Levels, $L_{eq,\ adj\ 15\ mins}$			
		Year 2027	Year 2043	Year 2066	Year 2085
NSR1	Vermont Park	19	30	32	33
NSR2	Seloh Nolem 1	10	31	29	28
NSR3	Seloh Nolem 2	10	34	32	32
NSR4	Old Bombandy	-	20	17	12
NSR5	Willunga	-	23	22	27
NSR6	Leichardt	-	22	19	13

6.3.7 Adverse Weather Conditions

Table 19 presents predicted operational noise levels at each receptor.

Table 19 shows noise levels during adverse weather conditions are predicted to be at or below the 35 dBA $L_{eq,\ adj\ 15\ mins}$ (day, evening and night time periods) noise objectives at all receptors with the proposed noise mitigation measures (refer to Section 7.2 and Appendix D for further details).

Table 19 –Predicted Operational Noise Levels ($L_{eq, adj\ 15\ mins}$) at the Nearest Noise Sensitive Receptors (Adverse Weather Conditions) - dBA

Receptor ID	Property Name	Operational Noise Levels, $L_{eq, adj\ 15\ mins}$			
		Year 2027	Year 2043	Year 2066	Year 2085
NSR1	Vermont Park	24	35	35	33
NSR2	Seloh Nolem 1	15	33	34	31
NSR3	Seloh Nolem 2	15	35	34	34
NSR4	Old Bombandy	-	25	21	17
NSR5	Willunga	7	29	28	32
NSR6	Leichardt	-	28	24	18

6.4 Low Frequency Noise

Table 20 presents predicted low frequency operational noise levels for neutral weather conditions at each receptor. The values represent Z-weighted L_{eq} for frequencies less than 200 Hz.

Table 20 –Predicted Operational Noise Levels (L_{eq}) at the Nearest Noise Sensitive Receptors (Neutral Weather Conditions), dBZ (<200Hz)

Receptor ID	Property Name	Operational Noise Levels, L_{eq}			
		Year 2027	Year 2043	Year 2066	Year 2085
NSR1	Vermont Park	39	48	47	48
NSR2	Seloh Nolem 1	34	52	50	48
NSR3	Seloh Nolem 2	35	54	51	49
NSR4	Old Bombandy	-	42	40	35
NSR5	Willunga	25	45	43	49
NSR6	Leichardt	12	44	42	37

Table 20 shows low frequency noise (<200 Hz) is expected to comply with the noise limits of 55 dBZ (measured 4m from the building facade) at all receptors.

Table 21 presents predicted low frequency operational noise levels for adverse weather conditions at each receptor. The values represent Z-weighted L_{eq} for frequencies less than 200 Hz.

Table 21 shows low frequency noise (<200 Hz) is expected to comply with the noise limits of 55 dBZ (measured 4 m from the building facade) at all receptors.

Table 21 – Predicted Operational Noise Levels (L_{eq}) at the Nearest Noise Sensitive Receptors (Adverse Weather Conditions), dBZ (< 200Hz)

Receptor ID	Property Name	Operational Noise Levels, L_{eq}			
		Year 2027	Year 2043	Year 2066	Year 2085
NSR1	Vermont Park	44	51	49	48
NSR2	Seloh Nolem 1	40	52	51	48
NSR3	Seloh Nolem 2	41	54	52	50
NSR4	Old Bombandy	-	47	45	41
NSR5	Willunga	35	50	51	53
NSR6	Leichardt	22	49	47	43

7 Noise Mitigation Measures

The assessment methodology involved a review of reasonable and feasible mitigation measures that could be implemented to reduce noise emissions from the Project. The iterative steps undertaken are described below:

1. Preliminary noise modelling of scenarios representative of various stages of the Project (including stages when noise levels at sensitive receptors would be expected to be greatest) to identify the potential for noise exceedances (Appendix D).

2. Evaluation of various combinations of noise management and mitigation measures to assess their relative effectiveness.

3. Review of the effectiveness of these measures and assessment of their feasibility by Pembroke.

4. Adoption of management and mitigation measures to appreciably reduce noise emissions associated with the Project.

The adopted mitigation and management measures are described in Sections 7.1 and 7.2.

Potential noise management and mitigation measures that would achieve a reduction in Project noise levels under neutral and adverse meteorological conditions were evaluated with respect to the feasibility of implementing the measures for the Project. These measures included significant attenuation of a number of mobile plant and sections of the overland conveyor.

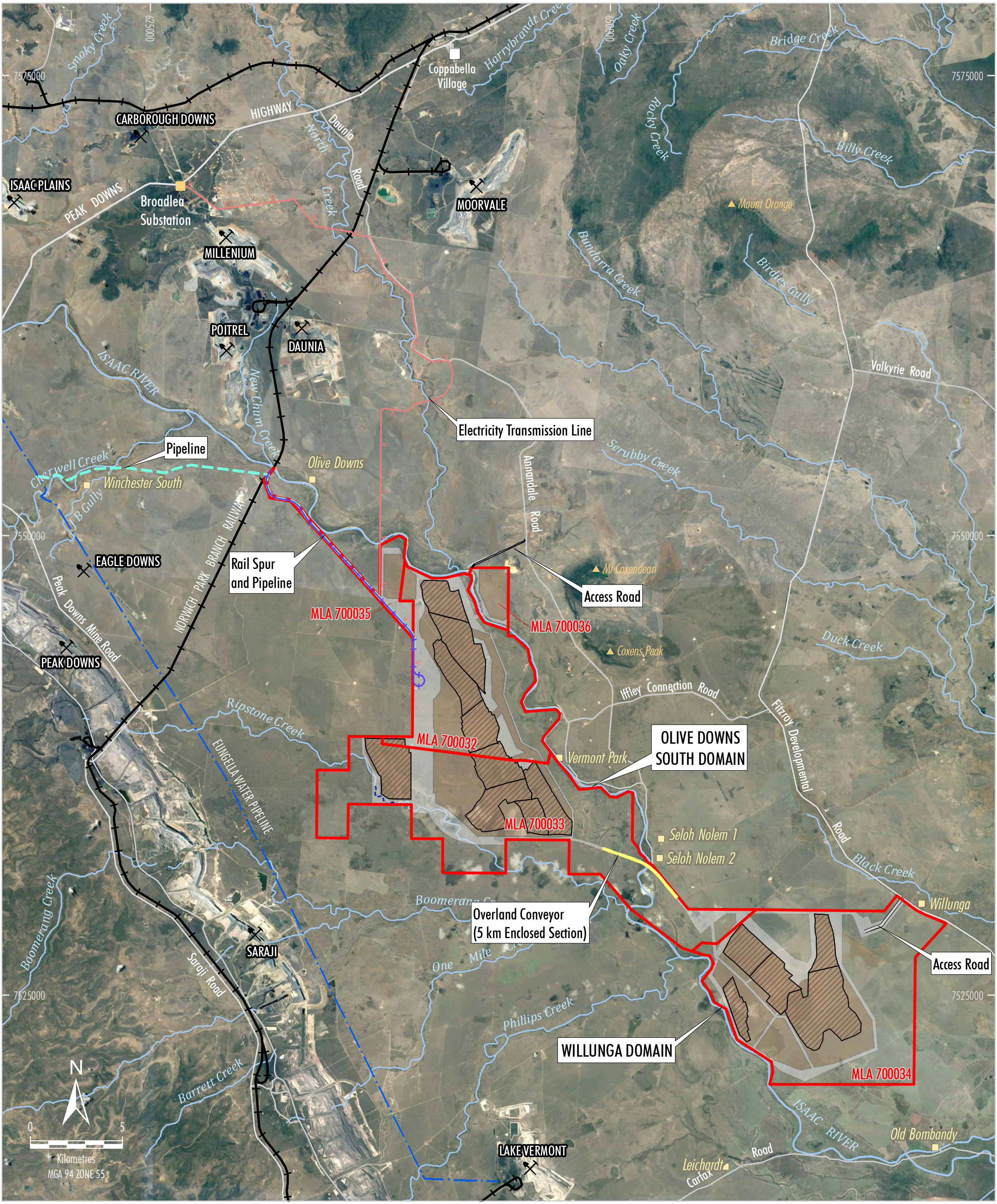
While technically feasible, measures to achieve the objective of reducing noise levels at the most-affected receivers were then evaluated in light of the relative costs and benefits that would arise, including potential receptor amenity benefits and corresponding capital and operating costs.

7.1 Neutral Weather Conditions

Our analysis of the noise model and noise source locations indicates that parts of the overland conveyor require sound suppression to achieve compliance with the relevant noise criteria at Seloh Nolem 1 (NSR2) and Seloh Nolem 2 (NSR3) during neutral weather conditions. The overland conveyor is located approximately 1,600 m south-west of Seloh Nolem 1 (NSR2) and approximately 800 m south-west of Seloh Nolem 2 (NSR3).

The conveyor was initially modelled as a line source (due to idlers spaced at regular intervals) with an unmitigated sound power level of 82 dBA Lw per metre length. Noise attenuation through enclosure of a section of the conveyor near Seloh Nolem 2 (NSR3) would reduce its sound power level to 72 dBA Lw per metre . Table 17 presents mitigated noise data for the enclosed conveyor section, which has been used for the 2043, 2066 and 2085 modelling scenarios.

Figure 9 shows the indicative 5 km section of overland conveyor that could be enclosed.



LEGEND

- Mining Lease Application Boundary
- Conveyor Enclosure
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Enclosed Section of Overland Conveyor (approx. 5 km length)

Figure 9

The results from the 2027, 2043 and 2066 modelling scenarios indicate that noise mitigation of mobile plant is not required to achieve compliance with the relevant criteria at sensitive receptors during these stages of the Project under neutral weather conditions.

In the 2085 scenario, certain mobile plant items proposed to be operated in the vicinity of Vermont Park (NSR1) (i.e. one dozer, one drill and nine coal haul trucks) were modelled with sound supression to reduce the sound power levels by approximately 5 dBA. This noise mitigation is predicted to result in compliance with the relevant noise criterion at Vermont Park (NSR1) during neutral weather conditions.

Table 17 presents mitigated noise data for these select plant items that has been modelled in the 2085 modelling scenario. Refer also to Appendix D for further details on mitigation.

7.2 Adverse Weather Conditions

Adverse weather conditions were determined to raise operational noise levels (above predictions for neutral conditions) by up to 7 dBA.

As described in Section 7.1, part of the overland conveyor would be enclosed to reduce its sound power level to achieve compliance with relevant noise criteria at Seloh Nolem 1 (NSR2) and Seloh Nolem 2 (NSR3) during neutral conditions. To achieve compliance during adverse weather conditions, the sound power level would be reduced to 62 dBA L_W per metre with the use of low noise idlers.

The results from the 2027 and 2043 modelling scenarios indicate that noise mitigation of mobile plant is not required to achieve compliance with the relevant criteria at sensitive receptors during these stages of the Project under adverse weather conditions.

In the 2085 scenario, mining operations in the Olive Downs South domain (within Pits ODS7 and ODS8) are restricted to daytime operations only. Adverse weather conditions are not predicted to occur during the daytime. As such, no further mitigation would be required in addition to the mitigation required to achieve compliance under neutral weather conditions.

In the 2066 scenario, certain mobile plant items proposed to be operated in the vicinity of Vermont Park (NSR1) (i.e. some of the haul truck fleet, a water truck and a grader) were modelled with sound supression to reduce the sound power levels by 5 to 7 dBA . This noise mitigation is predicted to result in compliance with the relevant noise criteria at Vermont Park (NSR1) during adverse conditions.

Table 17 presents mitigated noise data for these select plant items used for the 2066 model scenario. Refer also to Appendix D for further details on mitigation.

7.3 Operation Management

To manage noise impacts at the nearby sensitive receptors, Pembroke would implement noise mitigation on the overland conveyor and some of the mobile fleet, as described in Sections 7.1 and 7.2 and Appendix D.

Pembroke would also implement proactive and reactive noise control measures. These measures would include the use of weather forecasting and real-time measurement of meteorological conditions and noise levels to modify mining operations as required in order to achieve compliance with applicable noise limits at the nearest sensitive receptors.

Modifying mining operations could include reducing the intensity of particular operations, relocating particular operations or halting particular operations.

Real-time meteorological and noise monitoring would be undertaken at locations representative of the nearest sensitive receptors to assist in implementing operational controls. Although noise levels are predicted to comply with the relevant criteria, noise monitoring would validate the model predictions and inform the implementation of additional noise mitigation measures, if required. Additional noise mitigation measures could include modification of Project operations or at-receiver mitigation measures.

8 Blasting

The Project mining operations would include drilling and blasting overburden and interburden material. Potential blasting impacts from ground vibration and airblast overpressure are assessed below.

8.1 Ground Vibration

The 'minimum distance limits' from blasting in terms of the vibration have been determined using the attenuation formula in Australian Standard AS 2187.2-2006 *Explosives – Storage, Transport and Use – Part 2 Use of Explosives* . The standard presents information for estimating free face blasting in 'average field conditions'. Estimation of 'minimum distance limits' is based the following equation:

$$V = K\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

where

V = ground vibration as peak particle velocity (PPV) in mm/s.

K = constant related to site and rock properties for estimation purposes. K = 1140 for free face blasting in 'average field conditions'.

R = distance between charge and point of measurement in metres.

Q = effective charge mass per delay or maximum instantaneous charge (MIC) in kilograms.

Table 24 presents allowable MIC at various distances required to comply with blasting vibration limit of 5 mm/s PPV shown in Table 15. The minimum distance limits have been determined for free face blasting in 'average field conditions'.

Table 22 – Calculated MIC based on various separation distances to comply with 5 mm/s PPV

Distance from blasting (m)	MIC (kg) K = 1140
1,000	1,129
1,500	2,540
2,000	4,515
2,500	7,054

Based on Table 22 above and expected distance separation to the nearest sensitive receptors, typical MIC sizes (in the range of 4,000 kg to 5,000 kg) would be expected to be below the vibration objective for the Project at the sensitive receptors, however, blast designs may need to be adjusted when blasting in Pit ODS8, where parts of the pit are located within 2 km of the Vermont Park residence. Blast design would be informed by site-specific blast monitoring.

8.2 Airblast Overpressure

The 'minimum distance limits' from blasting in terms of the airblast overpressure have been determined using the attenuation formula in Australian Standard AS 2187.2-2006 *Explosives – Storage, Transport and Use – Part 2 Use of Explosives* . The standard presents information for estimating free face blasting in 'average field conditions'. Estimation of 'minimum distance limits' is based the following equation:

$$P = Ka\left(\frac{R}{Q^{1/3}}\right)^{-1.45}$$

where

P = pressure, in kilopascals (kPa).

Ka = site constant'.

R = distance (m) between charge and point of measurement.

Q = effective charge mass per delay or MIC in kilograms.

For confined blasthole charges, when using a site exponent of -1.45, the site constant Ka is commonly in the range of 10 to 100.

A second methodology was also used to calculate potential airblast overpressure levels based on research and analysis conducted by Renzo Tonin Ron Rumble at Rix's Creek Coal Mine located 5 km north-west of Singleton, New South Wales. The following equation was developed from the Rix's Creek Coal Mine data:

$Lp = 167 + 6.5 \times \log_{10}Q - 23 \times \log_{10}R$

where

Lp = airblast overpressure sound level in dBZ.

R = distance (m) between charge and point of measurement.

Q = effective charge mass per delay or MIC in kilograms.

Table 23 presents allowable MIC at various distances required to comply with the Model Mining Conditions Guideline blasting airblast overpressure objective of 115 dBZ shown in Table 15.

Table 23 – Calculated MIC based on various separation distances to comply with 115 dBZ

Distance from blasting (m)	Australian Standard AS 2187.2-2006		Renzo Tonin Ron Rumble equation based on Rix's Creek Coal Mine data
	K = 10	K = 100	
1,000 m	792	7	412
1,500 m	2,673	23	1,732
2,000 m	6,335	54	4,793
2,500 m	12,375	106	10,556

Table 23 shows a large range of MICs for various distances based on the equation used in the calculation process. The prediction equation developed by Renzo Tonin Ron Rumble indicates that the MIC sizes (typically in the range of 4,000 kg to 5,000 kg) would be expected to be below the airblast overpressure objective for the Project at the sensitive places, however, as with the predicted ground vibration levels, blast designs may need to be adjusted when blasting in Pit ODS8, where parts of the pit are located within 2 km of the Vermont Park residence. Blast design would be informed by site-specific blast monitoring.

9 Miscellaneous Issues

9.1 Cumulative Impact with Other Approved Industry

Ambient noise monitoring determined existing background noise levels for daytime, evening and night-time periods. This noise impact assessment has set applicable noise limits based on both the ambient noise monitoring and requirements of the Model Mining Conditions Guideline .

Our long term noise monitoring and numerous site inspections found that existing industrial noises were generally inaudible within the Project. Based on the predicted noise levels at receptors any cumulative noise impact from other industrial noise sources is expected to be insignificant.

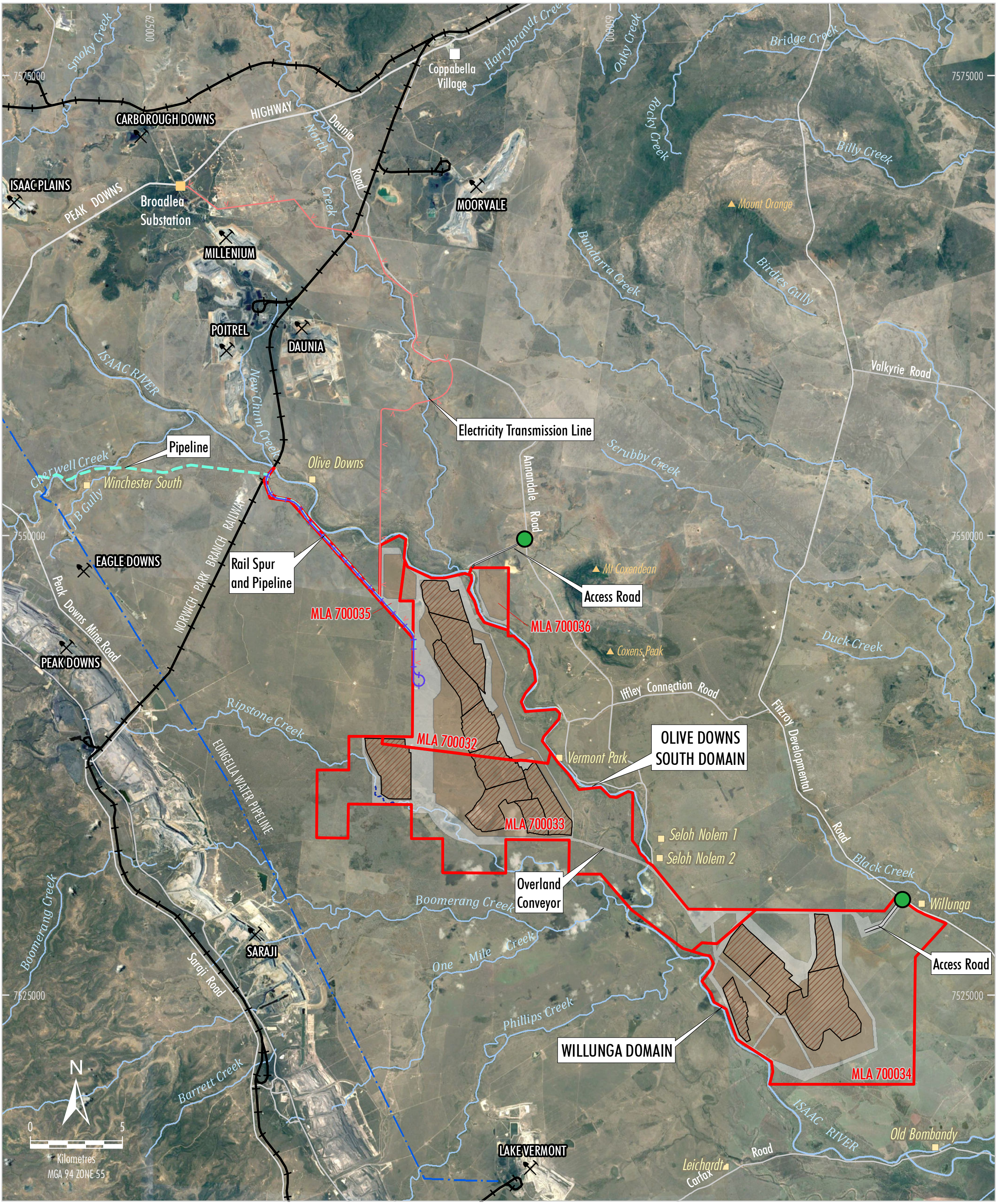
9.2 Health and Biodiversity of Ecosystems

Noise emissions from mining operations and processing plant are expected to be continuous and steady state in nature. Impulsive type noises on site are expected to be minimal and therefore there is a reduced potential to startle local fauna.

9.3 Road Traffic Noise

The TMR *Transport Noise Management Code of Practice* (2013) provides a noise limit of $L_{10\ (18hr)}$ 68 dBA at noise sensitive receptors for existing roads and road upgrades.

Two mine access roads are proposed to access the Olive Downs South and Willunga domains. Road access to Olive Downs South Domain is proposed via a section of private road from Annandale Road. Access to the Willunga Domain is proposed via Fitzroy Developmental Road. Figure 10 shows the two access points.



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LEGEND

- Mining Lease Application Boundary
- Road Access Points
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Road Access Points

Figure 10

The Road Transport Assessment prepared for the Project EIS (GTA, 2018) identifies the following project schedule:

- Construction of the Olive Downs South Domain will commence in 2019 and end in 2021, with peak construction to occur in 2020.
- Construction of the Willunga Domain will commence and end in 2027.
- The combined peak operations of Olive Downs South Domain and Willunga Domain will occur from 2034 – 2044.

Table 24 presents characteristics of Fitzroy Developmental Road and Annandale Road (GTA, 2018).

Table 24 – Characteristics of Roads Proximate to the Project site

Characteristic	Olive Downs South Domain Annandale Road	Willunga Domain Fitzroy Developmental Road
Trending Direction	North – South	North – South
Jurisdiction	Isaac Regional Council	TMR
Cross-section	Two way / undivided	Two way / undivided
Pavement	Unsealed	Sealed
AADT	Data not available	800
Speed Limit	Unposted	100km/hr

Table 25 presents Workforce Traffic Generation Summary (GTA, 2018).

Table 25 – Workforce Traffic Generation Summary

Design Year	Olive Downs South Domain				Willunga Domain			
	AM Peak		PM Peak		AM Peak		PM Peak	
	In	Out	In	Out	In	Out	In	Out
2020	449	449	449	449	0	0	0	0
2027	366	366	366	366	78	78	78	78
2028	365	365	365	365	130	130	130	130
2048	365	365	365	365	130	130	130	130

Table 26 presents Hourly Heavy Vehicle Traffic Generation Summary [extract from Reference 9].

Table 26 – Hourly Heavy Vehicle Traffic Generation Summary

Design Year	Olive Downs South Domain				Willunga Domain			
	AM Peak		PM Peak		AM Peak		PM Peak	
	In	Out	In	Out	In	Out	In	Out
2020	10	10	10	10	0	0	0	0
2027	2	2	2	2	8	8	9	9

Design Year	Olive Downs South Domain				Willunga Domain			
	AM Peak		PM Peak		AM Peak		PM Peak	
	In	Out	In	Out	In	Out	In	Out
2028	2	2	2	2	2	2	2	2
2048	2	2	2	2	2	2	2	2

The nearest noise sensistive receptor along Annandale Road (Olive Downs South Domain) is located approximately 180 m set back from the road. It is noted that Annandale Road is an unsealed dirt road and currently carries very low volumes of traffic.

Based on the expected traffic volumes shown in Table 25 and 26, traffic noise levels are predicted to be less than 50 dBA $L_{10,\ 18\ hours}$ at the nearest noise sensitive receptor. Annandale Road falls under the jurisdiction of Isaac Regional Council. Isaac Regional Council's Planning Scheme does not provide specific noise limits for traffic along local roads. In the absence of specific noise limits the predicted traffic noise levels are shown to comply with TMR's noise limit of $L_{10\ (18hr)}$ 68 dBA.

The nearest noise sensistive receptors along Fitzroy Development Road (Willunga Domain) are located approximately 50m set back from the road.

Based on the expected traffic volumes shown in Table 25 and 26, traffic noise levels are predicted to be less than 55dBA $L_{10,\ 18\ hours}$ at the nearest noise sensitive receptor. Fitzroy Development Road falls under the jurisdiction of TMR and therefore the predicted complies with TMR's noise limit of $L_{10\ (18hr)}$ 68 dBA.

The increase in traffic due to additional traffic from the Project are predicted to be less than 1 dBA and unlikely to be perceived by the nearest noise sensitive receptors located along Fitzroy Development Road.

9.4 Rail Noise

The Project would utilise the Norwich Park Branch Railway. The Norwich Park Branch Railway runs roughly north-south approximately 10 km to the west of the Project site. This branch forms part of the Goonyella Branch Railway line which transports coal from the Bowen Basin to the Hay Point and Dalrymple Bay Coal Terminal south-east of Mackay.

The Planning Levels for airborne noise from railway activities (train movements) are retained as 65 dBA $L_{eq,\ 24hour}$ and Single Event Maximum 87 dBA maxL_p.

The nearest noise sensitive receptor is located over 1.5 km from the rail line (a dwelling on the Olive Downs property). Figure 2 shows the proposed rail spur and nearest noise sensitive receptor.

As described in the EIS main text, based on a "Goonyella-based" train configuration with 126 wagons and a total payload of 10,800 t, an average of four product coal trains would be loaded per day for the Project at full development. Based on a "Blackwater-based" train configuration with 98 wagons and a total payload of 8,200 t, an average of 35 product coal trains would be loaded per week for the Project at full development.

However, to allow for cargo assembly for loading of ships to meet the required performance standards at the port, a peak of up to eight product coal trains per day may be required at times.

Based on separation distance of approximately 1.5 km (from the Olive Downs dwelling to the Project rail spur) and a peak of 16 train movements per day (8 unloaded and 8 loaded), noise levels from peak rail movements are predicted to comply with both the 65 dBA $L_{eq,\ 24hour}$ and Single Event Maximum 87 dBA $maxL_p$ noise limits at the Olive Downs dwelling.

9.5 Sleep Disturbance

The noise limit of 35 dBA L_{Aeq} is significantly lower than the sleep disturbance criterion of 52 dBA maxLp previously discussed in Section 5.5 of this report. Given the constant nature of the noise emissions from the Project (ie continuous operation of the process plant and mining equipment), the sleep disturbance criterion is considered unlikely to be exceeded at the nearest receptors as the difference between the two criterion (ie L_{Aeq} and maxLp) is unlikely to exceed 10 to 15 dBA.

Therefore, given the predicted compliance with the 35 dBA L_{Aeq} noise limit (Section 5.9), compliance with the sleep disturbance criterion of 52 dBA maxLp is also expected.

10 Conclusion

Renzo Tonin Ron Rumble has completed a noise and vibration impact assessment as part of an EIS for the Project.

The objective of this report is to assess noise and vibration levels from the Project against relevant noise and vibration objectives.

The following modelling results were determined:

Neutral weather conditions

With the implementation of mitigation and management measures, operational noise levels are predicted to comply with the relevant noise objectives at receptors including Vermont Park (NSR1), Seloh Nolem 1 (NSR2), Seloh Nolem 2 (NSR3), Old Bombandy (NSR4), Willunga (NSR5) and Leichardt (NSR6) for all modelling scenarios (2027, 2043, 2066 and 2085).

Mitigation and management measures that would be implemented include enclosing a 5 km section of the overland conveyor closest to Seloh Nolem 2 (NSR3) and sound suppression on certain mobile plant items proposed to be operated in the vicinity of Vermont Park (during the later stages of the mine life).

Adverse Weather Conditions

Adverse weather conditions were determined to raise operational noise levels (above predictions for neutral conditions) by up to 7 dBA.

With the implementation of mitigation and management measures, operational noise levels were predicted to comply with the noise objectives at receptors including Vermont Park (NSR1), Seloh Nolem 1 (NSR2), Seloh Nolem 2 (NSR3), Old Bombandy (NSR4), Willunga (NSR5) and Leichardt (NSR6) for all modelling scenarios (2027, 2043, 2066 and 2085).

In addition to the enclosure of a section of the overland conveyor described above, low noise idlers would be installed along parts of the conveyor to further reduce its sound power level. Sound suppression would also be used on select mobile plant items operating in parts of the mine closest to the sensitive receptors to achieve compliance with the relevant criteria under adverse conditions.

Low Frequency Noise

Operational noise predictions indicate low frequency noise (<200 Hz) is expected to comply with the noise limits of 55 dBZ (external location) at all receptors.

Sleep Disturbance

Based on predicted noise levels during neutral and adverse weather conditions, compliance with the sleep disturbance criterion is expected.

Blasting

Predicted Project ground vibration and airblast overpressure show that with the use of typical explosive charge sizes and practices, the relevant vibration and overpressure objectives for the Project would not be exceeded at receptors.

Operational Management

To reduce noise emissions at the nearest sensitive receptors, Pembroke would implement noise controls on fixed plant and mobile equipment, including the overland conveyor, as described in Sections 7.1 and 7.2 and Appendix D.

Pembroke would also implement proactive and reactive noise control measures. These measures would include the use of weather forecasting and real-time measurement of meteorological conditions and noise levels to modify mining operations as required in order to achieve compliance with applicable noise limits at the nearest sensitive receptors.

Modifying mining operations could include reducing the intensity of particular operations, relocating particular operations or halting particular operations.

Real-time meteorological and noise monitoring would be undertaken at locations representative of the nearest sensitive receptors to assist in implementing operational controls.

References

1. Queensland Environmental Protection Agency (2004) - Ecoaccess Guideline: Assessment of Low Frequency Noise.
2. Department of Environment and Heritage Protection - Noise Measurement Manual 2013.
3. Department of Environment and Heritage Protection (2016) - Ecoaccess Guideline: Planning for Noise Control.
4. Department of Environment and Heritage Protection (2017a) - Model Mining Conditions Guideline.
5. Department of Environment and Heritage Protection (2017b) – Guideline: Application requirements for activities with noise impacts.
6. Katestone Environmental Pty Ltd (2018) Air Quality and Greenhouse Gas Assessment of the Olive Downs Coking Coal Project.
7. GTA (2018) – Olive Downs Coking Coal Project Road Transport Assessment.

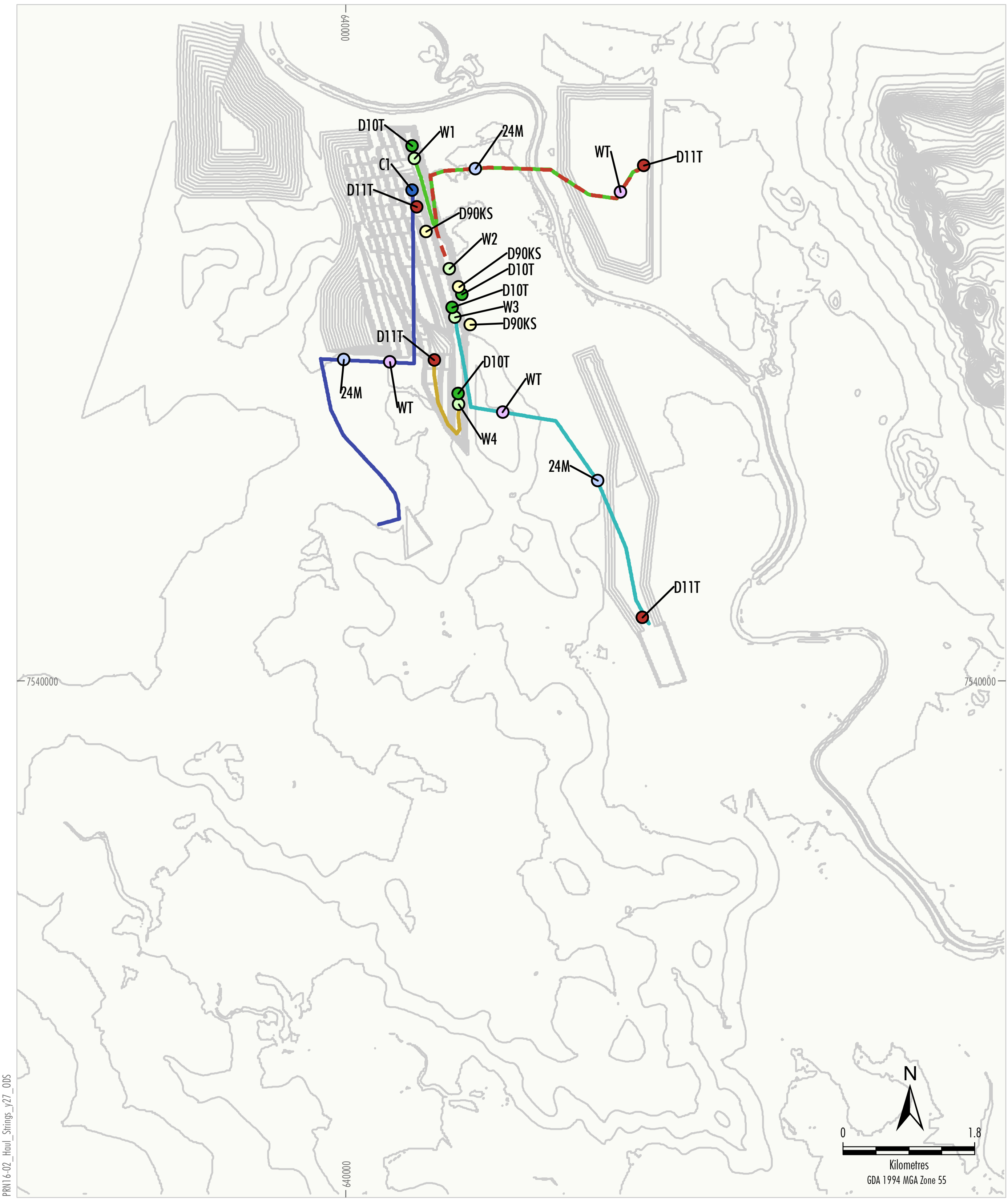
APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel (dB)	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0 dB The faintest sound we can hear 30 dB A quiet library or in a quiet location in the country 45 dB Typical office space. Ambience in the city at night 60 dB CBD mall at lunch time 70 dB The sound of a car passing on the street 80 dB Loud music played at home 90 dB The sound of a truck passing on the street 100 dB The sound of a rock band 115 dB Limit of sound permitted in industry 120 dB Deafening.
dBA	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dBZ	Z-weighting is a flat frequency response of 0.5Hz to 20kHz ±1.5dB. This response replaces the older "Linear" or "Unweighted" responses. Z-weighted measurements are expressed as **dB(Z).** Z-weighting is typically used to measure explosive sounds and in the assessment of low frequency noise.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dBA.
$L_{eq, T}$	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, T.
$MaxL_{pA}$	Maximum instantaneous noise level.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Fleet Locations for Modelling Years 2027, 2043, 2066 & 2085



LEGEND

2027 Olive Downs South Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C1
- Waste Route W1
- Waste Route W2
- Waste Route W3
- Waste Route W4

Source: Phronis (2018), Pembroke (2018)

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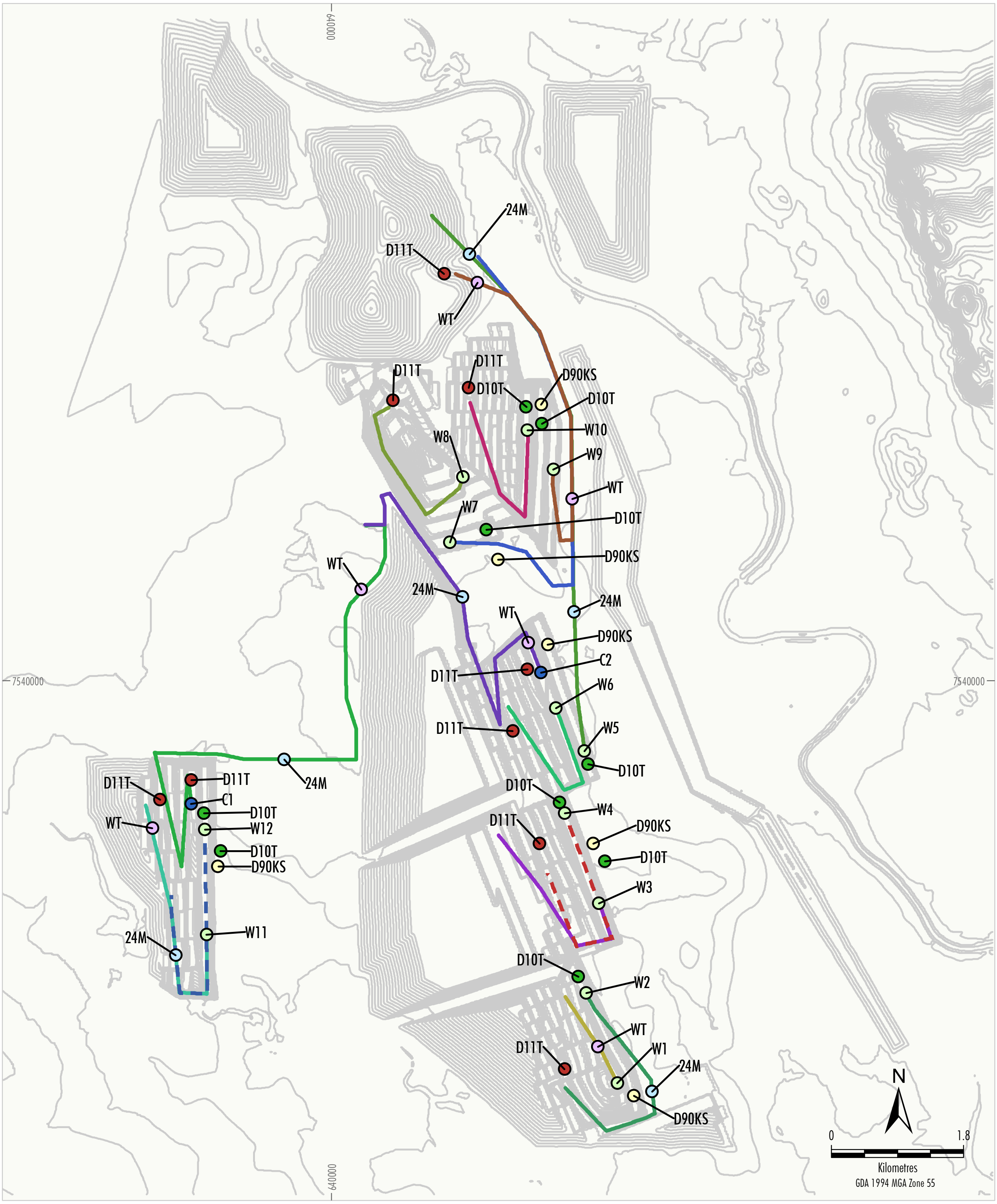
Indicative Haul Strings and Mobile Equipment Locations Olive Downs South Domain Year 2027

Figure 1



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LEGEND

2043 Olive Downs South Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C1
- Coal Route C2
- Waste Route W1
- Waste Route W2
- Waste Route W3
- Waste Route W4
- Waste Route W5
- Waste Route W6
- Waste Route W7
- Waste Route W8
- Waste Route W9
- Waste Route W10
- Waste Route W11
- Waste Route W12

Source: Phronis (2018), Pembroke (2018)

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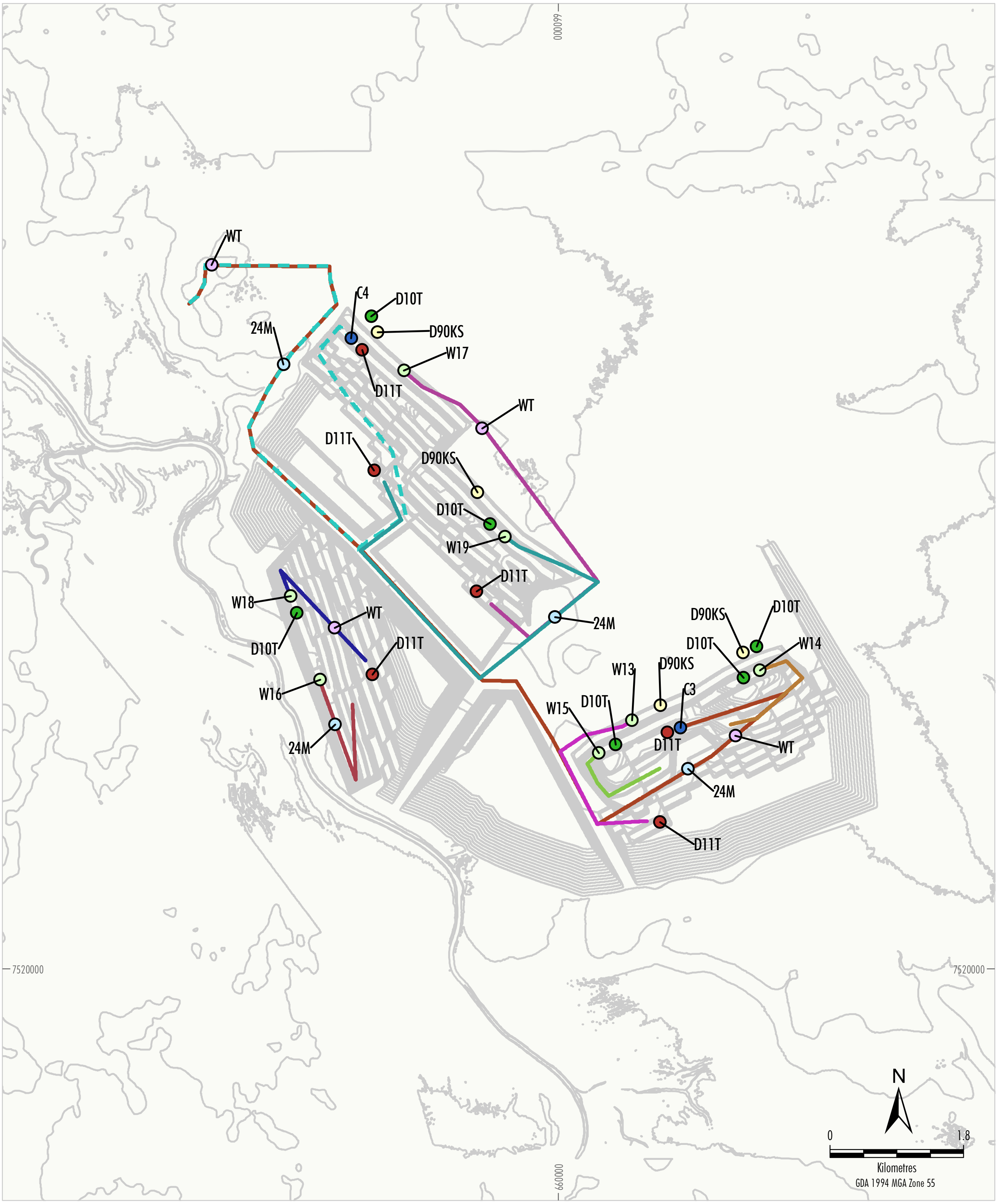
OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and Mobile Equipment Locations Olive Downs South Domain Year 2043

Figure 2a



LEGEND

2043 Willunga Domain Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C3
- Coal Route C4
- Waste Route W13
- Waste Route W14
- Waste Route W15
- Waste Route W16
- Waste Route W17
- Waste Route W18
- Waste Route W19

Source: Phronis (2018), Pembroke (2018)

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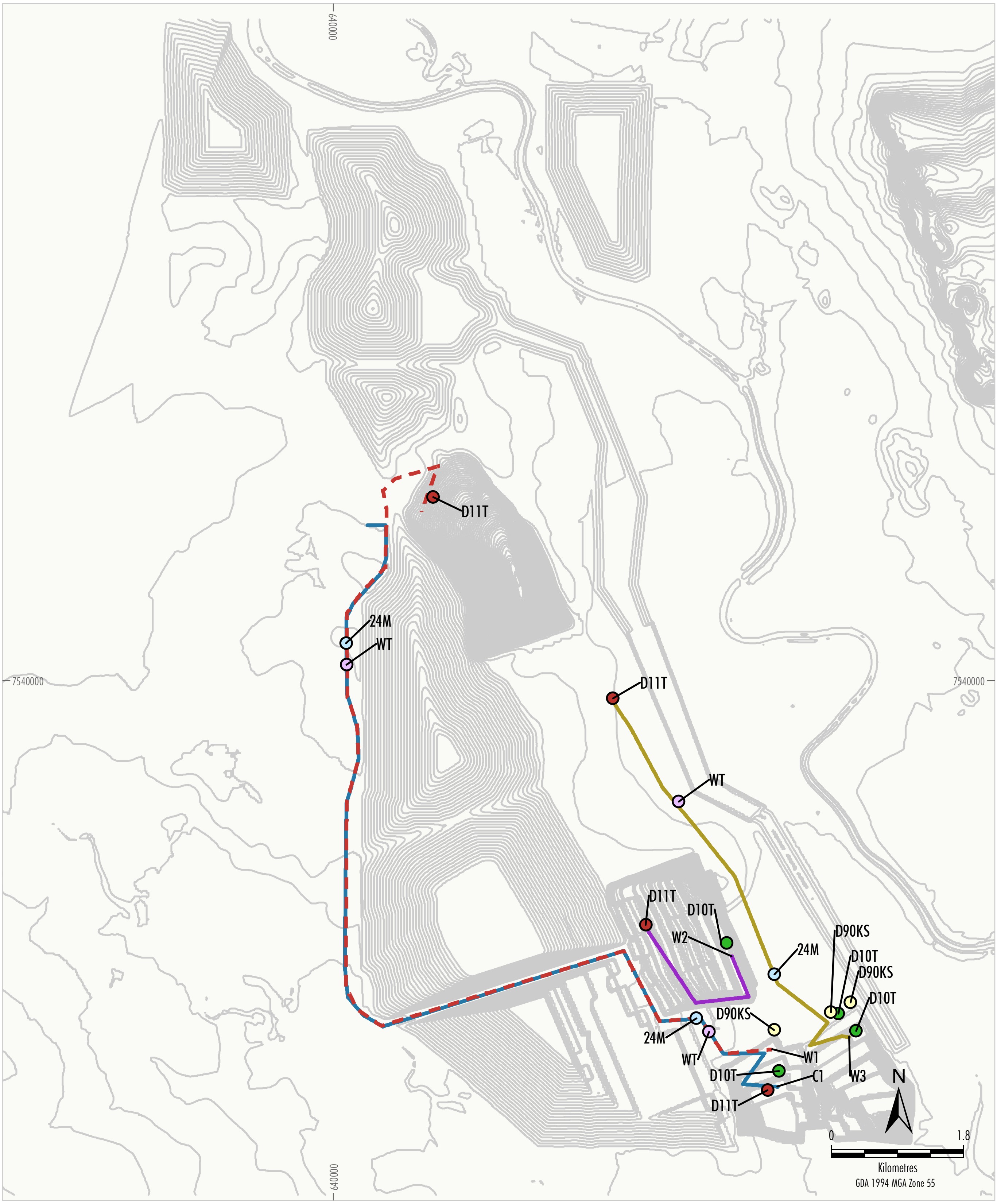
OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and Mobile Equipment Locations Willunga Domain Year 2043

Figure 2b



LEGEND

2066 Olive Downs South Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C1
- Waste Route W1
- Waste Route W2
- Waste Route W3

Source: Phronis (2018), Pembroke (2018)

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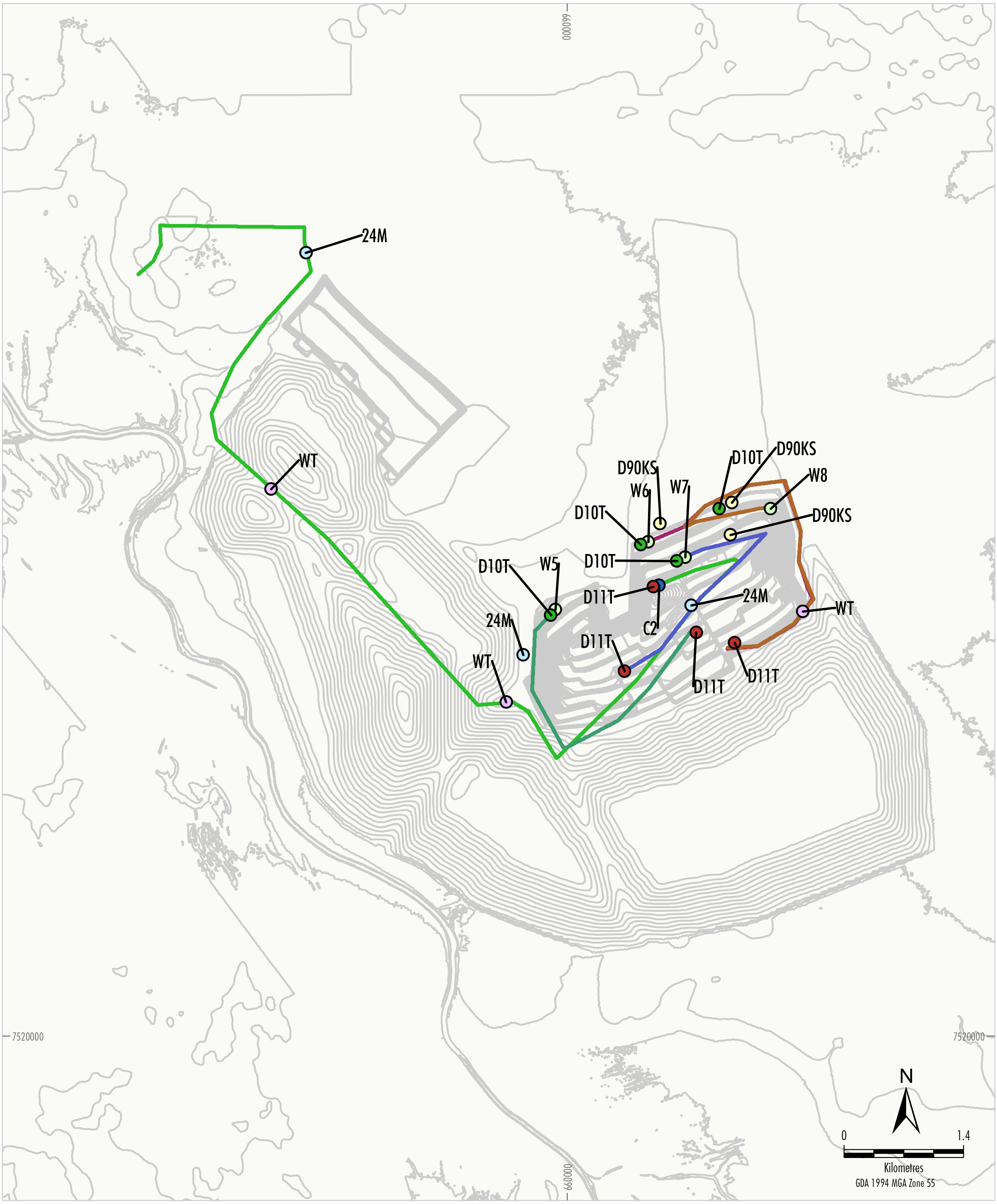
OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and Mobile Equipment Locations Olive Downs South Domain Year 2066

Figure 3a



LEGEND

2066 Willunga Domain Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C2
- Waste Route W5
- Waste Route W6
- Waste Route W7
- Waste Route W8

Source: Phronis (2018), Pembroke (2018)

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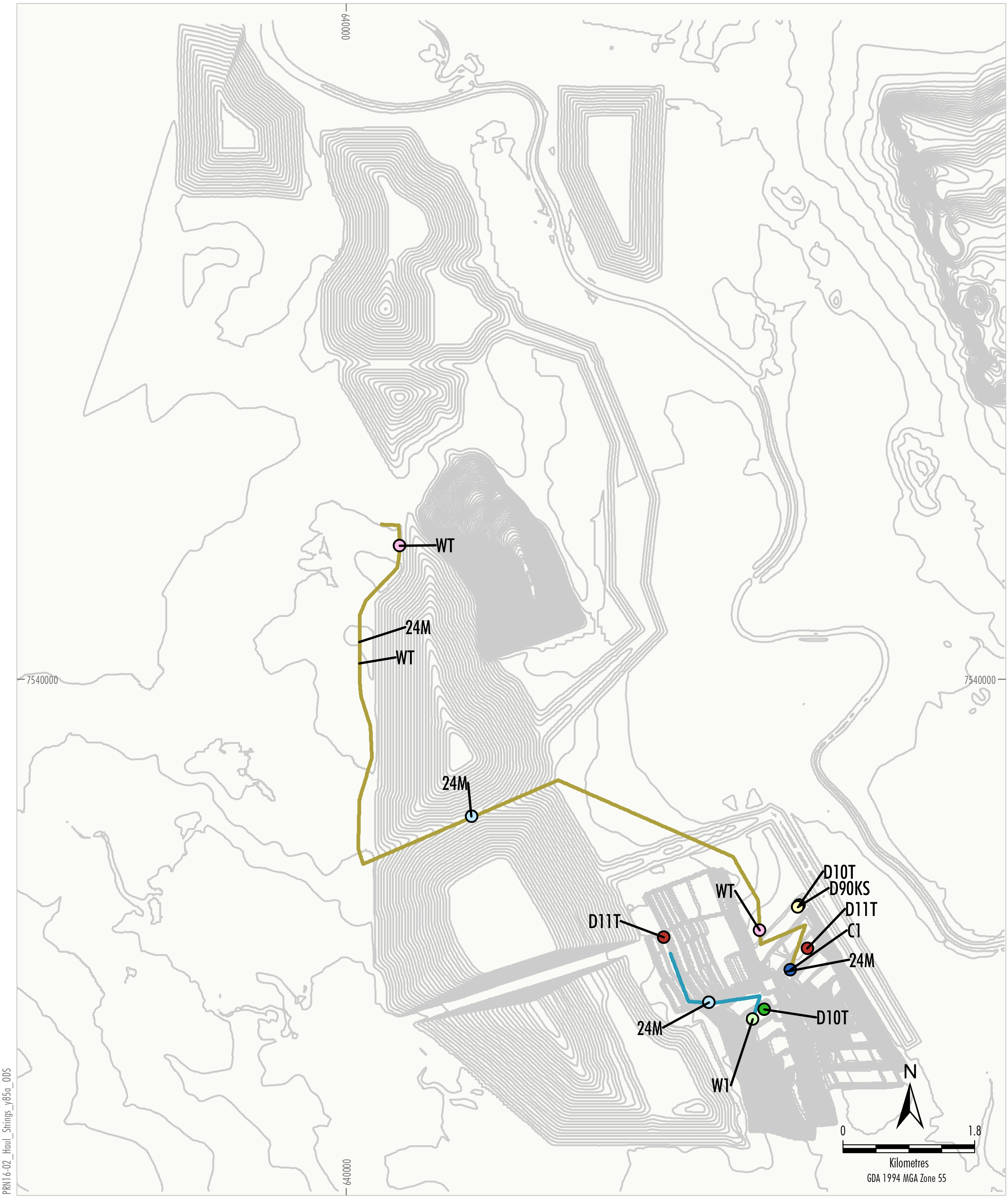
OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and Mobile Equipment Locations Willunga Domain Year 2066

Figure 3b



LEGEND

2085 Olive Downs South Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- Coal Route C1
- Waste Route W1

Source: Phronis (2018), Pembroke (2018)

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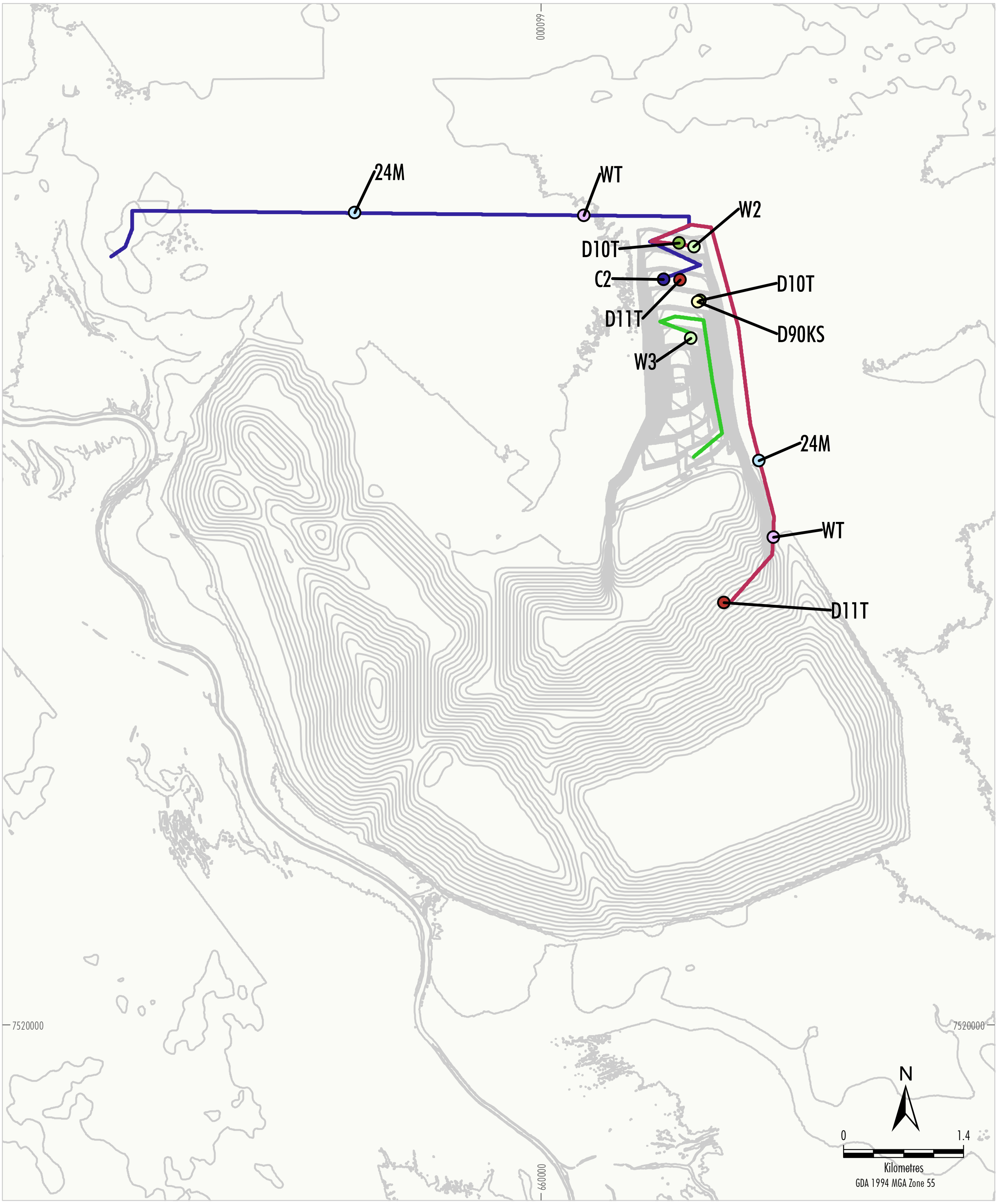
OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and Mobile Equipment Locations Olive Downs South Domain Year 2085

Figure 4a



LEGEND

2085 Willunga Domain Contours (5 m)

Mobile Equipment
- Coal Excavator
- Dozer (D10T)
- Dozer (D11T)
- Drill (D90KS)
- Grader (24M)
- Waste Excavator
- Water Truck (WT)

Haul Route
- C2
- W2
- W3

Source: Phronis (2018), Pembroke (2018)

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OLIVE DOWNS COKING COAL PROJECT

Indicative Haul Strings and
Mobile Equipment Locations
Willunga Domain
Year 2085

Figure 4b

APPENDIX C Analysis of Meteological Data

An Air Quality and Greenhouse Gas Assessment was prepared for the Project by Katestone Environmental Pty Ltd [Document Reference: Air Quality and Greenhouse Gas Assessment of the Olive Downs Coking Coal Project] dated February 2018.

Section 4.2.1 of the Katestone assessment summarises the following information for wind speed and wind direction potentially affecting the Project:

> *Wind speed and wind direction can determine the rate of dispersion of dust emissions from sources such as wheel generated dust, material transfers, material processing and wind erosion. Wind speed also determines the amount of dust lifted into the air by wind erosion. The annual, seasonal and diurnal frequency of winds at the Project site are shown as wind roses in Figure 10, Figure 11 and Figure 12, respectively.*
>
> *On average 70% of winds at the site are from the northeast through to the southeast. During the year winds vary with season, with south-easterlies most frequent during autumn and winter, and north-easterlies most frequent during spring. The highest frequency of winds above 6 m/s occur during summer, from the east and east-southeast which are also the most frequent wind directions. There is a diurnal variation in the wind distribution, with a higher frequency of light winds occurring overnight (6pm – 6am) compared to the day. Winds from the east and east-southeast are most frequent during the afternoon (midday – 6pm), whilst winds from the northeast quadrant are most frequent during the evening. Winds from midnight – midday are predominantly from the southeast.*

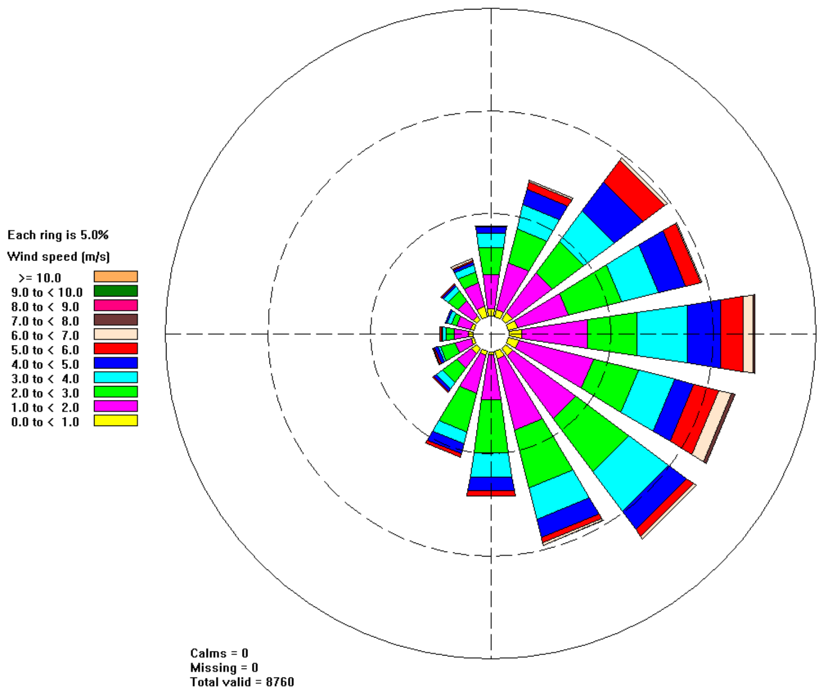


Figure 10 Annual wind rose for the Project site (extracted from CALMET)

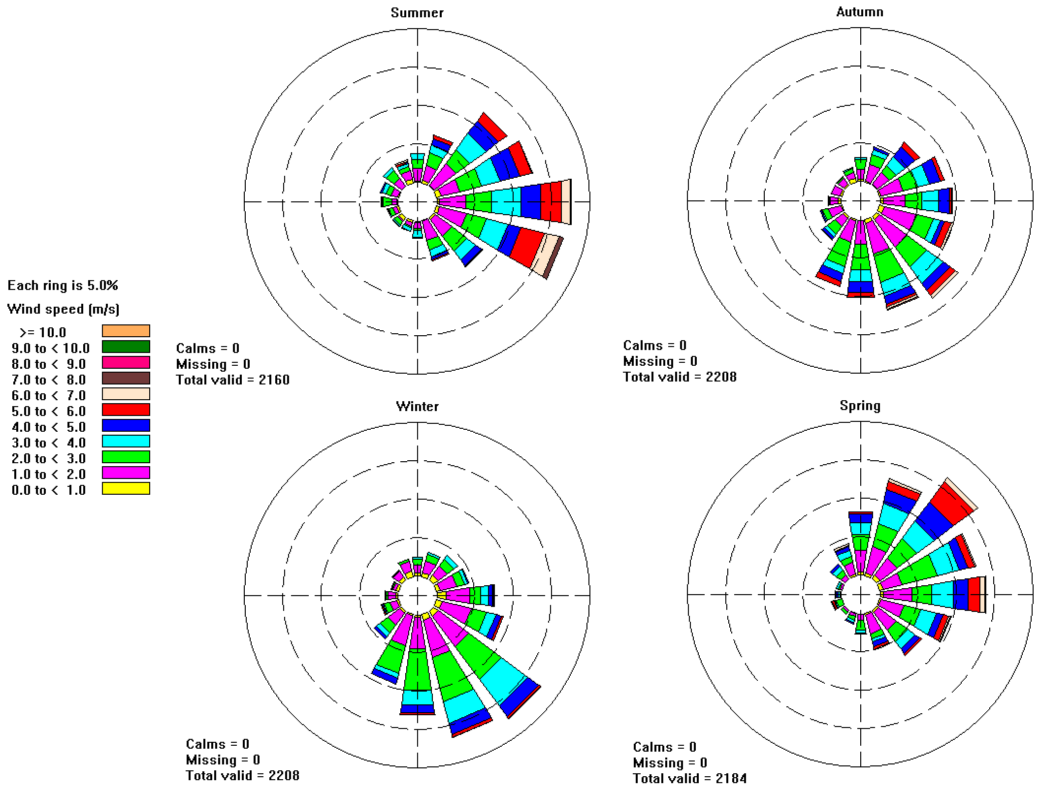


Figure 11 Seasonal wind rose for the Project site (extracted from CALMET)

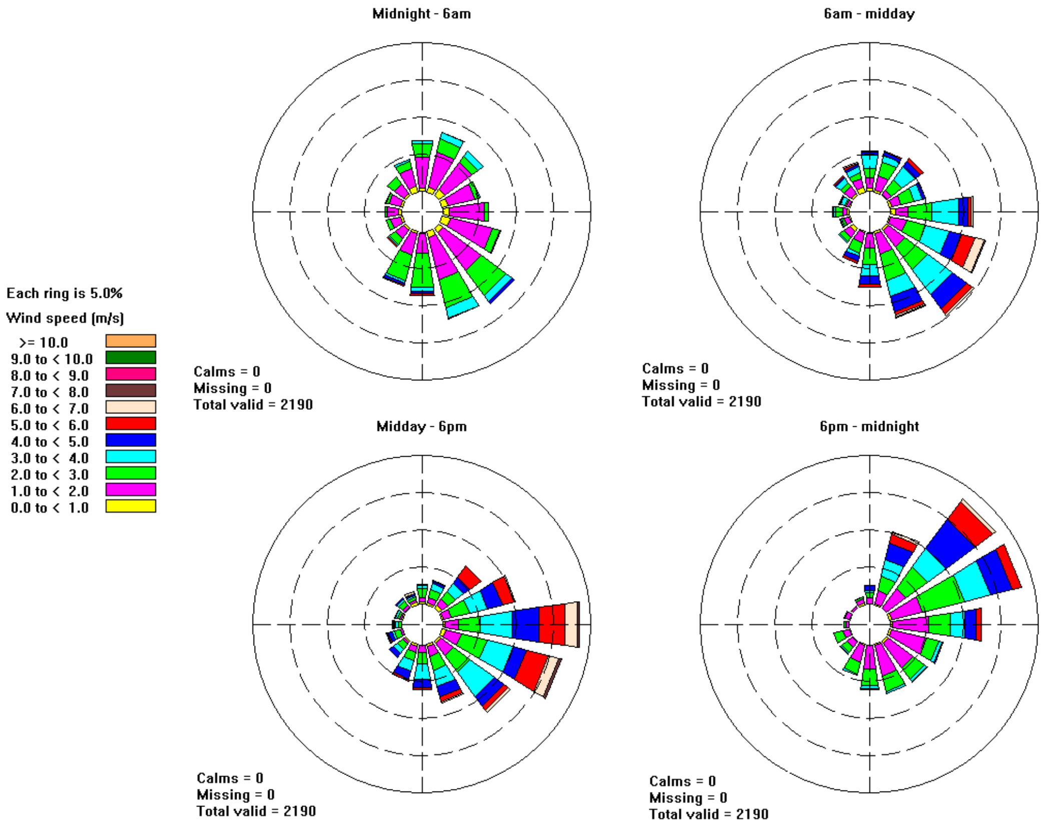


Figure 12 Diurnal wind rose for the Project site (extracted from CALMET)

Our analysis of the wind roses concluded that wind effects were not a particular feature of the area. That is, source to receiver winds (at 10 metre [m] height) of equal to or less than 3 metres per second (m/s) do not occur for 30% of the time or more in any assessment period (day, evening, night) in any season. For the Project we have therefore not used the default wind effects parameter of 3 m/s.

APPENDIX D Noise Mitigation Strategy

Preliminary Noise Modelling Results

Tables D1 to D4 present the preliminary noise modelling results (ie predicted operational noise levels at each receptor for the four modelling scenarios with no noise control treatment applied), as described in Step 1 of Section 7. It is important to note these preliminary noise modelling results do not reflect the proposed operation of the Project, rather they are intermediate results that have informed the mitigation strategy for the Project

Table D1 – Year 2027 - Predicted Noise Levels ($L_{eq\ adj\ 15mins}$) at the Nearest Noise Sensitive Receptors (unmitigated), dBA

Receptor ID	Description	Neutral Weather Conditions (Calm conditions with Stability Class D)	Adverse Weather Conditions (Stability Class F & 2m/s wind)
NSR1	Vermont Park	19	24
NSR2	Seloh Nolem 1	10	15
NSR3	Seloh Nolem 2	10	15
NSR4	Old Bombandy	0	0
NSR5	Willunga	0	7
NSR6	Leichardt	0	0

Table D1 shows operational noise levels comply at all receptors for both neutral and adverse weather conditions.

Table D2 – Year 2043 - Predicted Noise Levels ($L_{eq\ adj\ 15mins}$) at the Nearest Noise Sensitive Receptors (unmitigated), dBA

Receptor ID	Description	Neutral Weather Conditions (Calm conditions with Stability Class D)	Adverse Weather Conditions (Stability Class F & 2m/s wind)
NSR1	Vermont Park	30	35
NSR2	Seloh Nolem 1	**36**	**40**
NSR3	Seloh Nolem 2	**42**	**46**
NSR4	Old Bombandy	20	25
NSR5	Willunga	23	29
NSR6	Leichardt	22	28

Table D2 shows operational noise levels comply with the noise limit at NSR1 (Vermont Park), NSR4 (Old Bombandy), NSR5 (Willunga) and NSR6 (Leichardt) during both neutral and adverse weather conditions. Table D2 shows operational noise levels exceed the noise limit by 1 to 11dBA at NSR2 (Seloh Nolem 1) and NSR2 (Seloh Nolem 1) during both neutral and adverse weather conditions.

Table D3 – Year 2066 - Predicted Noise Levels ($L_{eq\ adj\ 15mins}$) at the Nearest Noise Sensitive Receptors (unmitigated), dBA

Receptor ID	Description	Neutral Weather Conditions (Calm conditions with Stability Class D)	Adverse Weather Conditions (Stability Class F & 2m/s wind)
NSR1	Vermont Park	35	**39**
NSR2	Seloh Nolem 1	**36**	**40**
NSR3	Seloh Nolem 2	**42**	**45**
NSR4	Old Bombandy	17	22
NSR5	Willunga	22	29
NSR6	Leichardt	9	24

Table D3 shows operational noise levels comply with the noise limit at NSR4 (Old Bombandy), NSR5 (Willunga) and NSR6 (Leichardt) during both neutral and adverse weather conditions. Table D3 shows operational noise levels exceed the noise limit by 1 to 10dBA at NSR1 (Vermont Park), NSR2 (Seloh Nolem 1) and NSR2 (Seloh Nolem 1) during both neutral and adverse weather conditions.

Table D4 – Year 2085 - Predicted Noise Levels ($L_{eq\ adj\ 15mins}$) at the Nearest Noise Sensitive Receptors (unmitigated), dBA

Receptor ID	Description	Neutral Weather Conditions (Calm conditions with Stability Class D)	Adverse Weather Conditions (Stability Class F & 2m/s wind)[1]
NSR1	Vermont Park	**37**	**42**
NSR2	Seloh Nolem 1	35	**39**
NSR3	Seloh Nolem 2	**42**	**45**
NSR4	Old Bombandy	12	17
NSR5	Willunga	27	32
NSR6	Leichardt	13	19

[1] In the 2085 scenario, mining operations in the Olive Downs South domain (within Pits ODS7 and ODS8) are restricted to daytime operations only. Adverse weather conditions are not predicted to occur during the daytime.

Table D4 shows operational noise levels comply with the noise limit at NSR4 (Old Bombandy), NSR5 (Willunga) and NSR6 (Leichardt) during both neutral and adverse weather conditions. Table D3 shows operational noise levels exceed the noise limit by 2 to 10dBA at NSR1 (Vermont Park), NSR2 (Seloh Nolem 1) and NSR2 (Seloh Nolem 1) during both neutral and adverse weather conditions.

Noise Mitigation Strategy

Our analysis of the noise model and noise source locations indicates that the overland conveyor, if unmitigated, would result in elevated noise levels at both Seloh Nolem 1 (NSR2) and Seloh Nolem 2 (NSR3). The overland conveyor is located approximately 1,600 m south-west of Seloh Nolem 1 (NSR2) and approximately 800 m south-west of Seloh Nolem 2 (NSR3).

The conveyor is modelled as a line source (due to idlers spaced at regular intervals) with an unmitigated sound power level of 82 dBA Lw per metre length. This sound power level would be reduced to 72 dBA Lw per metre with the use of an enclosure over a 4 km section of the overland conveyor near Seloh Nolem 2 (NSR3). This sound power level would be further reduced to 62 dBA Lw per metre with the use of 'low noise idlers' plus enclosure over a 1 km section of the overland conveyor closest to Seloh Nolem 2 (NSR3). Table 17 in Section 6.3.3 presents mitigated noise data for the 5 km conveyor section used for the 2043, 2066 and 2085 modelling scenarios.

Figure 9 in Section 7.2 shows the indicative 5 km section of overland conveyor that could be enclosed.

The preliminary noise modelling indicated a potential slight noise exceedance of 2 dBA for the 2085 modelling scenario at Vermont Park (NSR1). A number of the nearest mobile plant items including one dozer (D10T), one drill rig (D90KS) and nine coal haul trucks using the C1 haul road each require up to 5 dBA of noise reduction or mitigation treatment.

Table D5 shows the highest ranked plant items contributing noise at Vermont Park for 2085 (neutral weather conditions).

Table D5 –Loudest Ranked Noisy Plant Items for Vermont Park (NSR1) - 2085 modelling scenario (neutral weather), dBA

Plant Item	Assumed Sound Power Levels (unmitigated)	Predicted Component Noise Level	Noise Ranking	Recommended Noise Reduction per Plant Item
C1 – Coal haul road (9 trucks)	119 dBA	33	1	5
D90KS - Drill	118 dBA	31	2	5
D10T - Dozer	116 dBA	30	3	5

The preliminary noise modelling indicated potential exceedances of 4 dBA for the 2066 modelling scenario at Vermont Park (NSR1).

Table D6 shows the highest ranked plant items contributing noise at Vermont Park for 2066 modelling scenario (adverse weather) and the recommended noise reduction for each plant item.

Table D6 –Loudest Ranked Noisy Plant Items for Vermont Park (NSR1) – 2066 modelling scenario (adverse weather), dBA

Plant Item	No. of plant items	Assumed Sound Power Levels (unmitigated)	Predicted Component Noise Level	Noise Ranking	Recommended Noise Reduction per Plant Item
W3 – Waste haul road (7 trucks)	7 waste trucks	118 dBA	33	1	7
C1 – Coal haul road (10 trucks)	10 coal trucks	113 dBA	33	2	7
W1 – Waste haul road (13 trucks)	13 waste trucks	118 dBA	28	3	5
W2 – Waste haul road (7 trucks)	7 waste trucks	118 dBA	28	4	5
CAT24M - Grader	1 grader	121 dBA	27	5	5
WT – water truck operating along coal haul road C1 (1 truck)	1 water truck	119 dBA	27	6	5

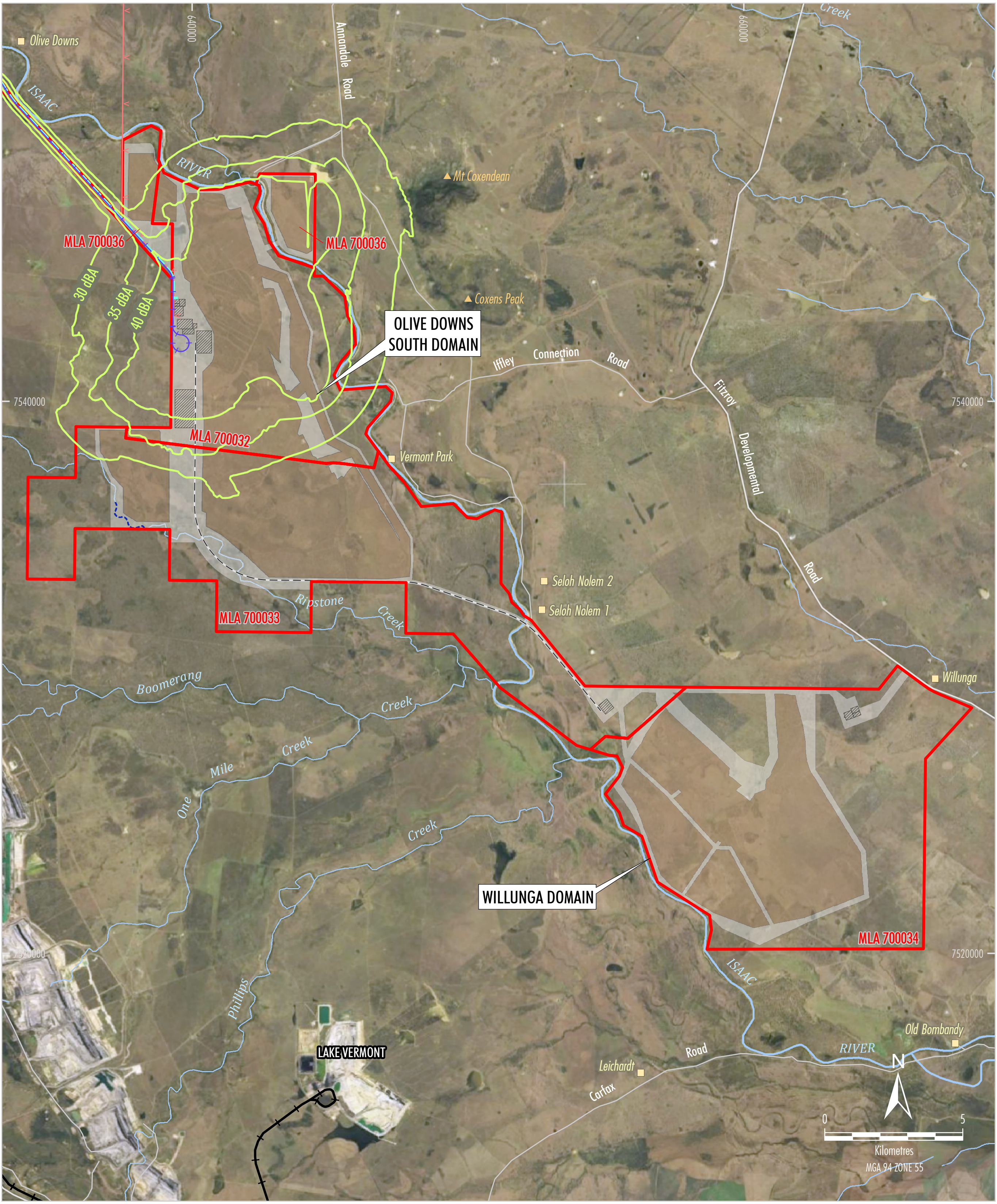
In the 2085 scenario, mining operations in the Olive Downs South domain (within Pits ODS7 and ODS8) are restricted to daytime operations only. Adverse weather conditions are not predicted to occur during the daytime. As such, no further mitigation would be required in addition to the mitigation required to achieve compliance under neutral weather conditions.

Refer to Appendix B for indicative fleet locations.

Table 17 in Section 6.3.3 presents mitigated noise levels for each modelling scenario (ie the predicted noise levels for the Project).

APPENDIX E Noise Contour Maps

The following contour maps show predicted noise levels for modelling Years 2027, 2026, 2066, 2085 under both neutral and adverse weather conditions.



LEGEND
- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\ (15\ minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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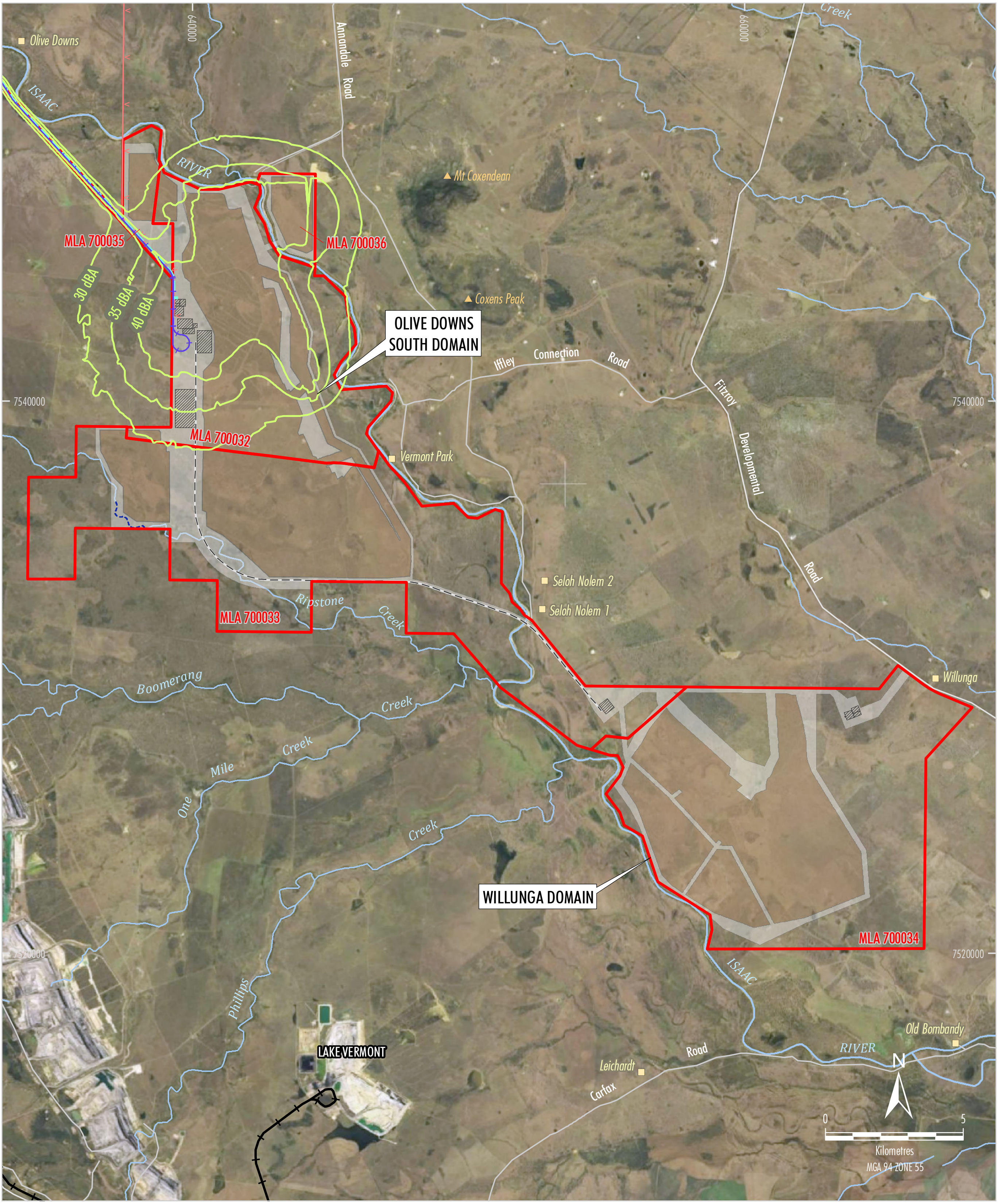
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2027
Adverse Meteorological Conditions

Figure 1



PRN-16-02_Noise_AppendE_202B

LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\,(15\,minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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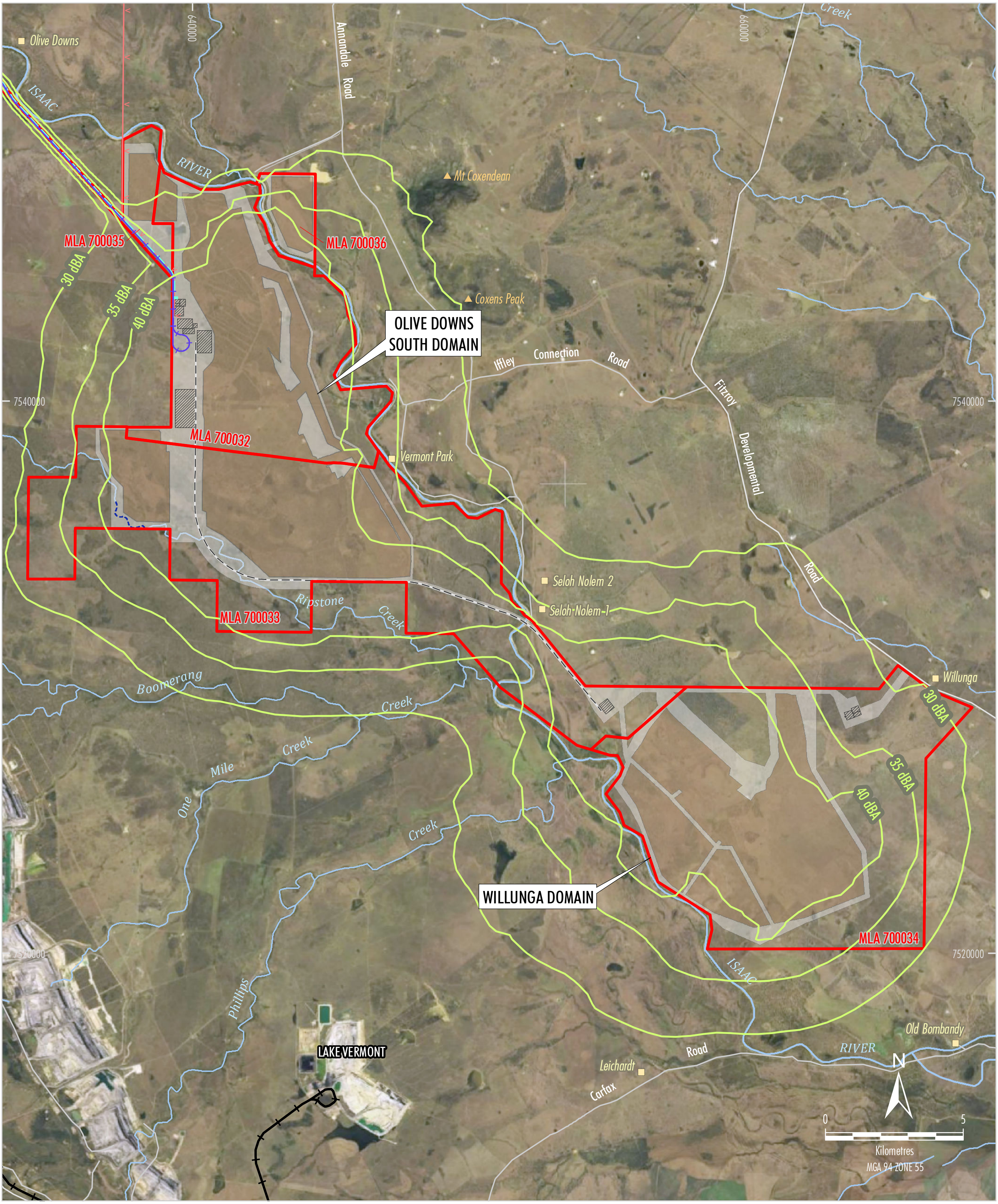
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2027

Netural Meteorological Conditions

Figure 2



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\,(15\,minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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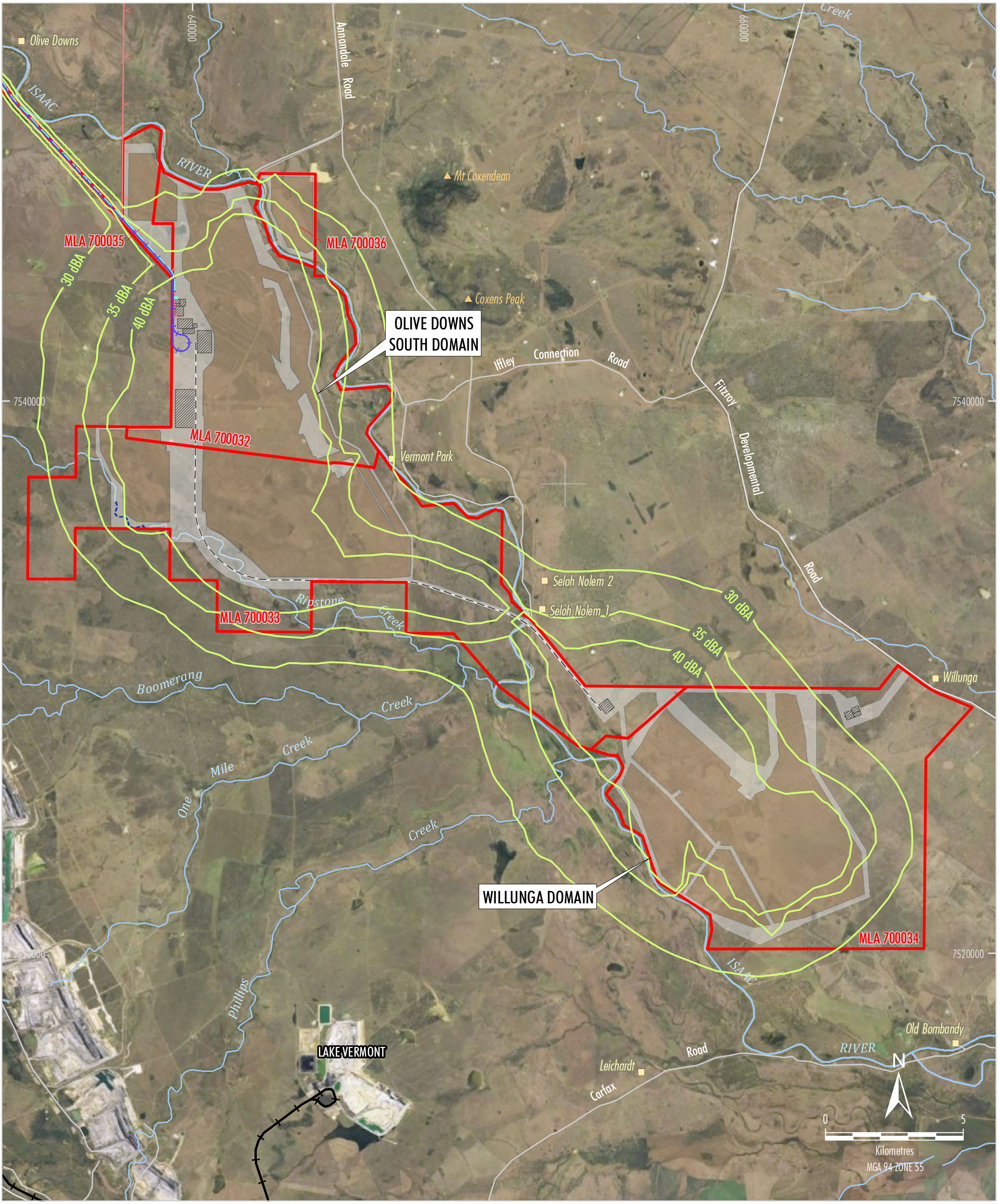
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2043
Adverse Meteorological Conditions

Figure 3



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\ (15\ minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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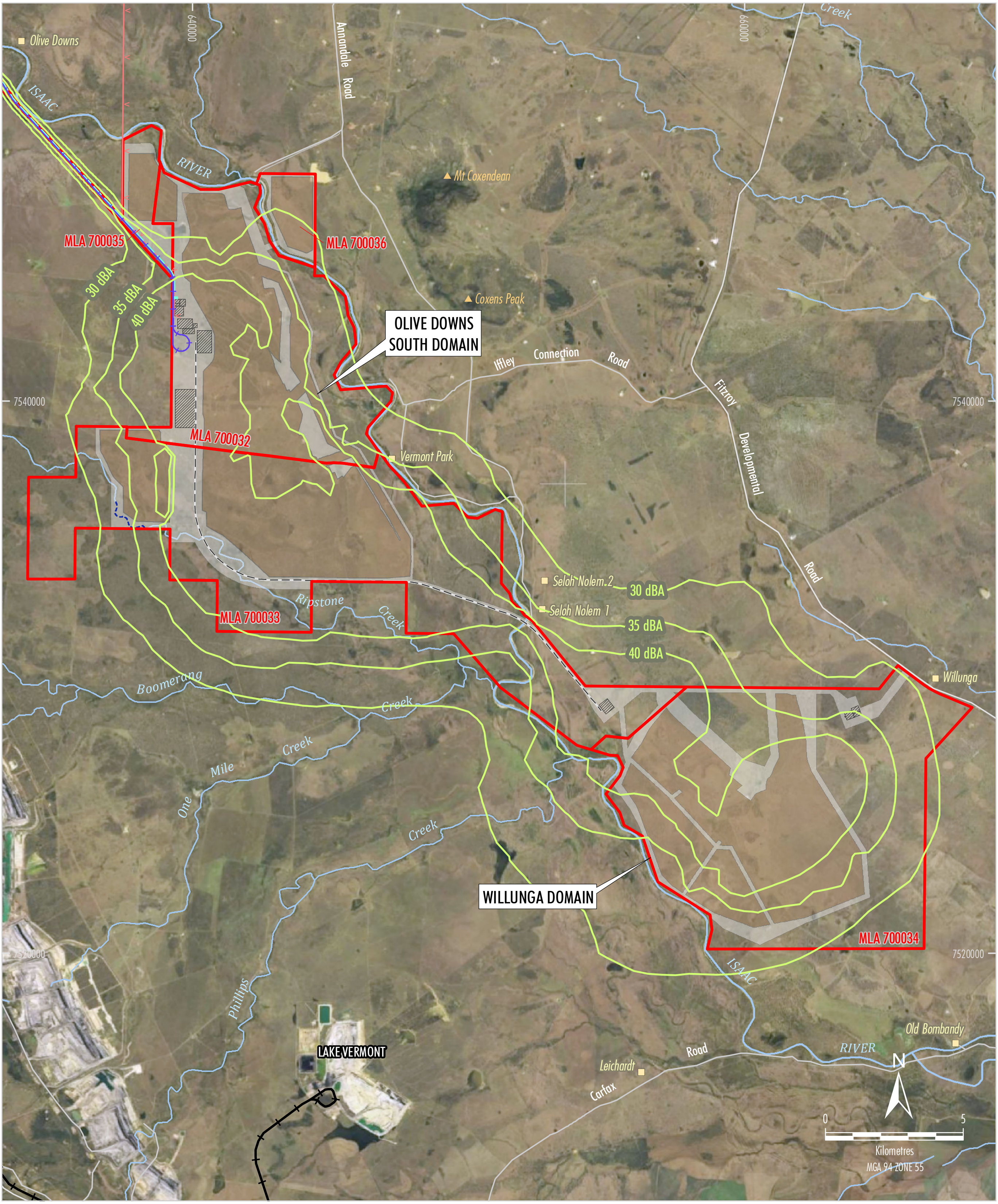
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2043
Netural Meteorological Conditions

Figure 4



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\ (15\ minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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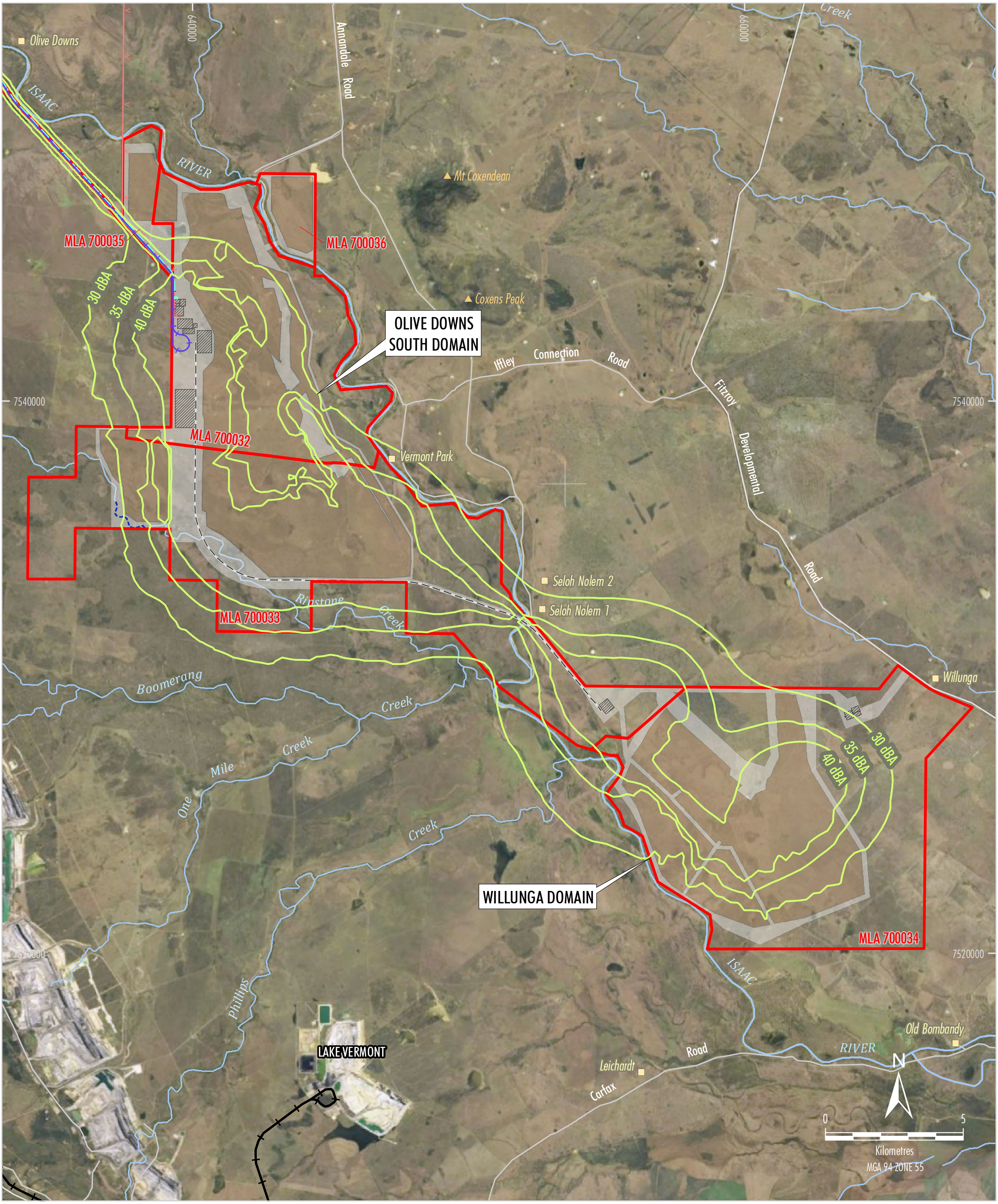
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2066
Adverse Meteorological Conditions

Figure 5



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\ (15\ minute)}$ Noise Contour

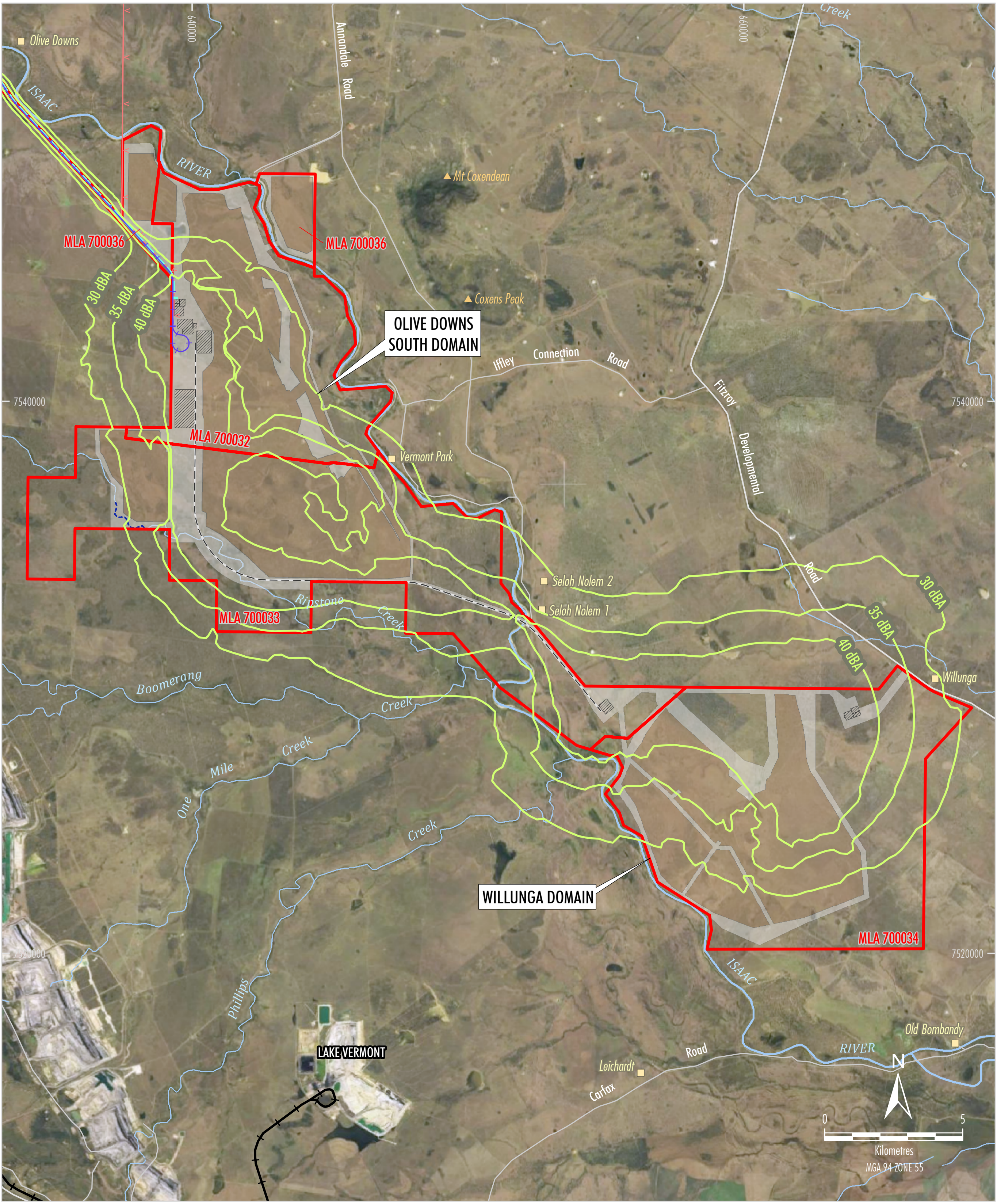
Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2066
Netural Meteorological Conditions

Figure 6



LEGEND
- Project Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\,(15\,minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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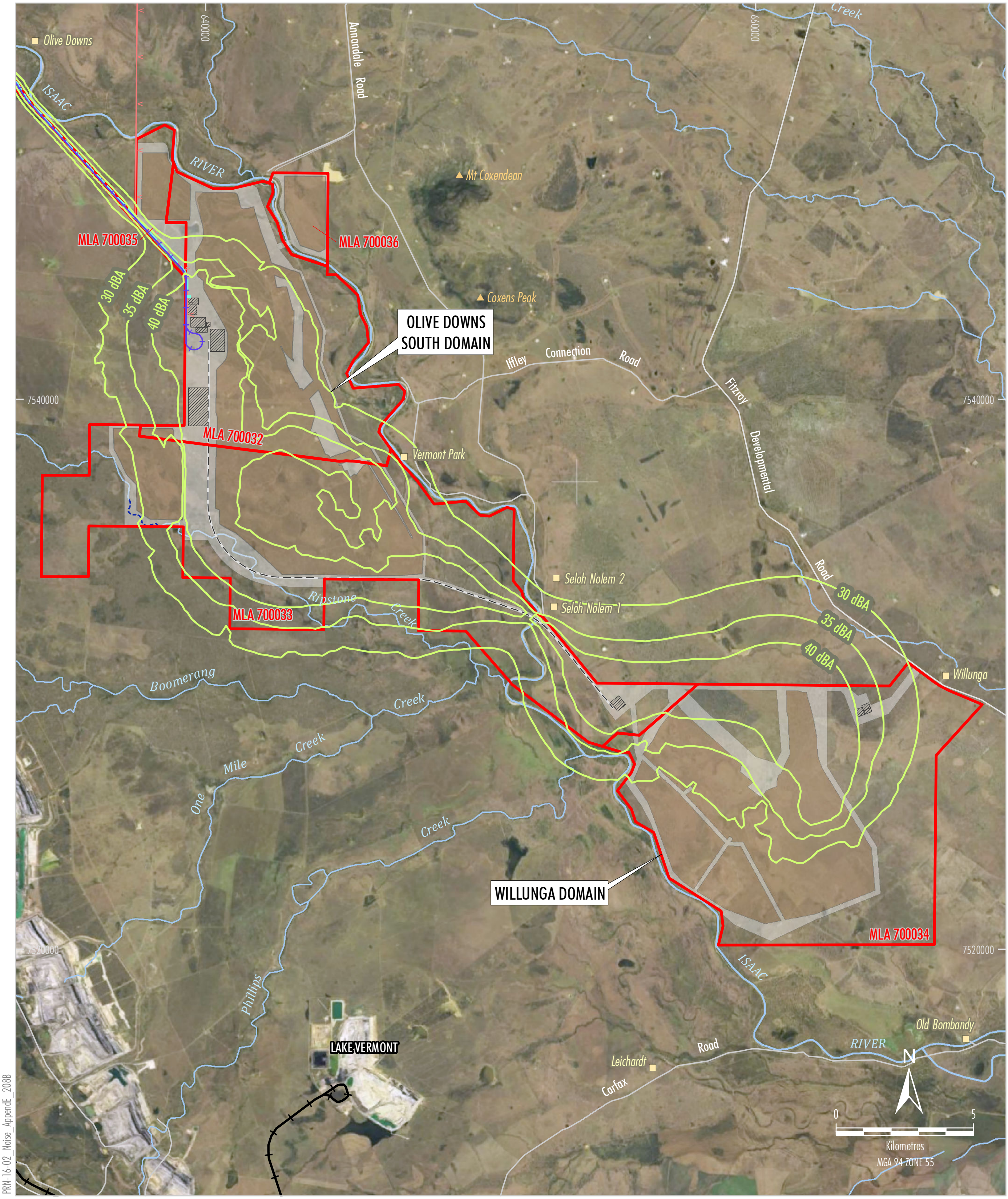
OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2085
Adverse Meteorological Conditions

Figure 7



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor
- $L_{Aeq\ (15\ minute)}$ Noise Contour

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Noise Contours - Year 2085
Netural Meteorological Conditions

Figure 8

APPENDIX F Attended Noise Monitoring Results

Operator attended noise measurements were conducted at three locations between 10.00pm and 11.45pm on Tuesday 8th August 2017.

The test instrumentation consisted of:

- portable noise logger NTi XL2 (S/N: A2A-05714-E0); and
- acoustical calibrator Bruel & Kjaer Type 4230 (S/N: 1206747).

The instrumentation complies with either AS1259 "Sound Level Meters" (now superseded) or Australian Standard (AS) IEC 61672.1 2004 "Electroacoustics - Sound Level Meters".

The instrument was calibrated prior and subsequent to measurements using the Bruel & Kjaer Type 4230 calibrator. No significant drift in calibration was observed. All equipment carries current National Association of Testing Authorities (NATA) certification (or if less than 2 years old, manufacturers certification).

Table F1 presents global positioning system (GPS) co-ordinates for operator attended noise measurements.

TableF1: Operator Attended Noise Monitoring Locations

Logger	Description	Coordinates in Universal Transverse Mercator (UTM)	
		Easting (m)	Northing (m)
S1	Intersection Annadale , Iffley Connection and Vermont Park Roads	650104 E	7540655 S
S2	Fitzroy Development Road, unsealed road leading to Old Bombandy	671917 E	7523032 S
S3	Fitzroy Development Road, driveway to Willunga	666712 E	7529620 S

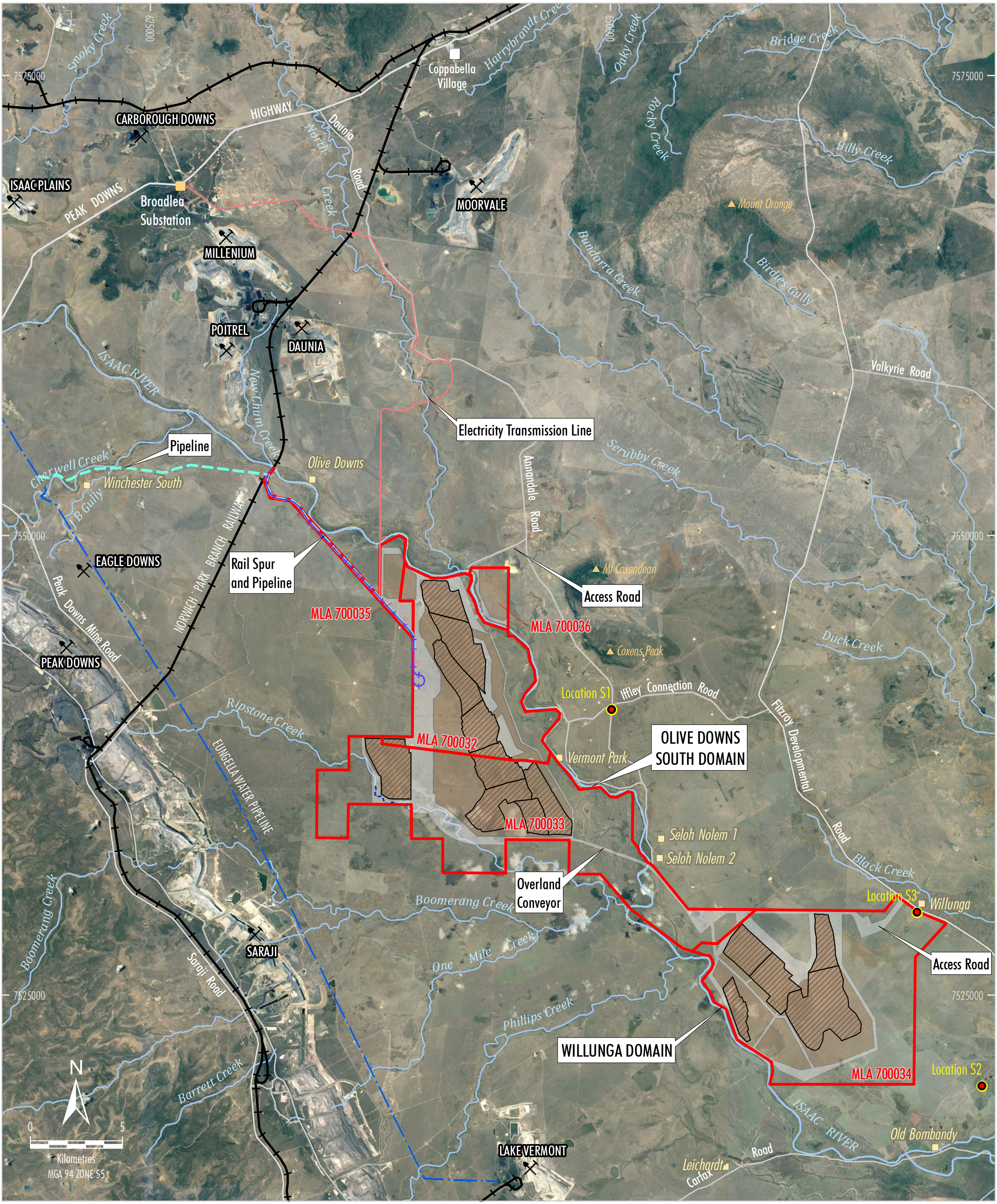
Figure F1 presents a locality map showing operator attended noise monitoring locations.

Table F2 presents results of operator attended noise monitoring.

Table F2: Operator Attended Noise Monitoring Results (8/08/2017)

Location	Period	Measured Background Noise Levels, dBA			Comments
		$L_{eq\ 15\ minute}$	$L_{1\ 15\ minute}$	$L_{90\ 15\ minute}$	
S1	10.15 pm – 10.30 pm	31	41	18	Very quiet ambient noise environment. No wind, no cloud cover, temperature 16 degrees Celsius (°C).
S2	10.45 pm – 11.00 pm	34	48	24	Very quiet ambient noise environment. No wind, no cloud cover, temperature 16°C.
S3	11.15 pm – 11.30 pm	18	24	17	Very quiet ambient noise environment. No wind, no cloud cover, temperature 16°C.

All measurement procedures used and the results reported in this document were conducted in accordance with Renzo Tonin Ron Rumble's Quality Assurance System, Australian Standard 1055-1989 "Acoustics - Description and Measurement of Environmental Noise" and the Department of Environment and Heritage Protection's (DEHP) Noise Measurement Manual 2013.



LEGEND

- Mining Lease Application Boundary
- Operator Attended Noise Monitoring Location
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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OLIVE DOWNS COKING COAL PROJECT

Operator Attended
Noise Monitoring Locations

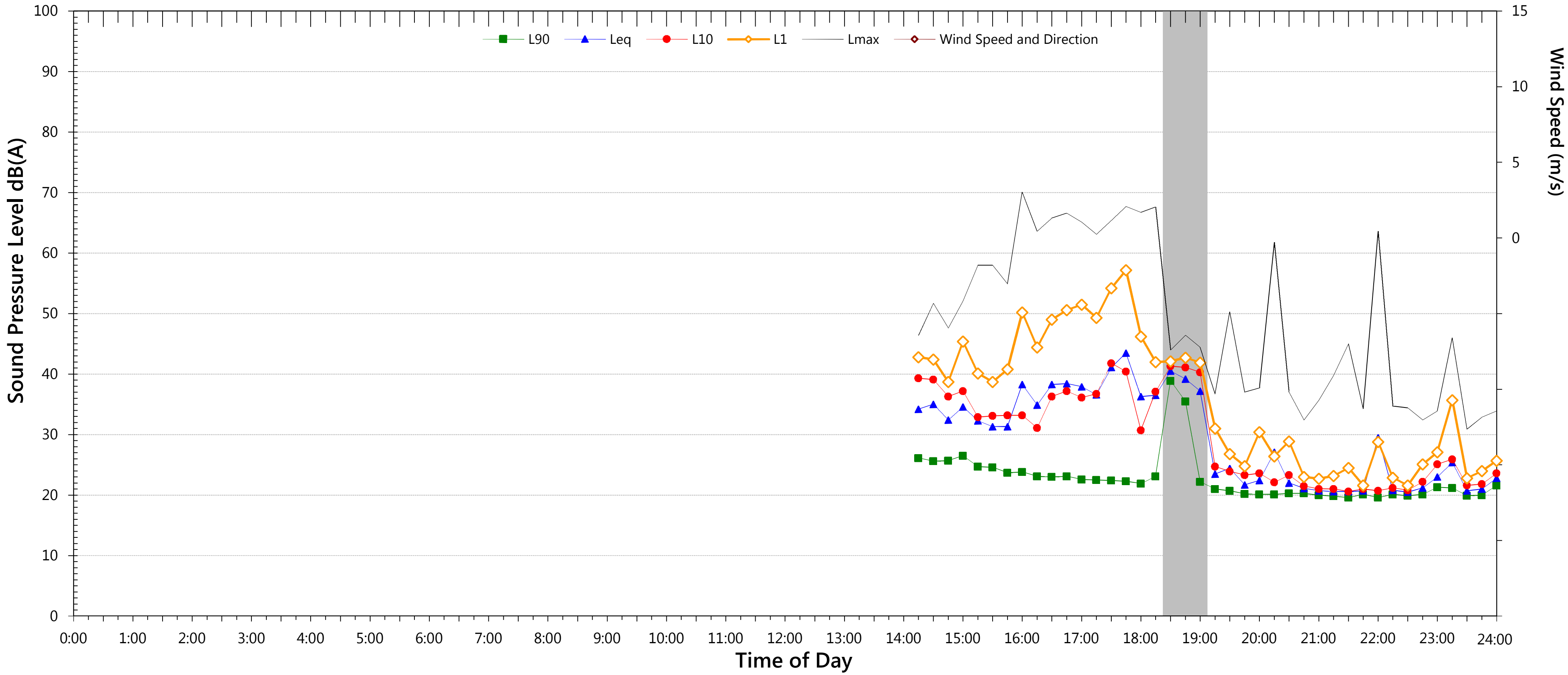
Figure 1

APPENDIX G Noise Monitoring Results

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Tuesday, 8 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	60.2	44.5	41.4
L_1	46.3	27.2	30.6
L_{10}	35.9	23.4	25.1
L_{90}	22.6	19.8	19.6
Leq	37.4	27.6	37.3

Notes:

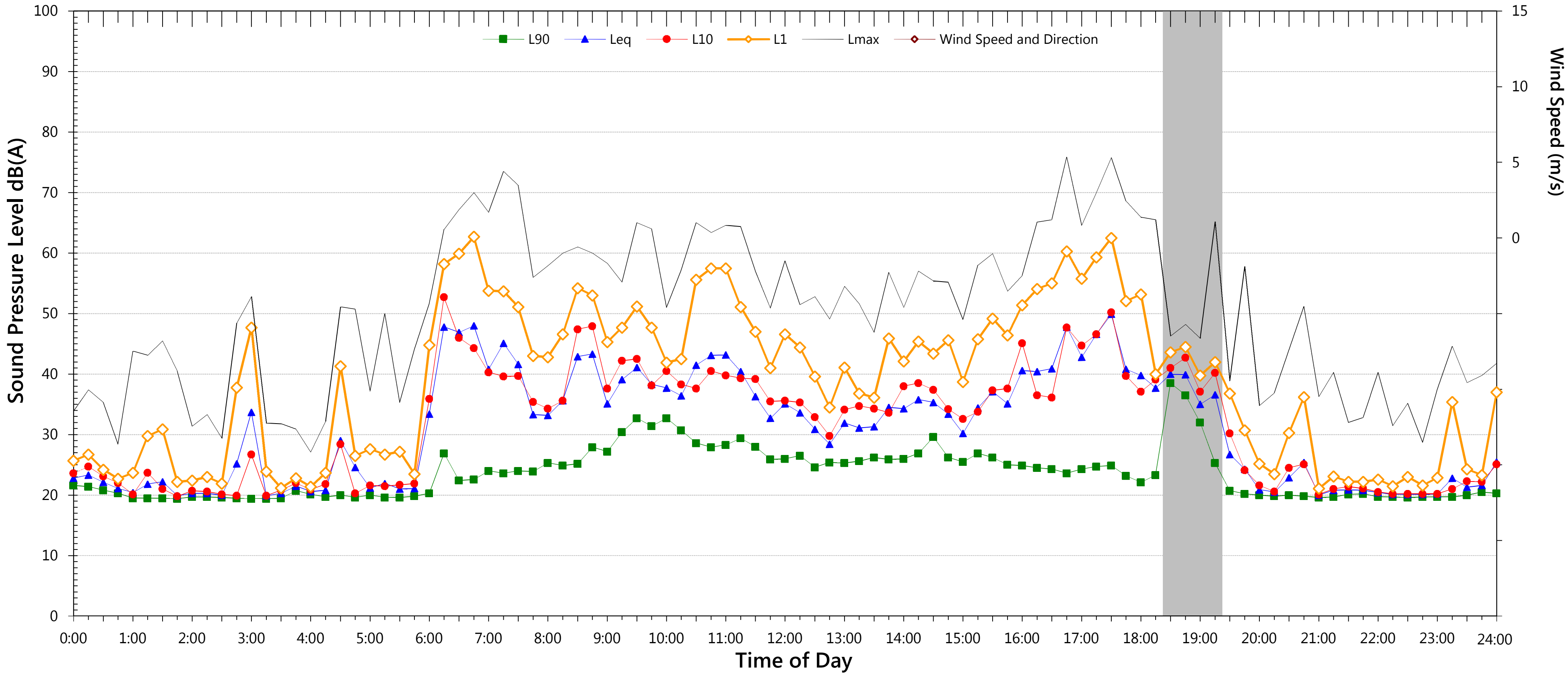
1. Grey areas indicate periods of time that are either affected by rain,wind or other extraneous factors

2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Wednesday, 9 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	59.6	42.6	41.6
L_1	48.1	27.8	30.3
L_{10}	38.5	24.1	24.3
L_{90}	24.5	19.7	19.6
Leq	40.8	28.2	36.6

Notes:

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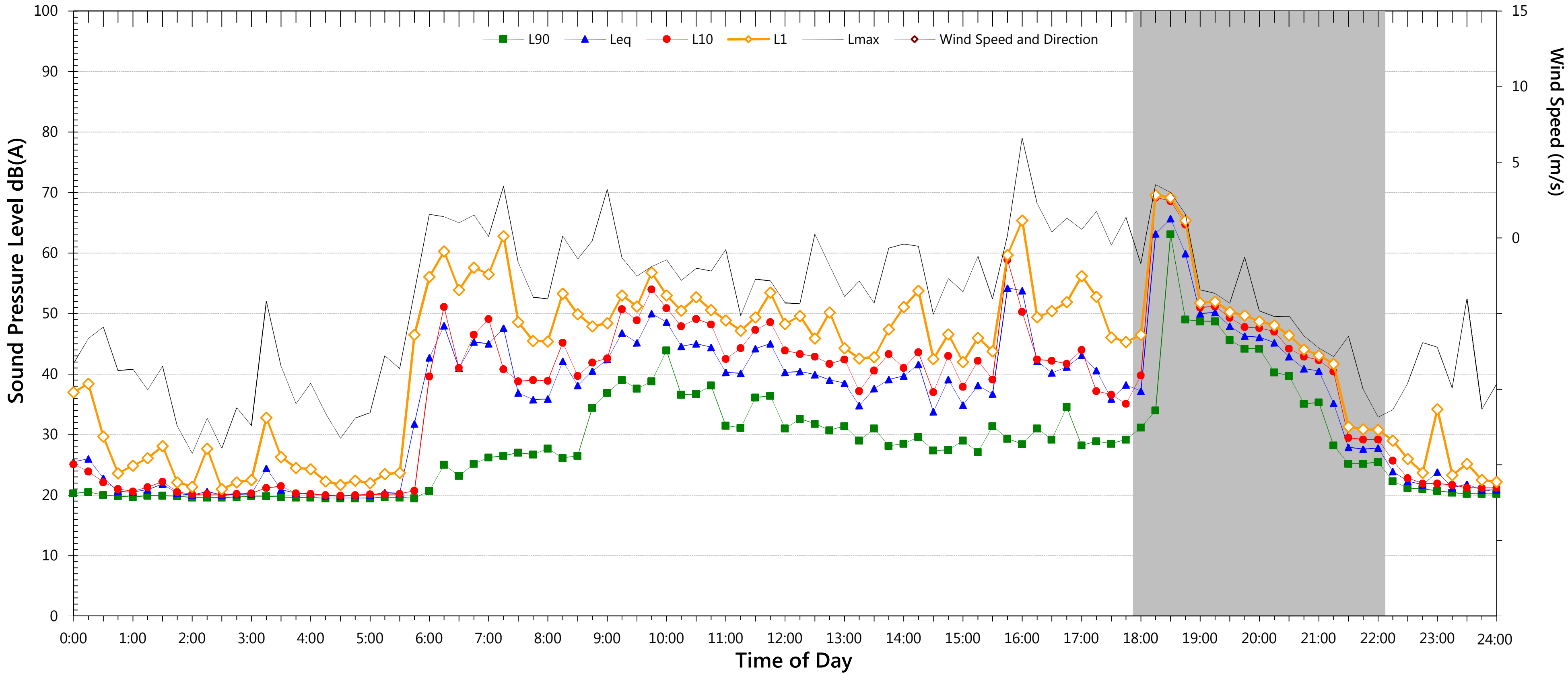
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Thursday, 10 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	59.3	-	44.4
L_1	49.8	-	31.9
L_{10}	43.4	-	25.9
L_{90}	28.0	-	19.8
Leq	44.6	-	38.8

Notes:

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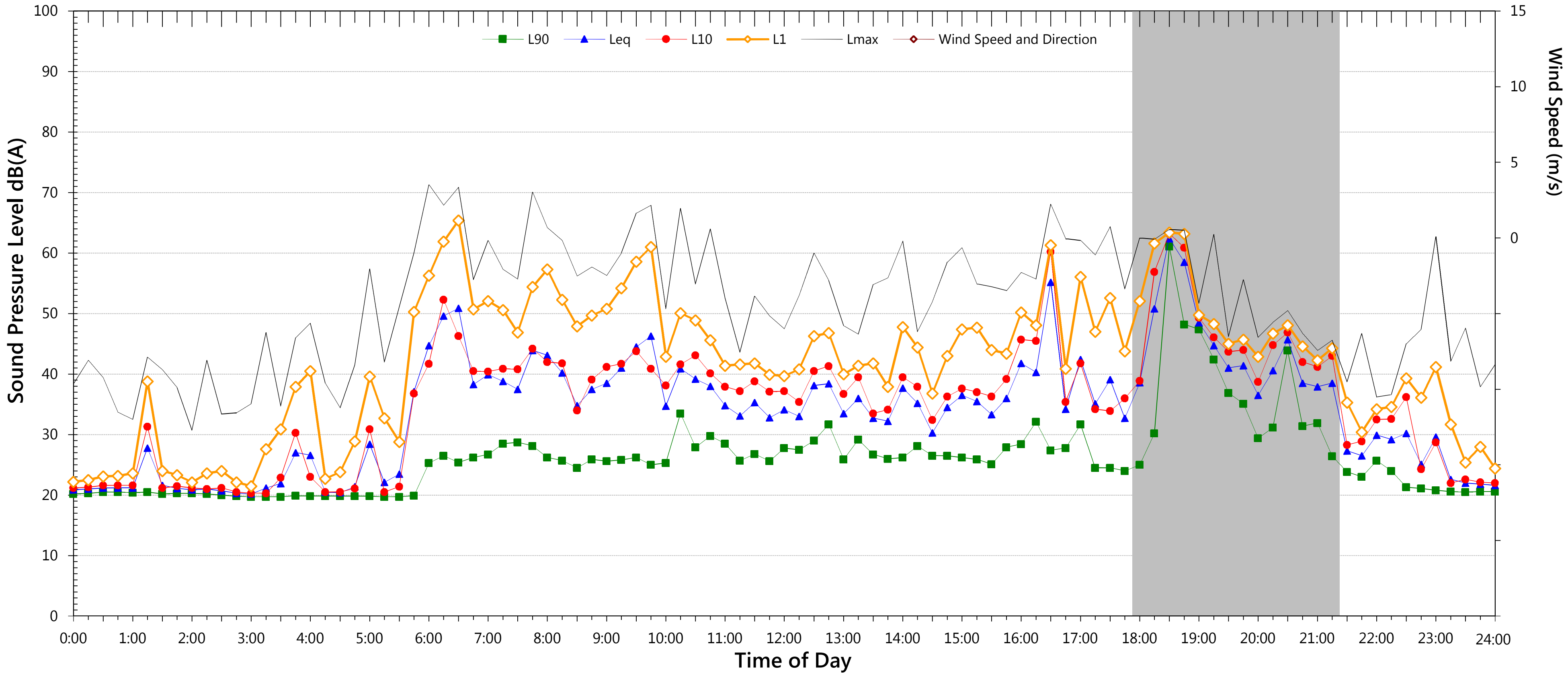
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Friday, 11 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	57.2	40.5	44.9
L_1	47.1	33.3	32.6
L_{10}	39.3	29.9	26.7
L_{90}	25.5	23.0	20.4
Leq	41.8	28.2	38.9

Notes:

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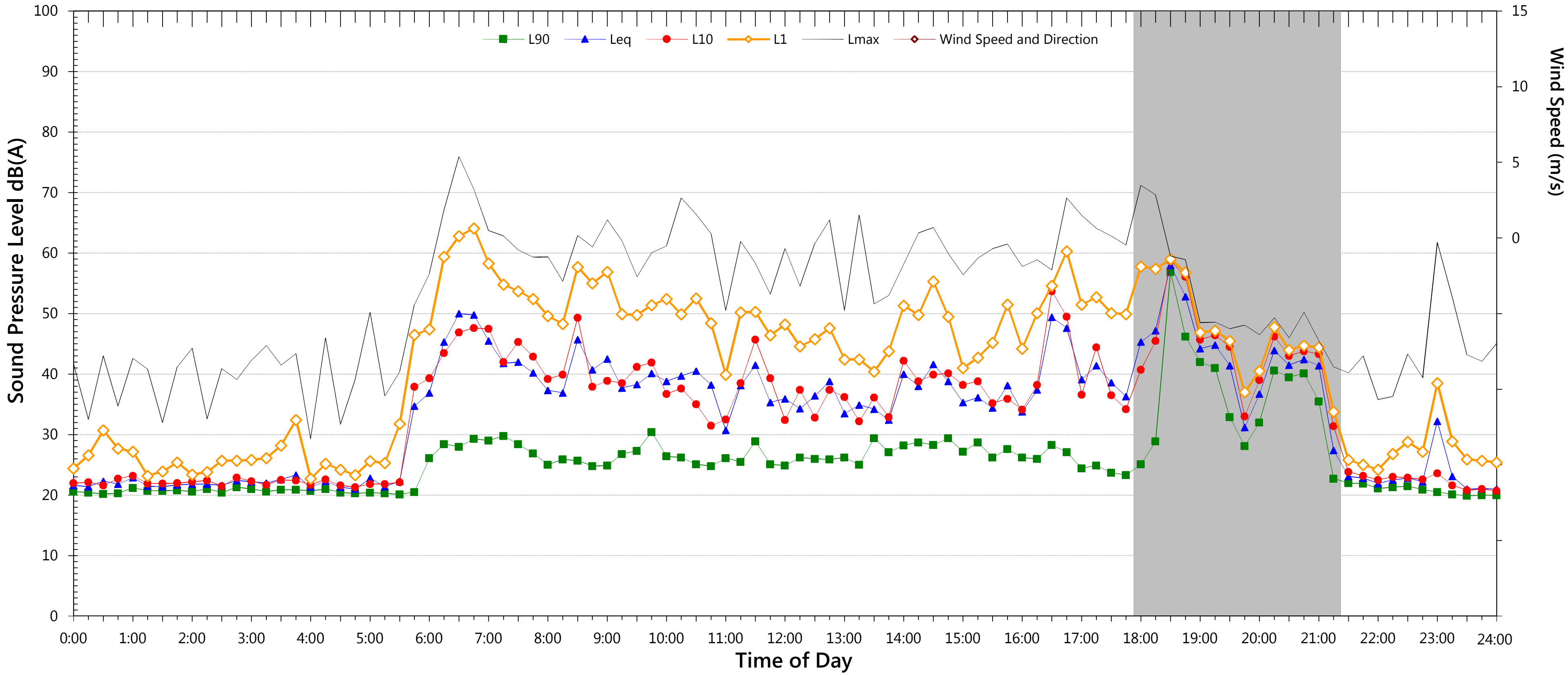
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Saturday, 12 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	60.3	39.7	46.6
L_1	49.4	25.0	32.2
L_{10}	38.8	23.2	24.9
L_{90}	25.1	21.1	19.6
Leq	40.4	22.6	41.4

Notes:

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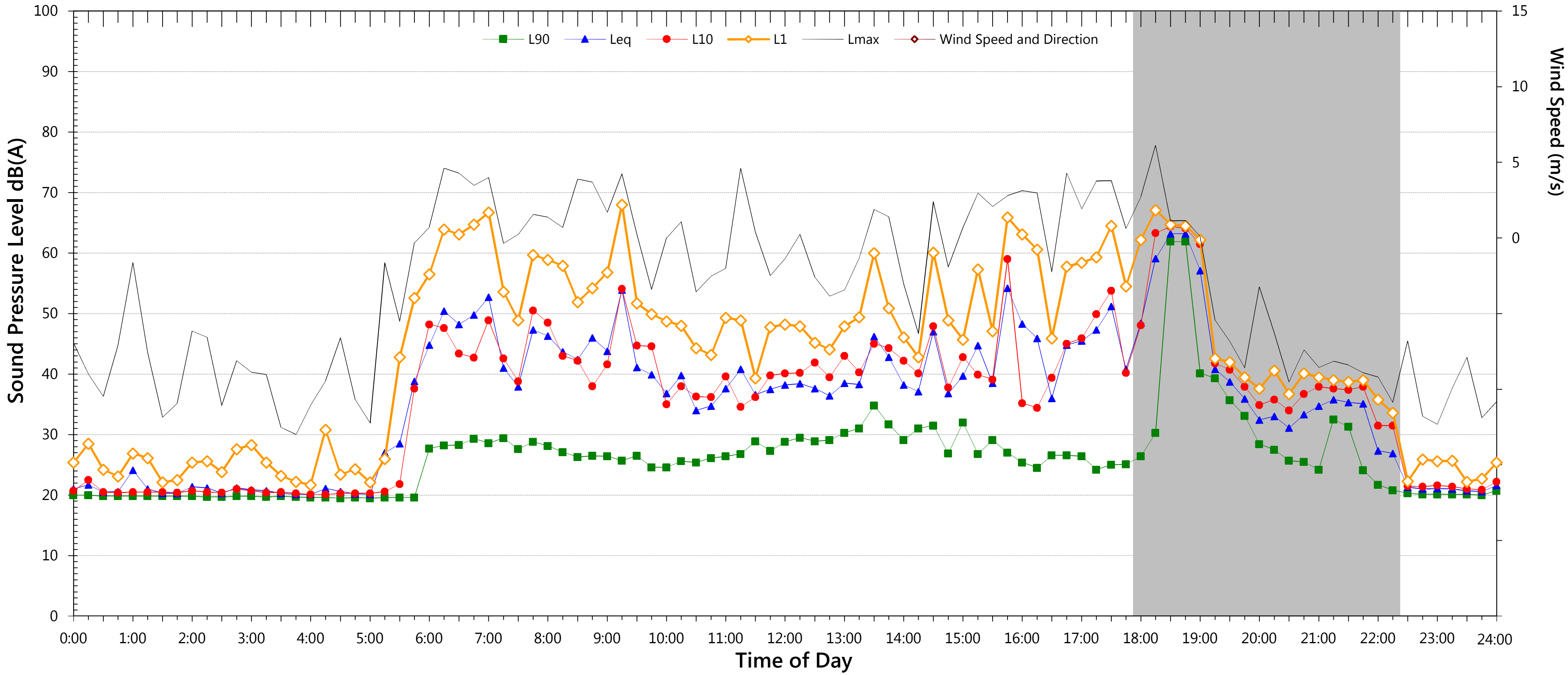
Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Sunday, 13 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	63.6	-	44.4
L_1	52.4	-	30.1
L_{10}	42.1	-	24.8
L_{90}	25.8	-	19.9
Leq	45.1	-	42.1

Notes:

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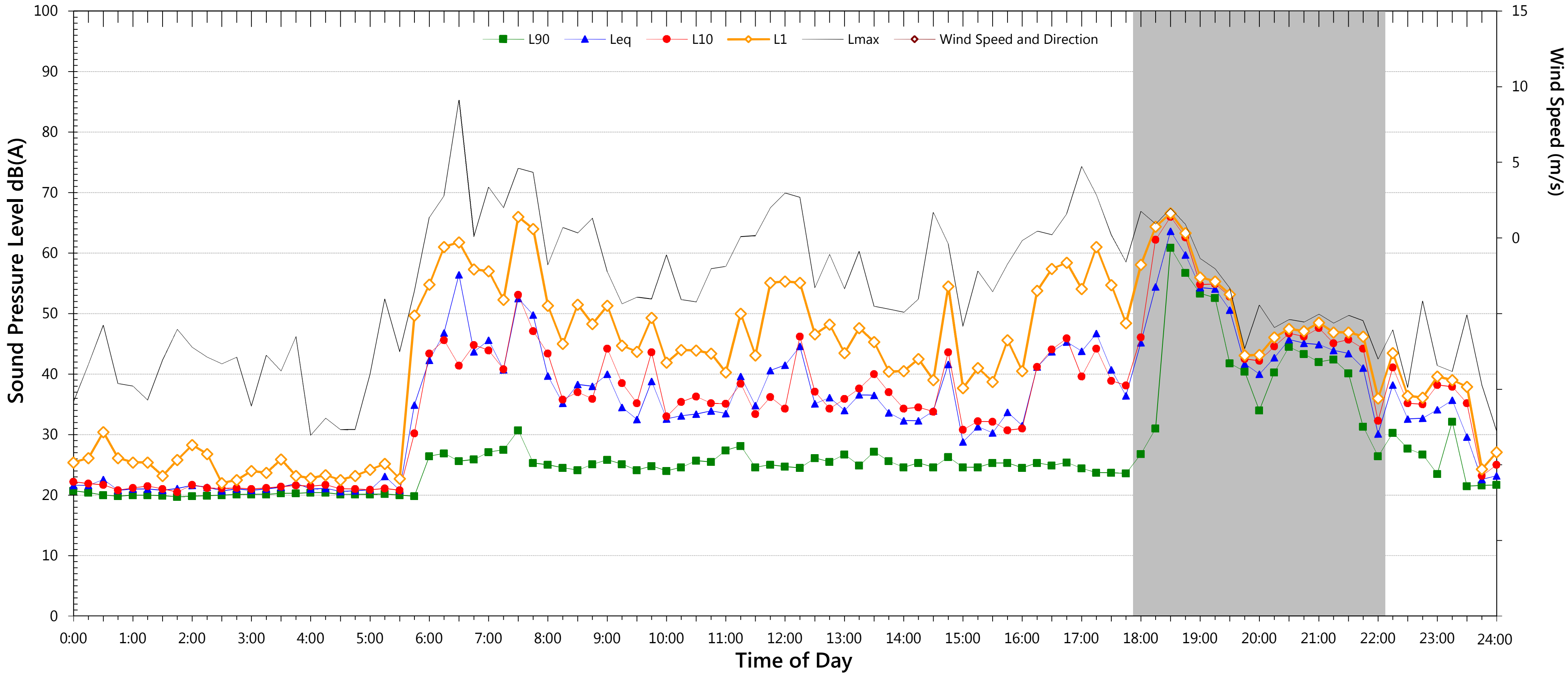
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Monday, 14 August 2017



Representative Noise Levels			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
Lmax	60.2	-	44.8
L_1	48.3	-	33.4
L_{10}	38.0	-	28.4
L_{90}	24.4	-	20.1
Leq	41.6	-	40.1

Notes:

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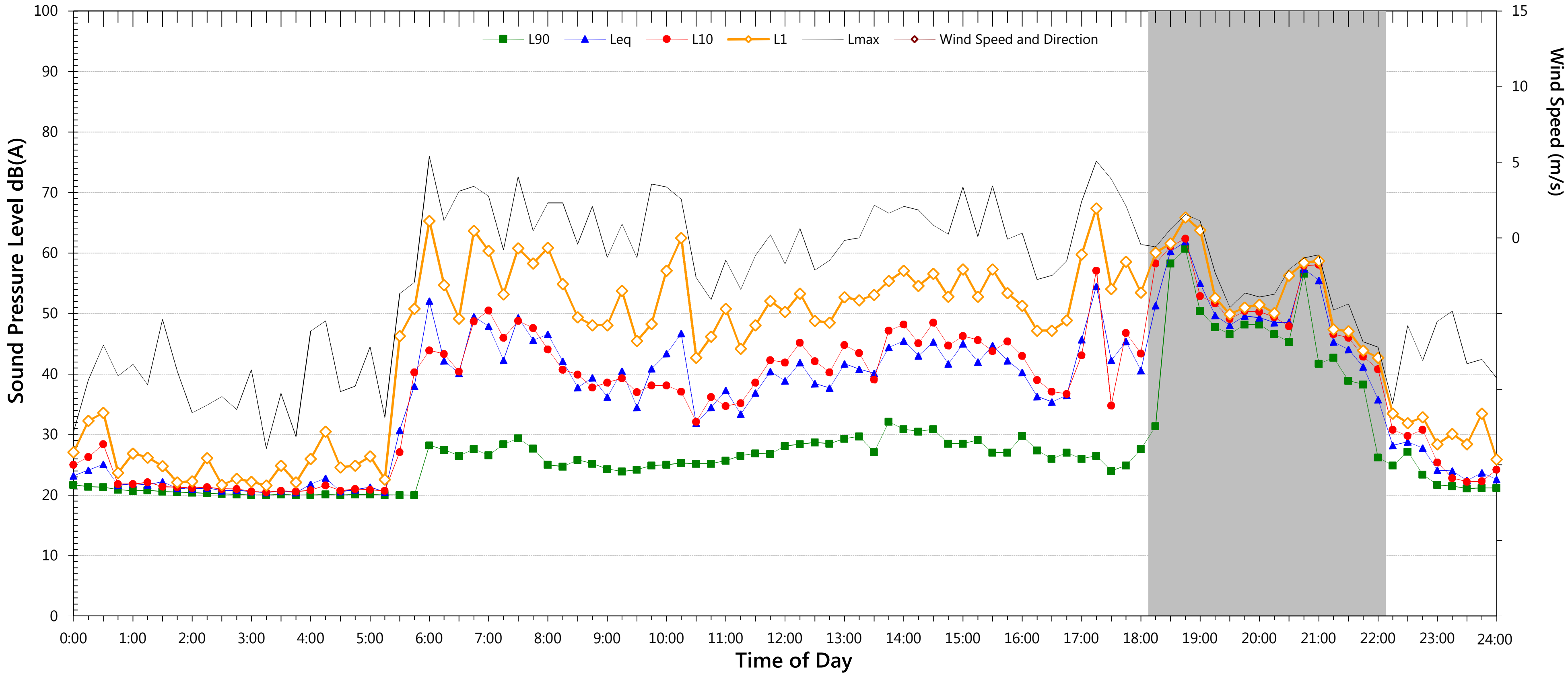
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Tuesday, 15 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	63.8	-	45.7
L_1	52.9	-	31.7
L_{10}	41.9	-	25.9
L_{90}	25.3	-	20.1
Leq	43.8	-	36.1

Notes:

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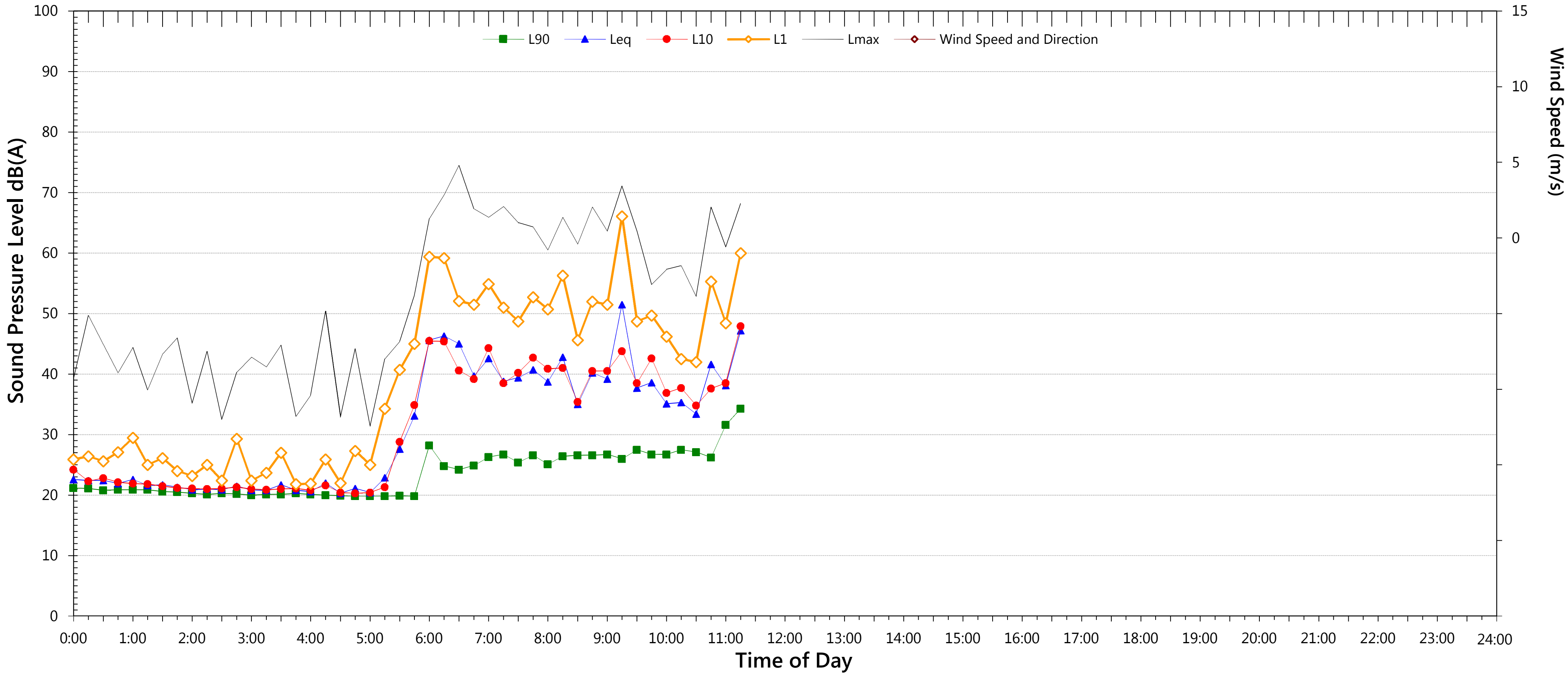
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Deverill

Wednesday, 16 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	63.0	-	-
L_1	51.0	-	-
L_{10}	39.9	-	-
L_{90}	26.1	-	-
Leq	42.7	-	-

Notes:

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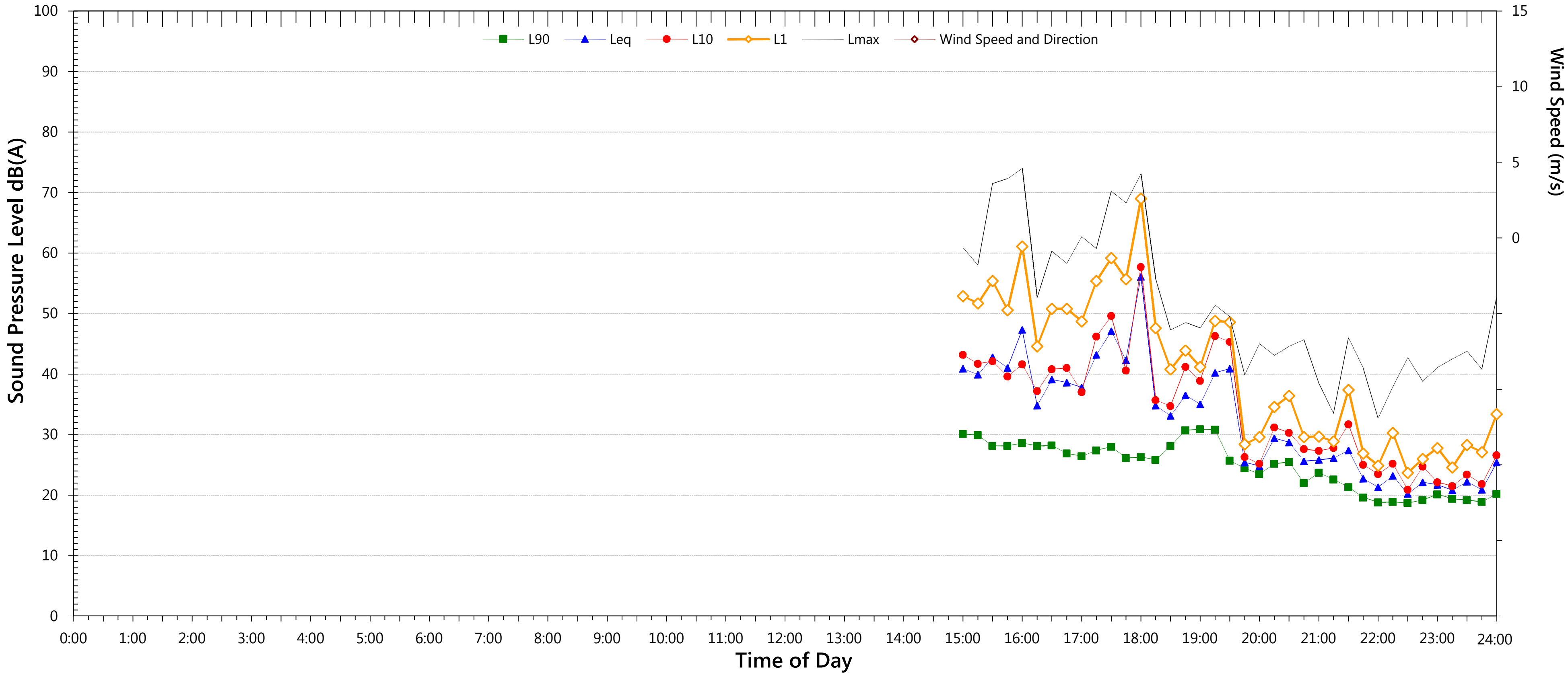
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Tuesday, 8 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	64.8	44.4	43.7
L_1	54.3	36.1	32.4
L_{10}	42.9	32.4	28.3
L_{90}	26.9	22.0	18.6
Leq	46.8	34.0	39.1

Notes:

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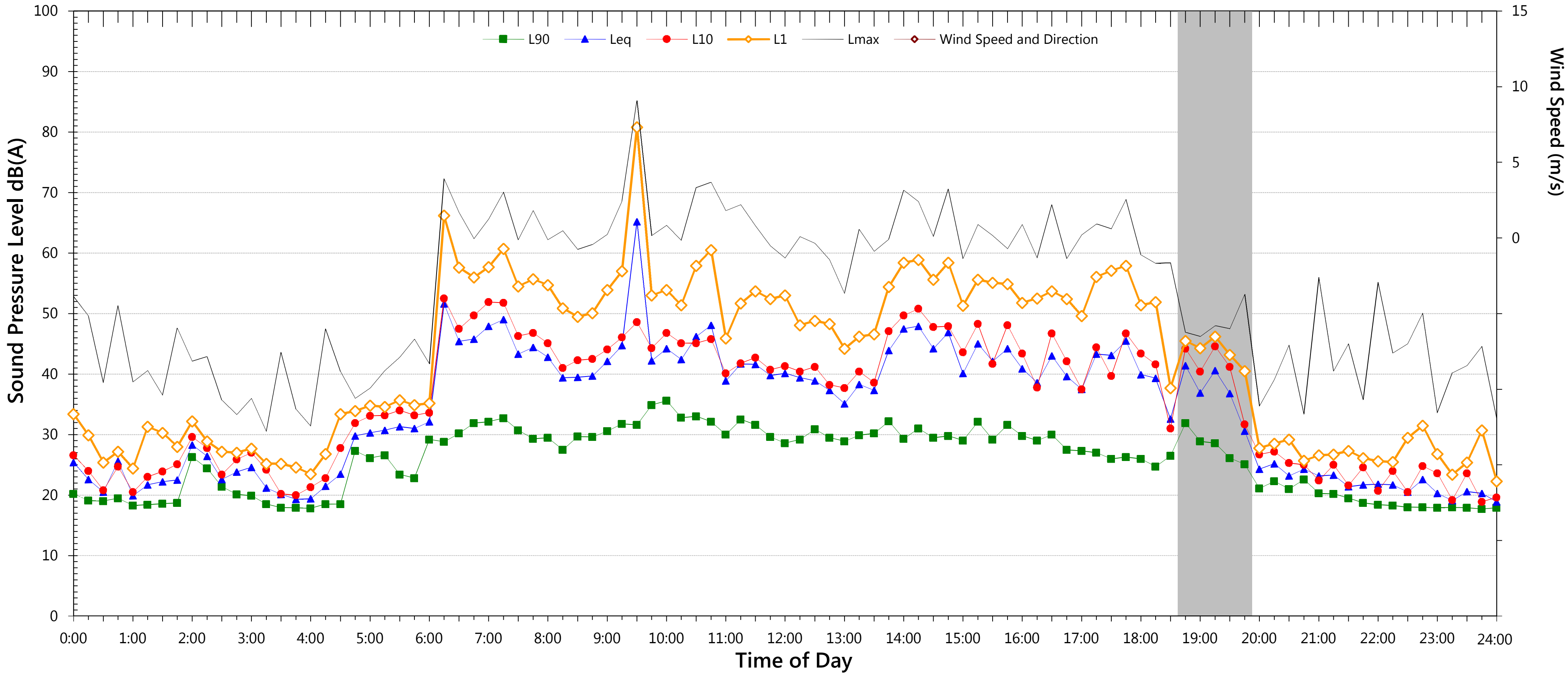
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Wednesday, 9 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	64.3	45.6	45.0
L_1	53.8	30.3	31.6
L_{10}	43.9	26.5	25.7
L_{90}	28.5	19.4	17.7
Leq	49.8	30.5	41.8

Notes:

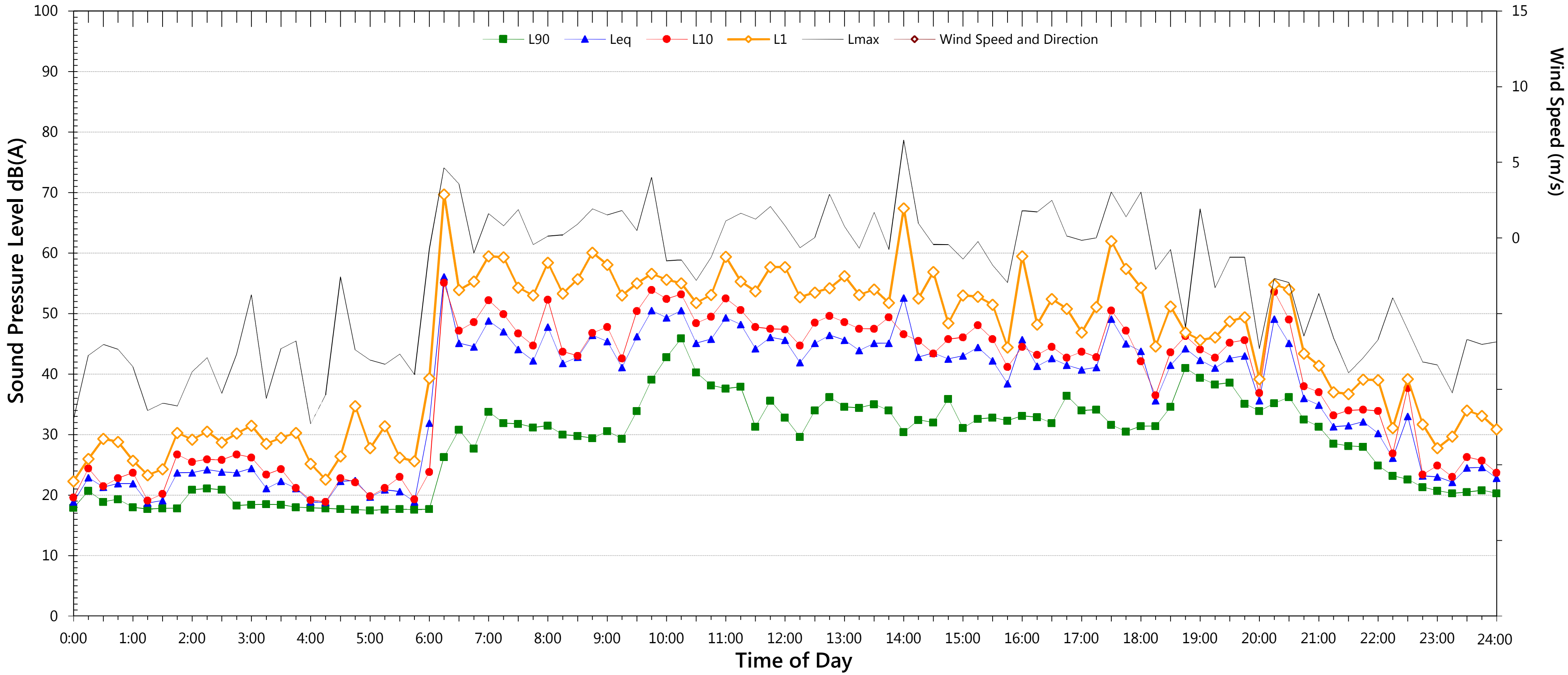
1. Grey areas indicate periods of time that are either affected by rain,wind or other extraneous factors

2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Thursday, 10 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	64.2	52.2	46.2
L_1	54.6	44.8	33.7
L_{10}	47.1	40.9	28.1
L_{90}	31.1	29.8	19.6
Leq	45.9	41.8	44.2

Notes:

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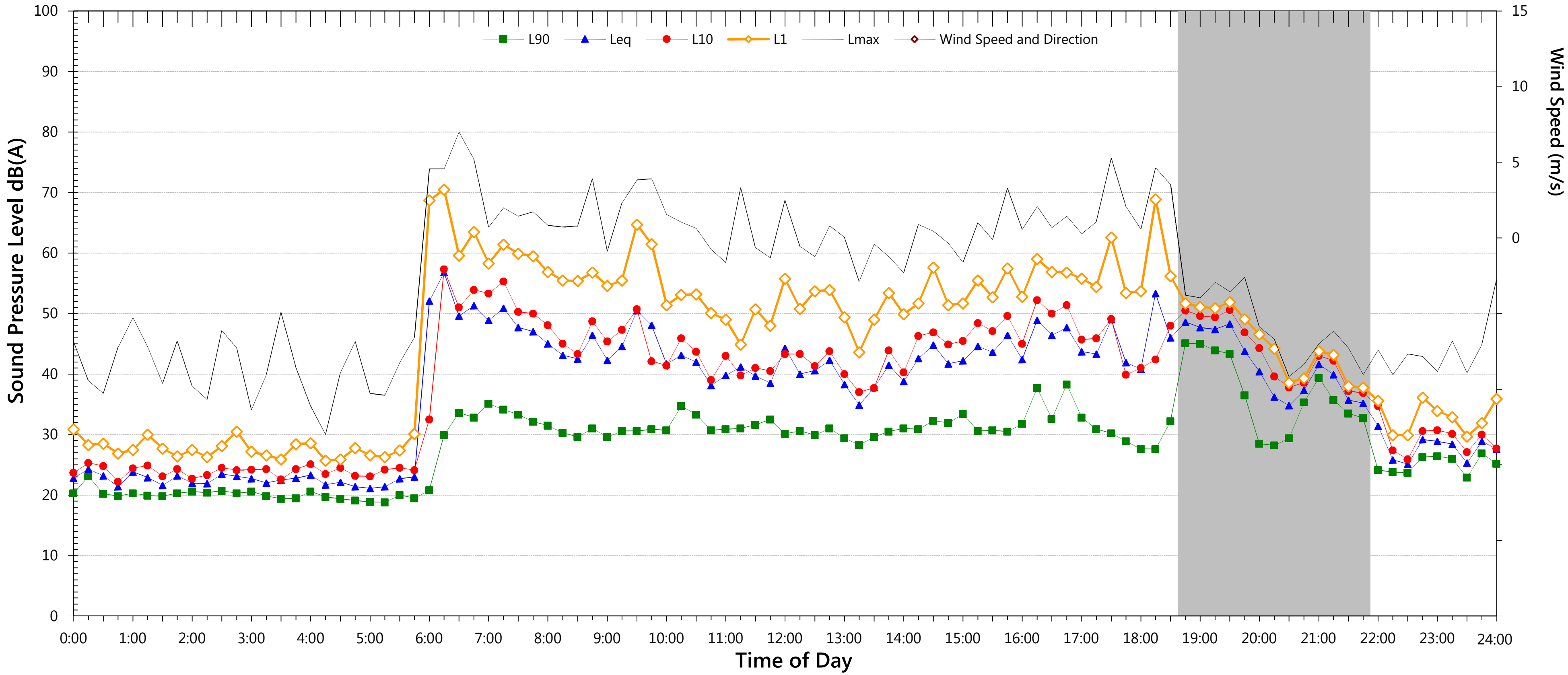
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Friday, 11 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	64.5	63.1	46.9
L_1	54.2	53.6	36.9
L_{10}	45.0	41.7	31.8
L_{90}	30.0	24.1	22.5
Leq	44.7	49.3	42.1

Notes:

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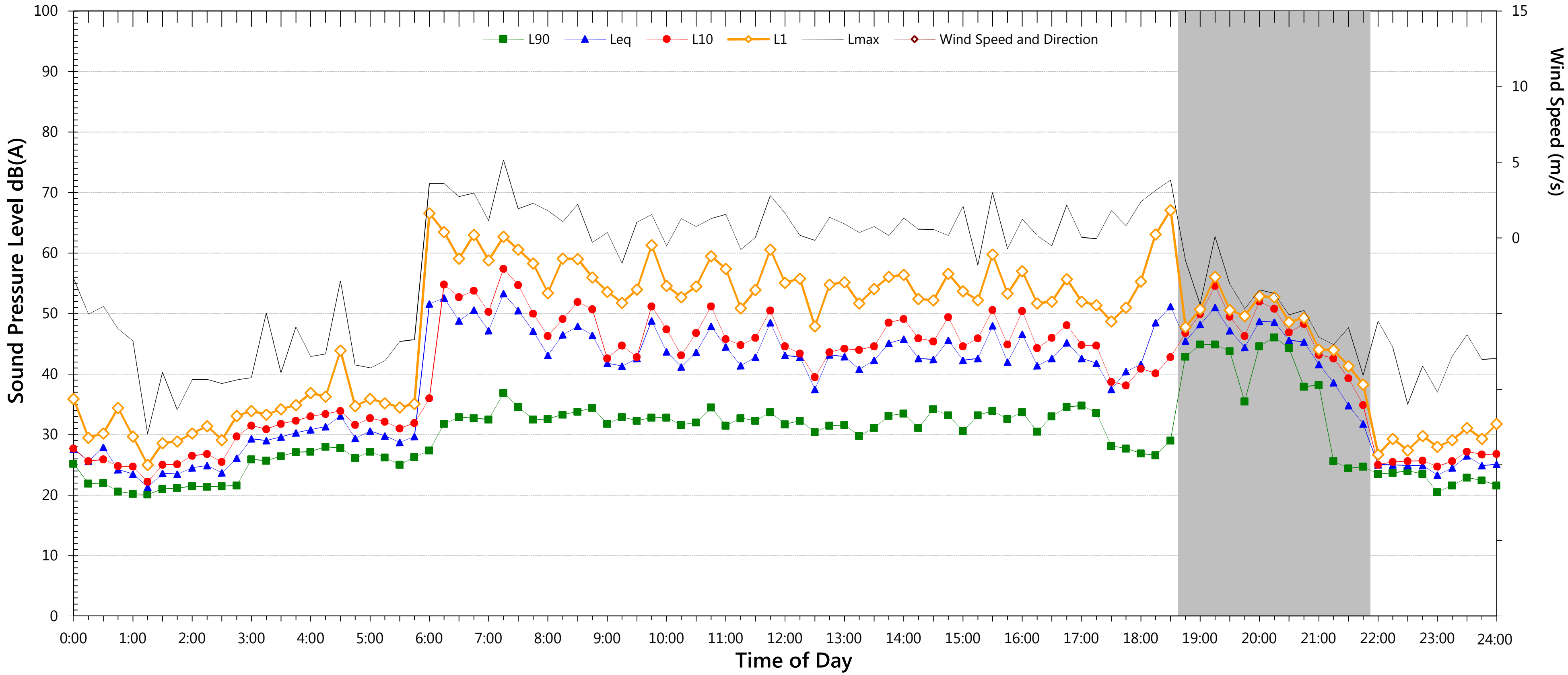
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Saturday, 12 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	64.8	63.7	46.9
L_1	54.9	52.3	34.3
L_{10}	46.4	36.0	28.2
L_{90}	31.0	23.5	18.5
Leq	45.2	48.3	44.2

Notes:

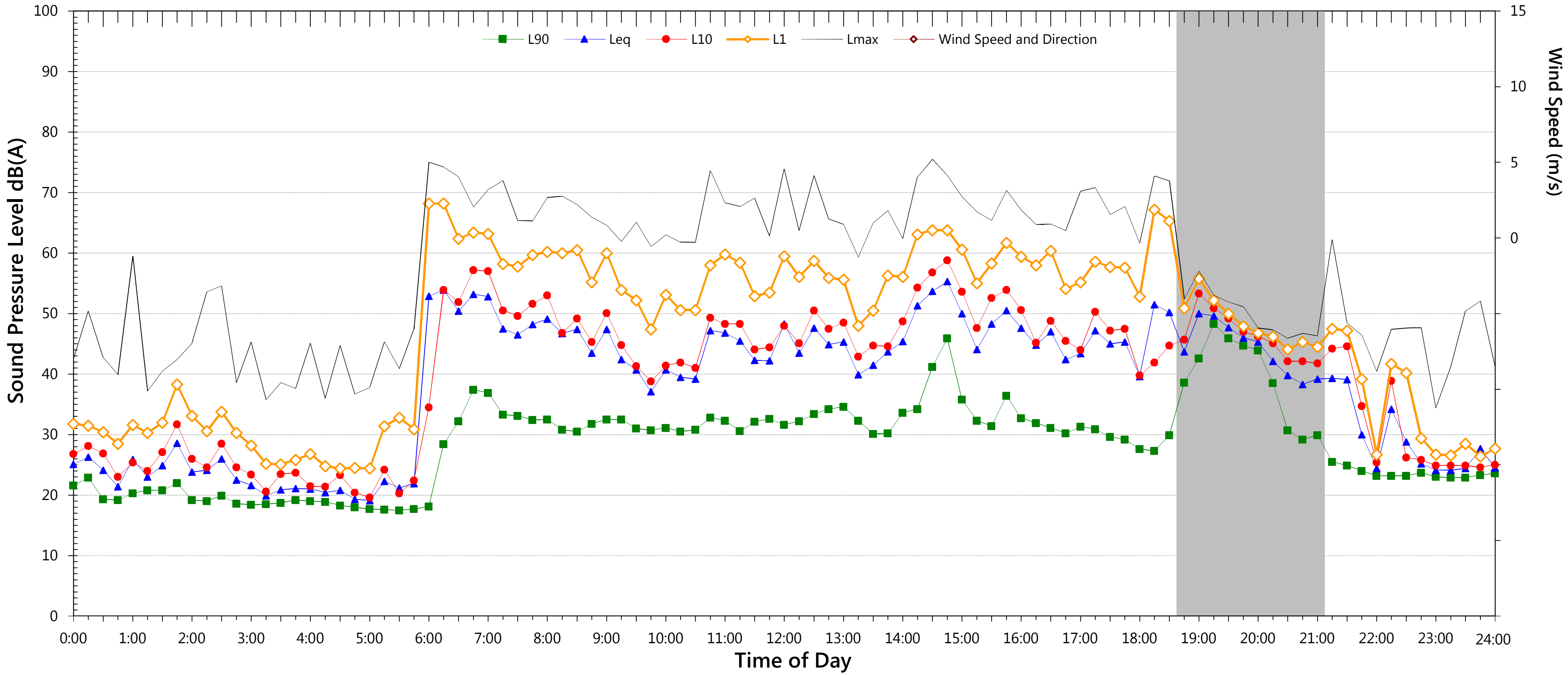
1. Grey areas indicate periods of time that are either affected by rain,wind or other extraneous factors

2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Sunday, 13 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	66.8	57.0	45.9
L_1	56.8	48.9	33.4
L_{10}	47.7	39.3	28.0
L_{90}	30.7	24.0	18.6
Leq	47.1	46.4	44.3

Notes:

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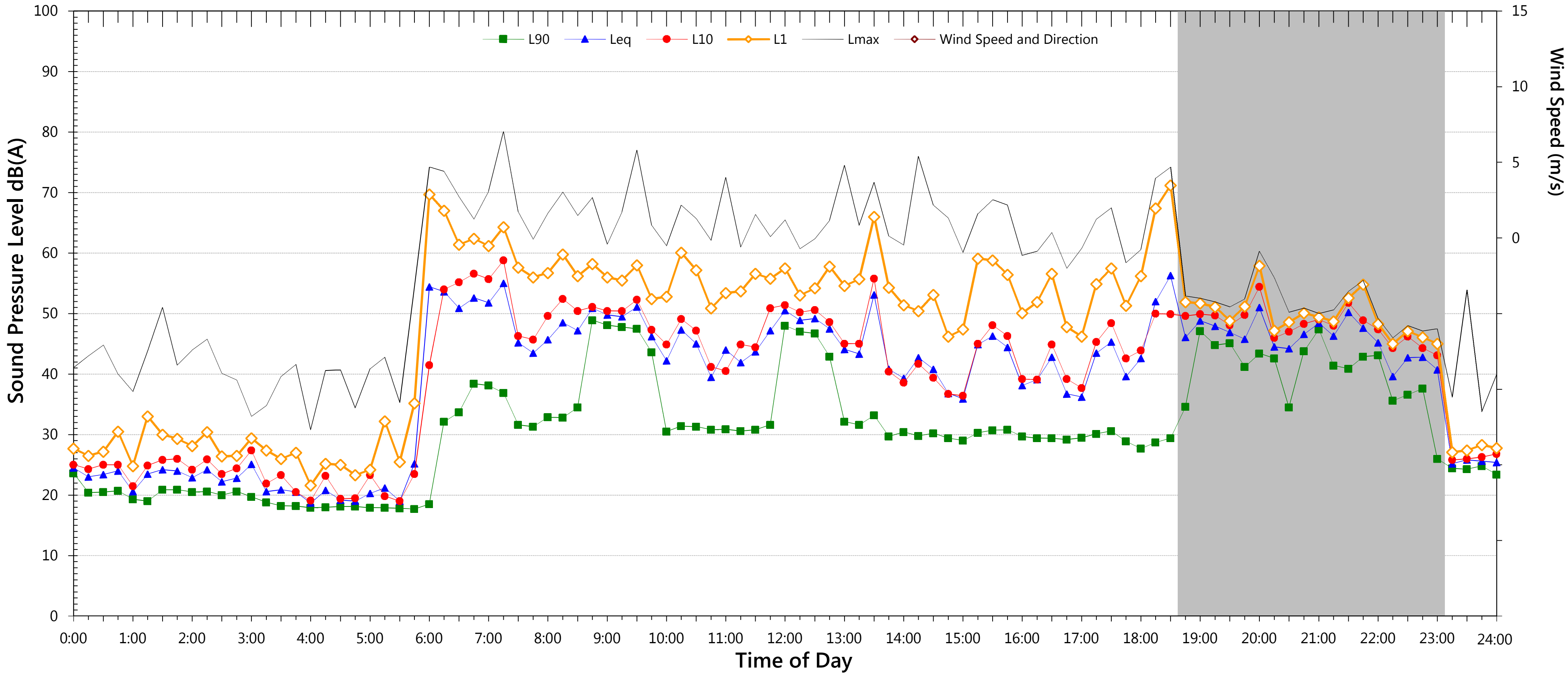
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Monday, 14 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	65.6	73.3	44.6
L_1	55.0	69.3	33.1
L_{10}	45.8	50.0	29.3
L_{90}	29.9	28.7	19.8
Leq	46.8	54.7	45.2

Notes:

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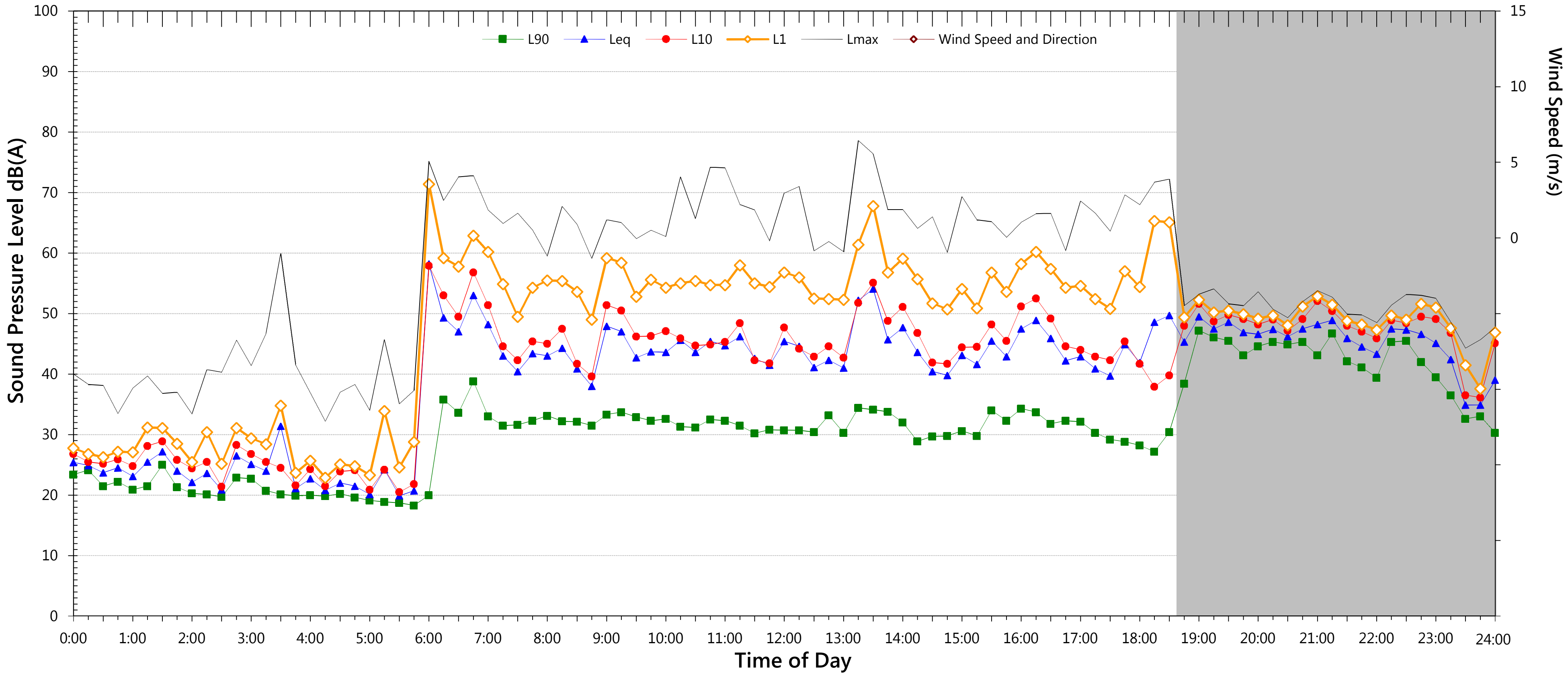
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Tuesday, 15 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	66.1	72.0	47.0
L_1	55.2	65.2	36.8
L_{10}	45.8	38.9	31.5
L_{90}	30.4	27.2	19.0
Leq	45.4	49.2	45.5

Notes:

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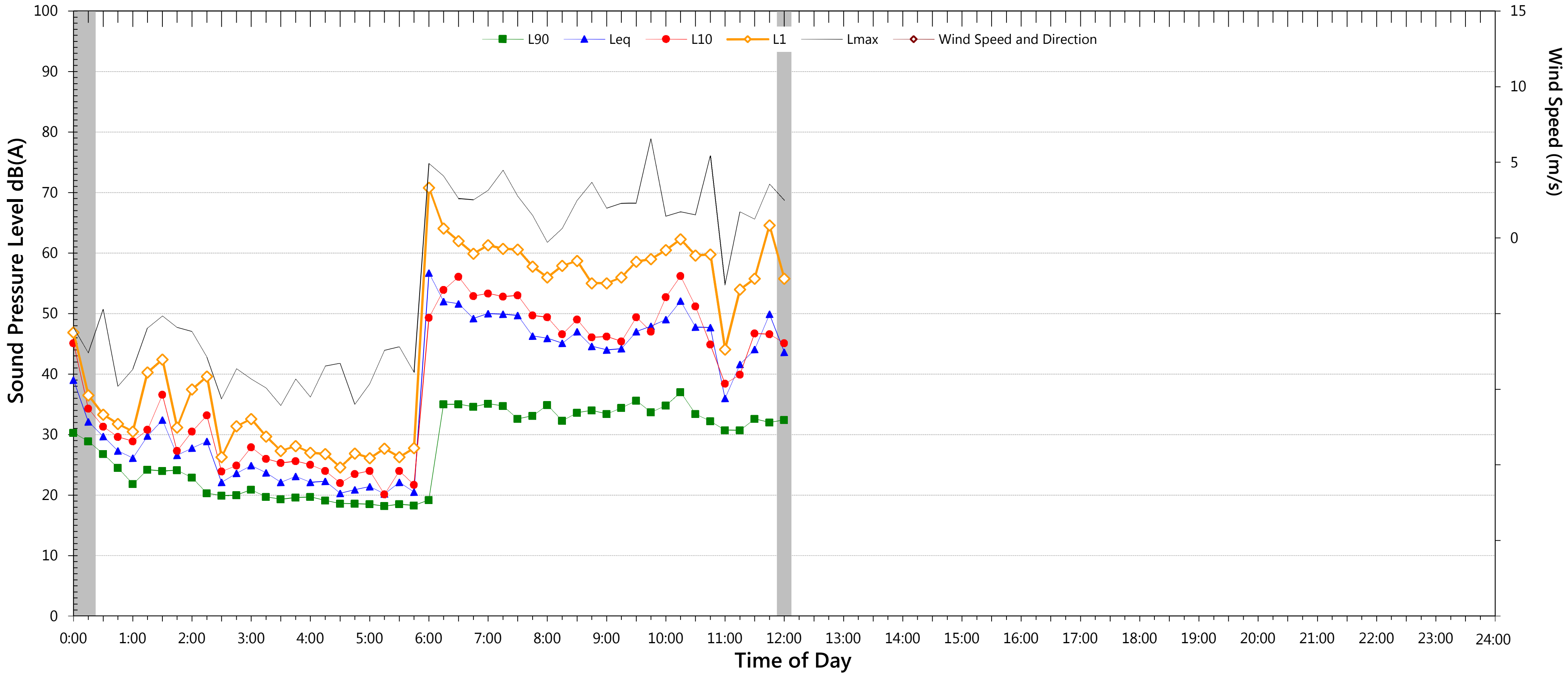
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Vermont Park

Wednesday, 16 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	68.0	-	-
L_1	57.7	-	-
L_{10}	48.0	-	-
L_{90}	32.0	-	-
Leq	47.4	-	-

Notes:

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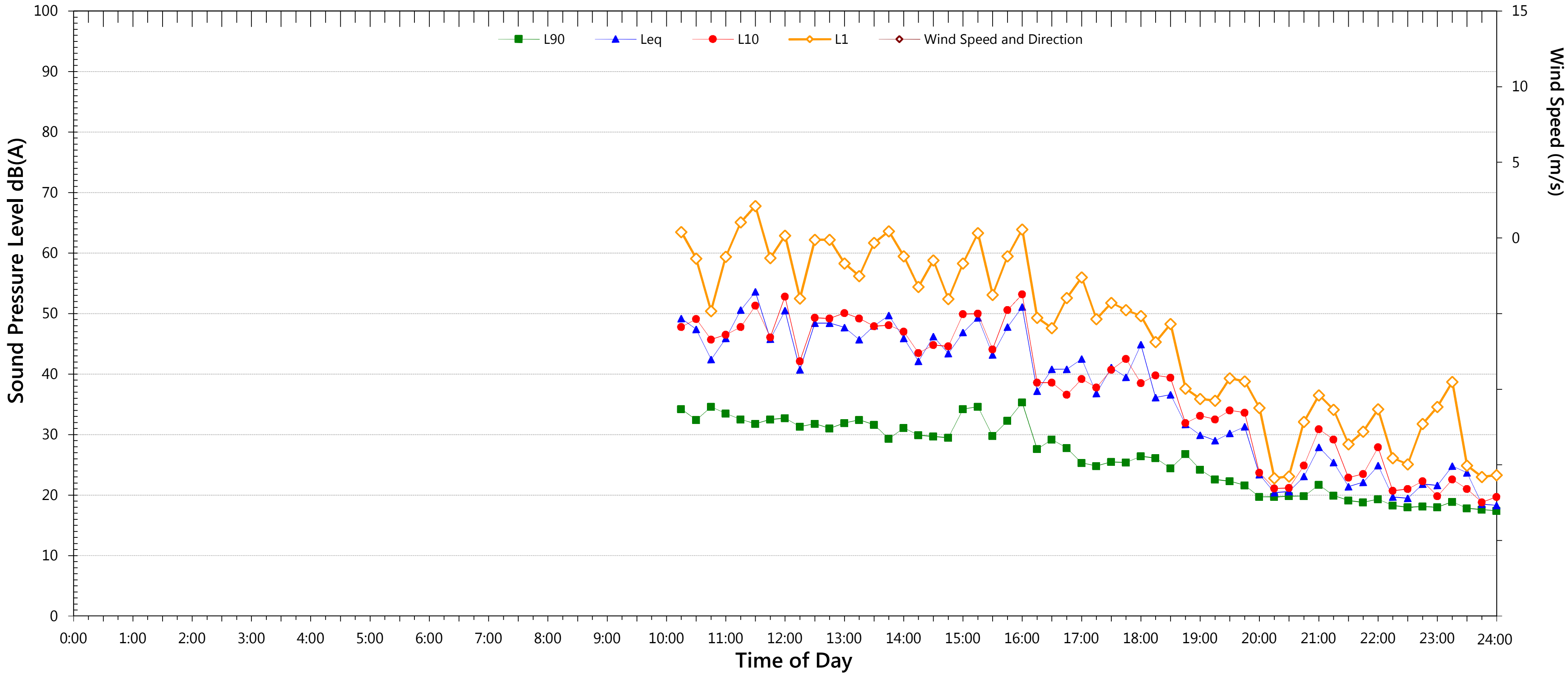
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Wednesday, 9 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	57.3	34.8	29.9
L_{10}	45.7	29.4	23.6
L_{90}	28.4	19.5	17.1
Leq	47.1	30.1	41.7

Notes:

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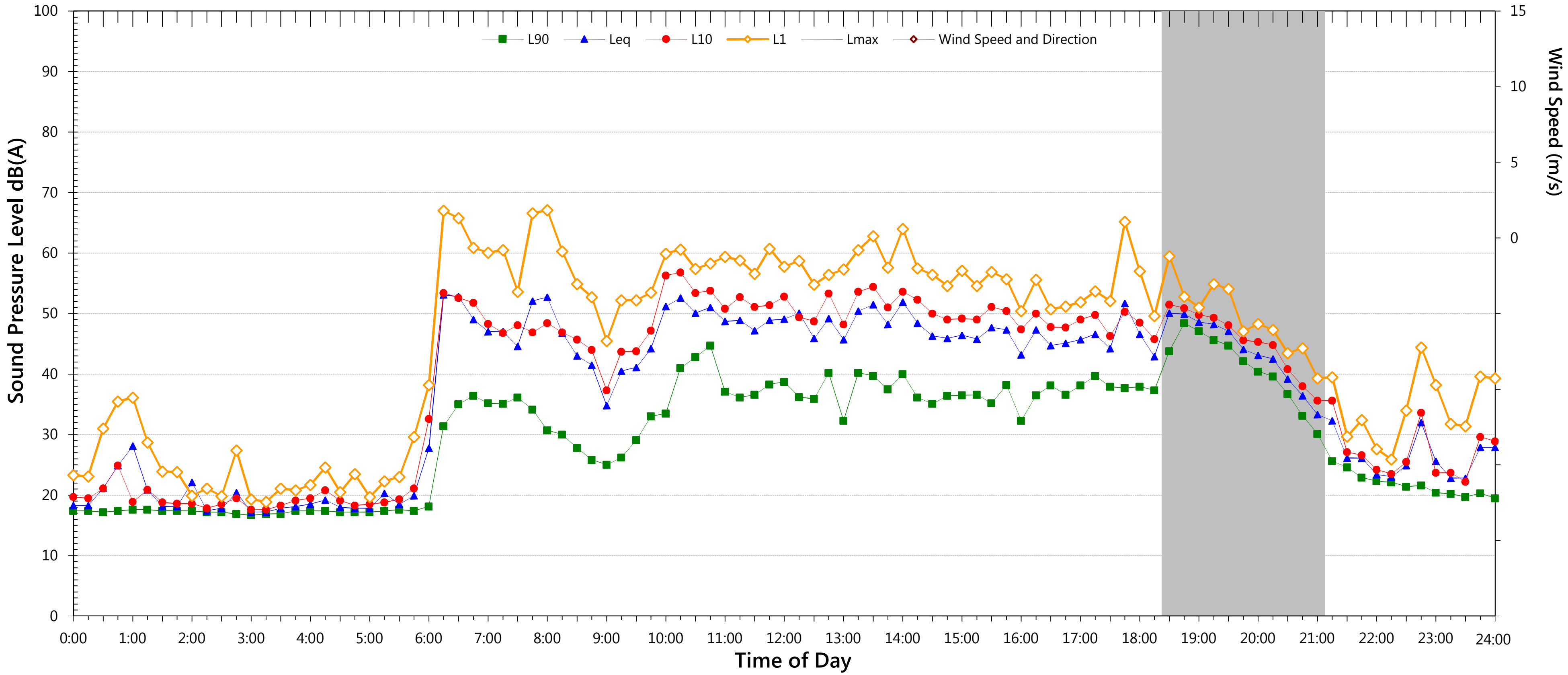
2. Graphed & tabulated data measured in free-field

Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Thursday, 10 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	56.8	35.8	34.4
L_{10}	49.5	31.9	27.1
L_{90}	32.5	22.6	17.9
Leq	48.3	36.5	43.4

Notes:

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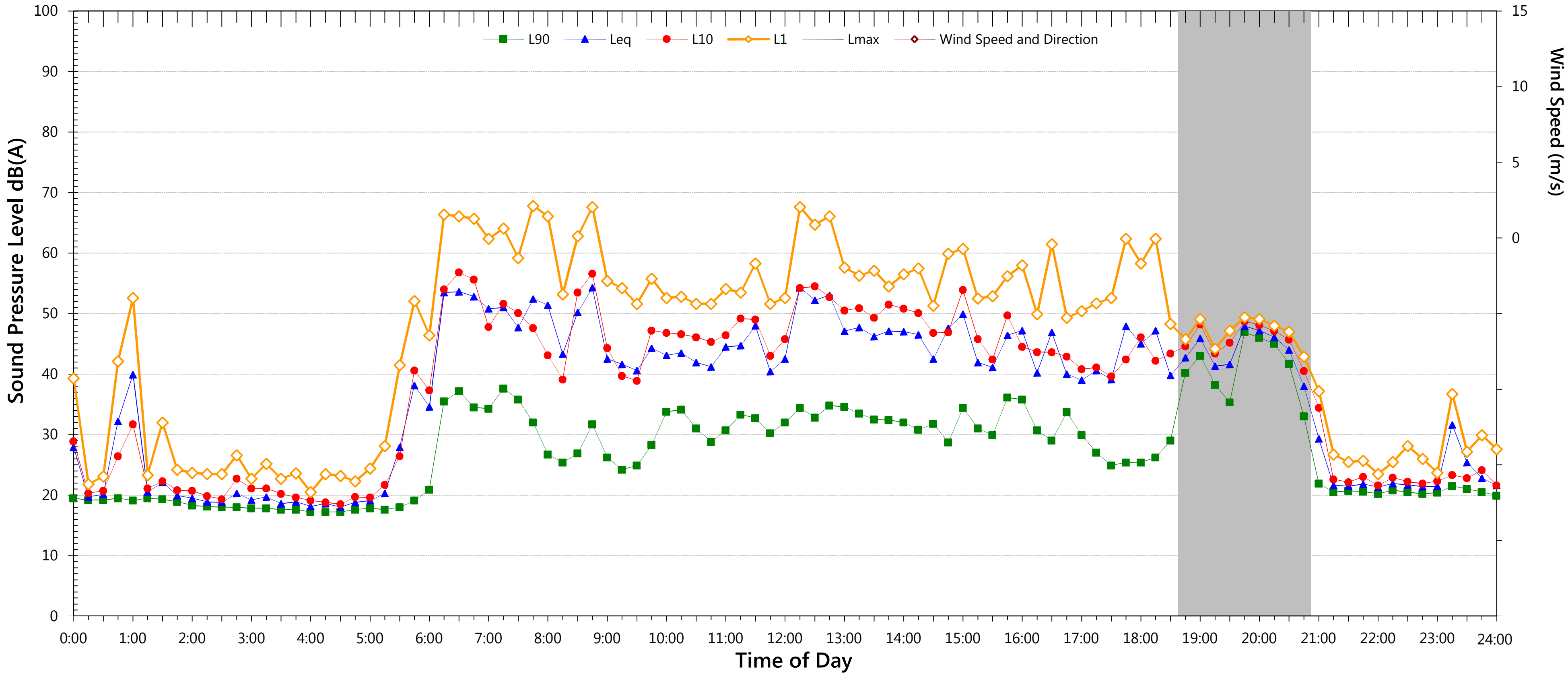
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Friday, 11 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	56.9	35.6	37.9
L_{10}	46.9	29.9	28.5
L_{90}	28.0	20.4	18.5
Leq	47.7	39.6	45.6

Notes:

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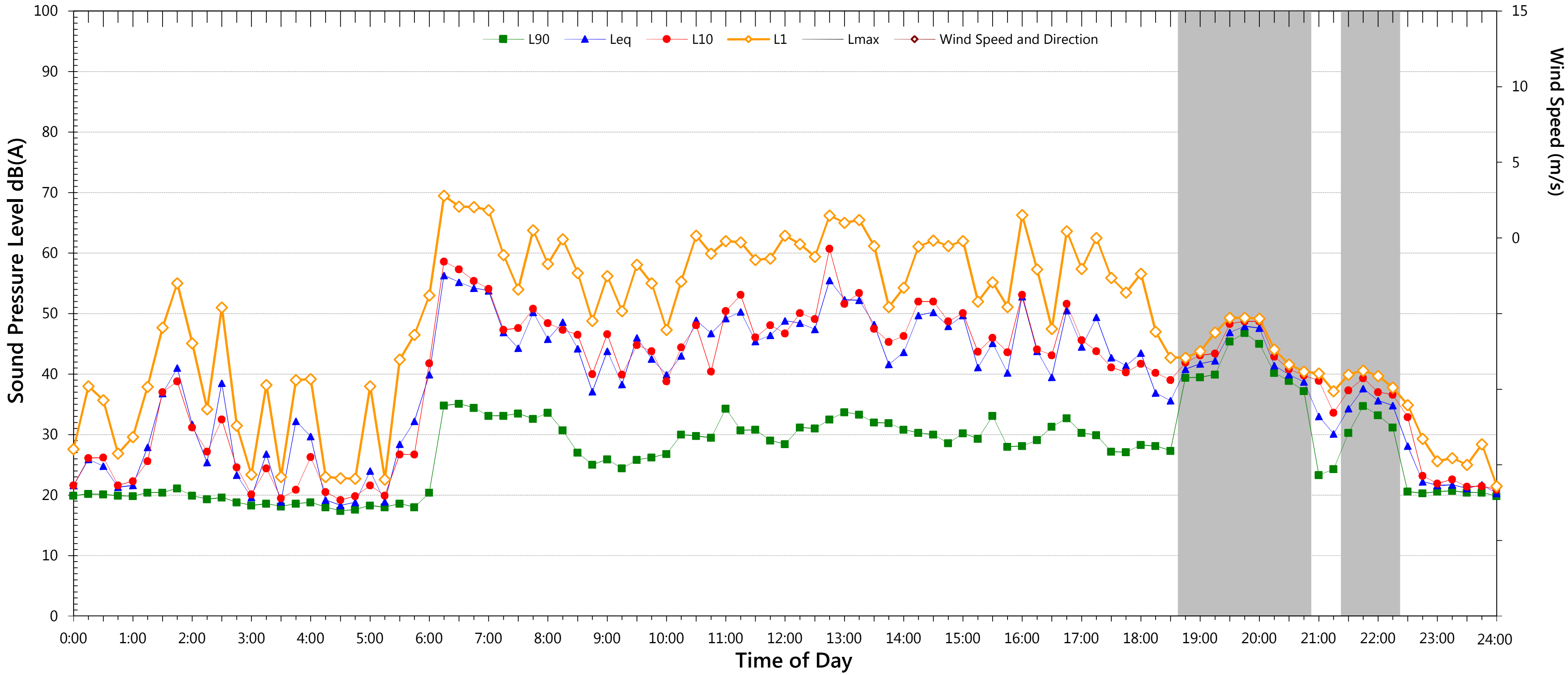
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Saturday, 12 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	58.2	41.8	36.1
L_{10}	46.9	37.9	28.8
L_{90}	27.9	23.8	17.8
Leq	47.9	34.6	48.9

Notes:

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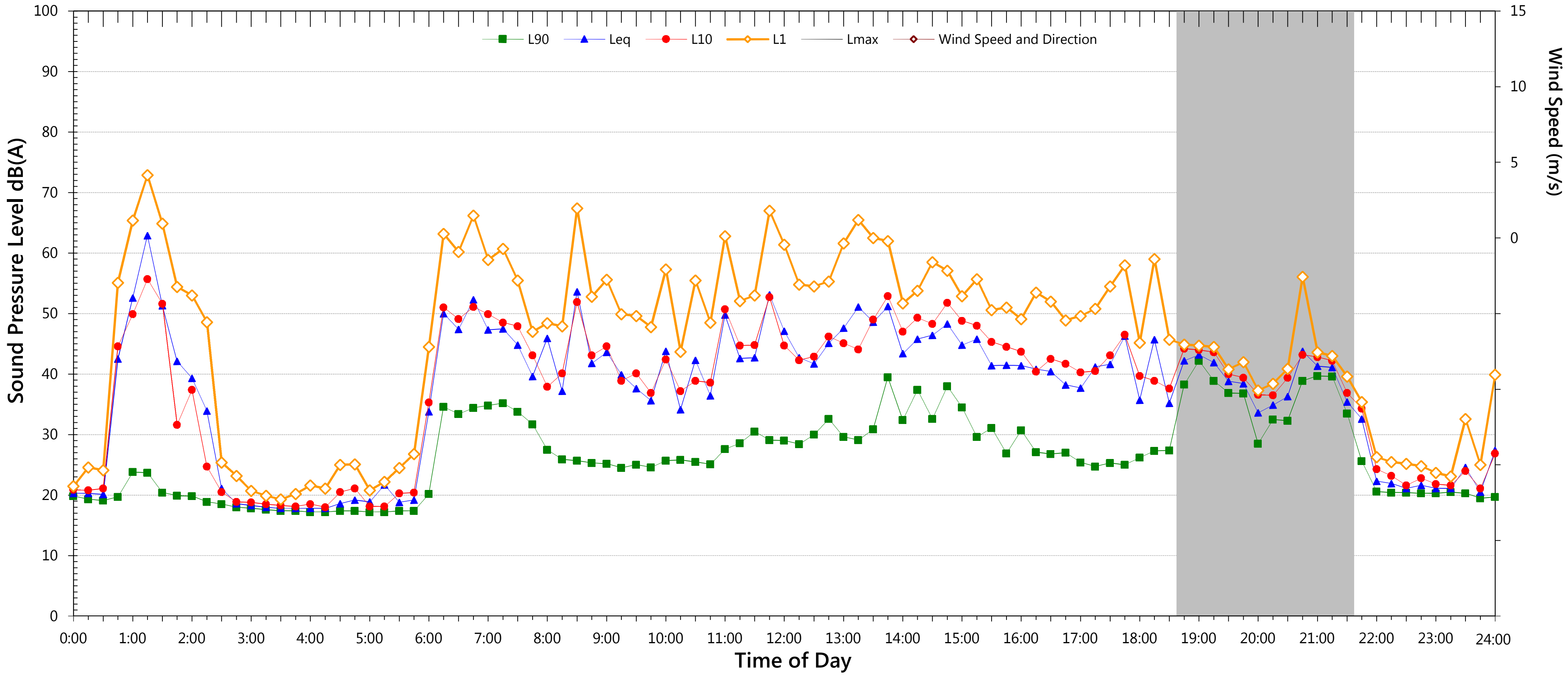
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Sunday, 13 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	54.4	41.6	34.3
L_{10}	44.4	33.8	27.0
L_{90}	25.8	23.1	18.2
Leq	45.9	40.3	40.0

Notes:

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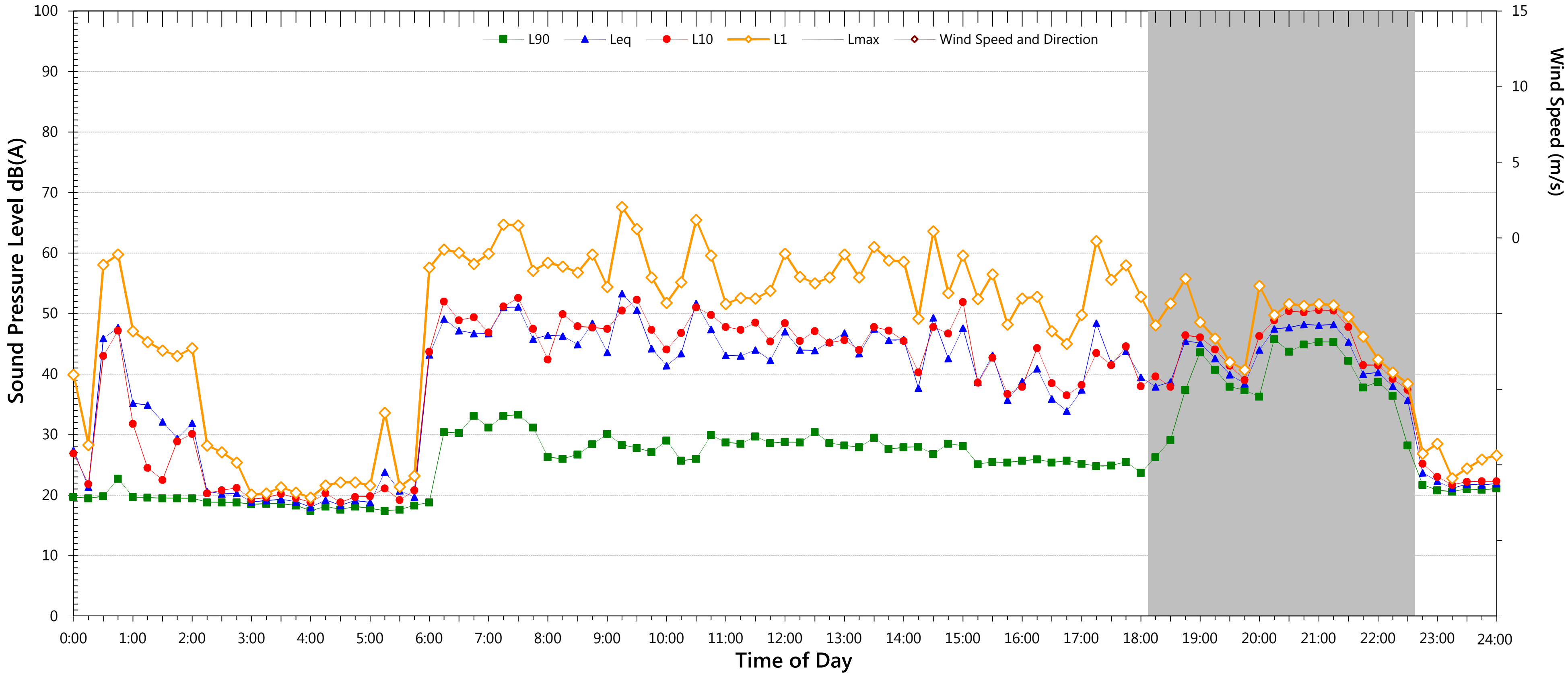
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Monday, 14 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	56.4	-	35.3
L_{10}	45.5	-	27.6
L_{90}	25.8	-	19.2
Leq	46.3	-	41.6

Notes:

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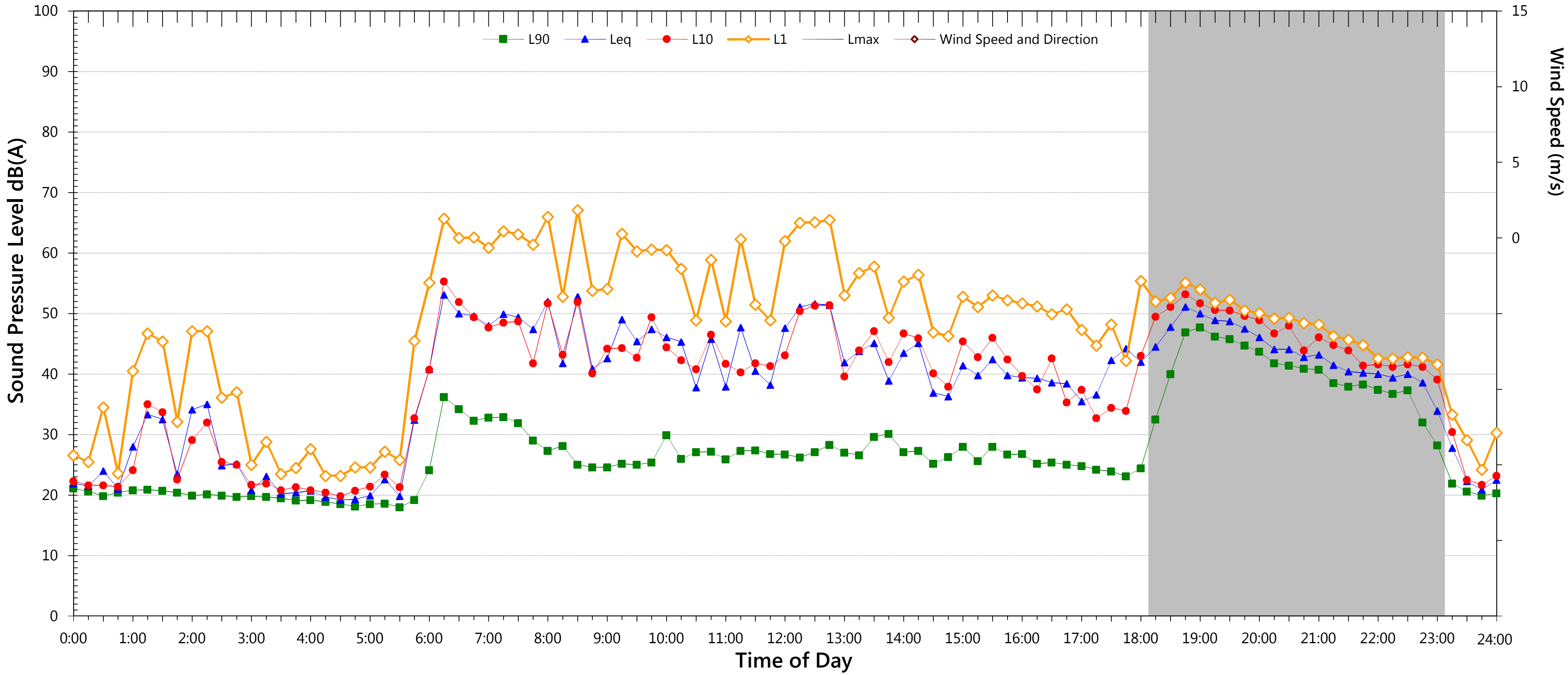
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Tuesday, 15 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	55.3	-	33.6
L_{10}	43.1	-	27.6
L_{90}	25.1	-	20.0
Leq	46.0	-	40.5

Notes:

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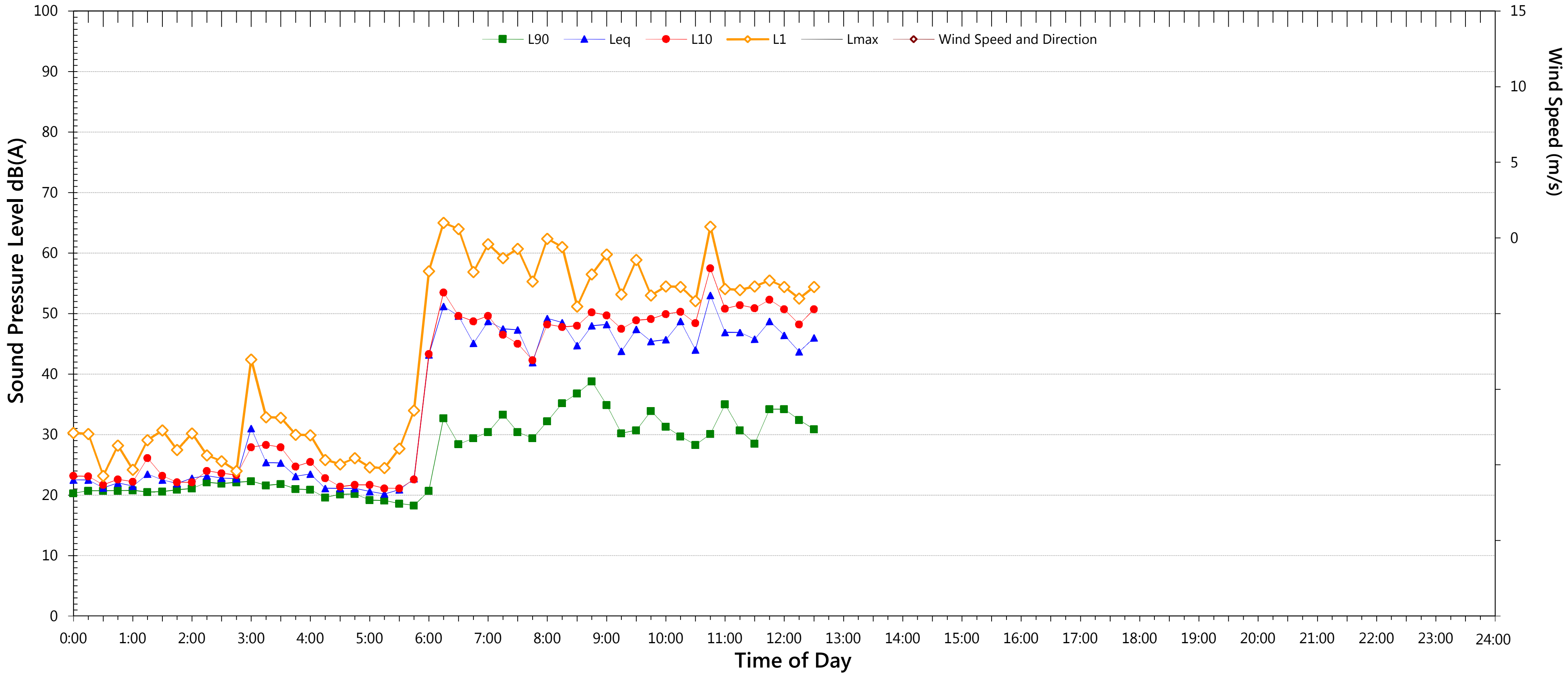
Unattended Noise Monitoring Results

Olive Downs Project - Old Bombandy

Wednesday, 16 August 2017



Representative Noise Levels			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
Lmax	-	-	-
L_1	56.2	-	-
L_{10}	49.3	-	-
L_{90}	30.0	-	-
Leq	47.4	-	-

Notes:

1. Grey areas indicate periods of time that are either affected by rain,wind or other extraneous factors

2. Graphed & tabulated data measured in free-field