NOISE AND DUST ASSESSMENT

PROPOSED CORAKI QUARRY

SEELEMS ROAD

CORAKI

Commissioned by:

Quarry Solutions Pty Ltd
c/- Groundwork Plus

Prepared by:

MWA Environmental

4 November 2015

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1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

MWA Environmental was commissioned by Quarry Solutions Pty Ltd to undertake a Noise and Dust Assessment for the proposed Coraki Quarry.

The assessment has been conducted as supporting documentation for the Environmental Impact Statement ("EIS") prepared by Groundwork Plus in accordance with the Secretary's Environmental Assessment Requirements ("SEARs") issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015.

The NSW Environmental Protection Authority advised by email dated 22 June 2015 that no quantitative assessment of diesel emissions associated with the project will be required. As such, the scope of the air quality assessment has been limited to particulate emissions.

1.2 SITE DESCRIPTION

The subject site is located at Seelems Road, Coraki, New South Wales. The site is located approximately 2 kilometres to the north-west of Coraki Village.

The site location is shown on **Figure 1**.

The subject site comprises the following properties:

Primary Resource Area

- Lot 401 on DP633427

Access Road via Easement

- Lot 403 on DP802985

Existing Petersons Quarry

- Lot 402 DP802985
- Lot 408 DP1166287
- Lot A DP397946
- Lot A DP389418
- Lot 3 DP701197
- Lot 2 DP954593
- Lot 1 DP954592
- Lot 1 DP310756

An aerial photograph of the subject site and surrounding area is included as **Figure 2**.

Access to the Pacific Highway from the quarry is via Seelems Road / Petersons Quarry Road, Lagoon Road, Casino-Coraki Road, Queen Elizabeth Drive and Coarki-Woodburn Road.

The haulage route to the Pacific Highway is shown on **Figure 3**.

1.3 SURROUNDING LAND USES

Surrounding land uses are shown on the aerial photograph included as **Figure 2**.

Surrounding land uses generally comprise rural allotments with scattered detached dwellings.

The nearest surrounding residential dwellings relative to the subject site boundaries are described as follows:

To the North:	Dwelling 310 metres to north, on Newmans Road
To the South:	Dwelling 85 metres to the south of the access road through Lot 403 on DP802985, 600m south of new resource area on Lot 401 on DP633427
To the West:	Dwelling 980 metres to the southwest of the access road through Lot 403 on DP802985
To the East:	Dwelling 285 metres to the east of the existing Petersons Quarry 825 metres east of the new resource area on Lot 401 on DP633427

Only one residential dwelling (to the north on Newmans Road) is located within 500 metres of the proposed new resource area on Lot 401 on DP633427.

Nine (9) residential dwellings surrounding the subject site have been nominated R1 to R9 on **Figure 2** for the purposes of this assessment.

Based upon aerial photography and site inspection, 44 residential dwellings were identified as being located within 100 metres of the haulage route between the quarry access and the Pacific Highway. These residences are shown on **Figure 3** for the purposes of this assessment.

1.4 PROPOSED DEVELOPMENT

Key elements of the Description of the Proposal contained in the Environmental Impact Statement by Groundwork Plus are reproduced as follows:

Site layout and quarry design

- Extraction will primarily occur within Lot 401 as an extension of the existing Peterson's Quarry pit. Stockpiling areas will be established on both Lot 401 and the Peterson's Quarry land to achieve stockpile capacity for up to 1,000,000 tonnes of materials as requested by the delivery partner for the Pacific Highway upgrade project.

- The existing site office, weighbridge and visitor car parking area of the Peterson's Quarry will be utilised for the project.
- The processing plant for the project will be established within the existing Peterson's Quarry pit to take advantage of the topographic screening available to that location which will assist in minimising potential risk of environmental nuisance from noise and dust emissions. Given the time limited, project specific nature of the project, the processing plant will consist of mobile crushing and screening plants rather than a permanent fixed plant.
- Conceptual Quarry Development Plan Initial Extraction Stage (refer **Attachment 1**) illustrates how the initial extraction area will be developed from the existing Peterson's Quarry pit into Lot 401. The existing Peterson's Quarry pit has a floor of approximately RL18. This will be continued into Lot 401. Internal benches will be developed to enable progressive extraction to occur from east to west within lot 401. The internal northern face of the extraction area will be a single wall of approximately 20m in height to retain the receding rim of the hill, topographically screening the extraction operations both visually and acoustically from the surrounding land to the north, east and west. Stockpile areas will be established with earth works required as necessary to establish pads of suitable slope. Topsoil and overburden will be used to establish perimeter bunds where necessary to assist in visually screening the stockpile areas and also direct stormwater to the stormwater detention basins for treatment.
- Conceptual Quarry Development Plan Final Extraction Stage (refer **Attachment 1**) illustrates the full extraction of the resource on Lot 401 to a floor of RL18m. Internal benches will adjoin the existing Peterson's Quarry to facilitate continued efficient development of that resource for the Richmond Valley Council into the future. The internal northern and eastern face of the extraction area will be retained as a single wall of approximately 20m in height. The internal western face of the extraction area will be approximately 3m in height to transition to the western stockpile area on Lot 401. A ramp between the extraction area and the western stockpile area on Lot 401 will be retained in the final land form to accommodate continued connection for any potential redevelopment of the land.

Production quantities

It is proposed to extract a maximum of 1,000,000 tonnes of hard rock material per annum. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway. As the proposed development will involve extracting and processing more than 30,000 tonnes of extractive materials per year, it will require an environment protection licence under the *Protection of the Environment Operations Act 1997* (POEO Act).

Hours of operation and project duration

The proposed hours of operation are 6am to 7pm Monday to Saturday, 9am to 3pm Monday to Friday for blasting, and no work on Sundays or public holidays. Operation of the quarry is planned to take place as soon as possible, subject to the appropriate approval being granted and timing of the Pacific Motorway upgrade works. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway.

Concurrent Operation of Petersen's Quarry

Quarry Solutions has a contract to operate the Petersen's Quarry for Richmond Valley Council for a period extending beyond the expected five (5) to seven (7) year operating life of the Coraki Quarry. The Coraki Quarry will integrate the current extraction area and processing area of the Petersen's Quarry for the life of the project. Any quarry materials required by Richmond Valley Council through the life of the project will be sourced from the existing Petersen's Quarry resource area, crushed in the Coraki Quarry processing plant and stockpiled within the nominated Coraki Quarry stockpile areas.

Given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise and dust emissions.

2.0 QUARRY NOISE ASSESSMENT

2.1 AMBIENT NOISE MONITORING

In order to characterise the existing ambient noise environment at the locality, noise dataloggers were placed adjacent to the nearest residences to the north and east.

The noise datalogger locations are shown on **Figure 4**.

The noise dataloggers were programmed to provide a statistical noise level analysis based on 15-minute sampling periods continuously over the monitoring period. The recorded noise levels are presented as statistical components, which are described as:

- L_1: Noise level exceeded for 1 percent of the measurement period, referred to as the adjusted maximum sound pressure level.
- L_{10}: Noise level exceeded for 10 percent of the measurement period, referred to as the averaged maximum sound pressure level.
- L_{90}: Noise level exceeded for 90 percent of the measurement period. AS1055.1–1997[1] notes that the L_{90} is described as the background sound pressure level.
- L_{eq} An "average" measurement, and as per AS1055.1–1997 defined as the value of the sound pressure level of a continuous steady sound state, that within a measurement period, has the same mean square sound pressure as a sound under consideration whose level varies with time.

Table 1 below provides the minimum, maximum and average statistical noise levels recorded by the 'North' Location 1 noise datalogger.

Table 1: Range of Datalogger Recorded Statistical Noise Levels 21 to 27 April 2015 'North' Location 1

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	33.5	80.0	51.8
	Evening (6pm-10pm)	29.0	58.0	36.5
	Nighttime (10pm-7am)	28.5	76.0	50.3
L_{10}	Daytime (7am-6pm)	30.0	71.5	42.6
	Evening (6pm-10pm)	27.0	36.0	31.1
	Nighttime (10pm-7am)	27.0	64.5	41.9
L_{90}	Daytime (7am-6pm)	28.0	52.5	34.8
	Evening (6pm-10pm)	26.0	34.0	28.2
	Nighttime (10pm-7am)	26.0	56.0	32.8
L_{eq}	Daytime (7am-6pm)	29.0	70.0	43.7
	Evening (6pm-10pm)	26.5	47.5	31.4
	Nighttime (10pm-7am)	26.5	64.0	41.3

[1] Australian Standard *AS 1055.1-1997 Acoustics – Description and measurement of environmental noise, Part 1: General procedures*

MWA Environmental is not aware of the operation of the Petersen's Quarry during the 'North' Location 1 noise datalogging period but notes that:

- There was no apparent operation of the Petersen's Quarry on 21 April 2015;
- There was no apparent operation of the Petersen's Quarry on 27 April 2015;
- More recent information regarding the Petersen's Quarry indicates that extraction and processing activities are occasional only; and
- The pit location where crushing is typically undertaken at the Petersen's Quarry is well topographically shielded from the 'North' Location 1 noise monitoring location.

On this basis it is expected that Petersen's Quarry operations did not influence the Rating Background Levels measured at 'North' Location 1.[2]

Table 2 below provides the minimum, maximum and average statistical noise levels recorded by the 'East' Location 2 noise datalogger.

Table 2: Range of Datalogger Recorded Statistical Noise Levels 12 to 21 August 2015 'East' Location 2

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	42.6	71.8	53.5
	Evening (6pm-10pm)	30.9	55.9	42.1
	Nighttime (10pm-7am)	27.9	72.0	42.2
L_{10}	Daytime (7am-6pm)	34.4	65.7	44.7
	Evening (6pm-10pm)	28.2	48.2	35.9
	Nighttime (10pm-7am)	26.0	61.5	35.9
L_{90}	Daytime (7am-6pm)	27.8	55.3	33.7
	Evening (6pm-10pm)	25.1	42.2	28.1
	Nighttime (10pm-7am)	24.8	38.9	28.9
L_{eq}	Daytime (7am-6pm)	33.7	62.3	43.6
	Evening (6pm-10pm)	26.6	46.0	33.6
	Nighttime (10pm-7am)	25.6	59.1	34.0

The dataloggers used were an Acoustic Research Laboratories noise datalogger, model EL-215 (Location 1) and an Acoustic Research Laboratories noise datalogger, model EL-316 (Location 2). Each logger was pre-calibrated to 94 dB at 1kHz using a Rion Sound Level Calibrator, model NC-73. At post-calibration, the dataloggers exhibited less than ±0.5 dB deviation.

[2] Refer to Section 2.2 which indicates that the adopted Rating Background Levels are the 30 dB(A) minimum as per the NSW Industrial Noise Policy and thus potential influences from extraneous sources are somewhat immaterial

Quarry Solutions has advised MWA Environmental that the following activities occurred at the Petersen's Quarry during the 'East' Location 2 noise datalogging period:

- No extraction;
- No crushing or screening; and
- Loading and dispatch of between 50 tonnes to 370 tonnes of aggregates/roadbase on 13, 14, 18 & 19 August with no activity on other days – overall low numbers of trucks loaded and dispatched.

On this basis operations at the Petersen's Quarry during the 'East' Location 2 were limited to intermittent loading of trucks and would not have significantly influenced 1 hour average background noise levels or the measured Rating Background Levels.[3]

From the noise datalogger measurements, the following **Table 3** details the measured Rating Background Levels (RBLs)[4].

Table 3: Measured Rating Background Levels – dB(A)

Noise Monitoring Location	Time Period	RBL dB(A)
'North' Location 1	7am to 6pm	30
	6pm to 10pm	27
	10pm to 7am	28
'East' Location 2	7am to 6pm	30
	6pm to 10pm	26
	10pm to 6am	27

[3] Refer to Section 2.2 which indicates that the adopted Rating Background Levels are the 30 dB(A) minimum as per the NSW Industrial Noise Policy and thus potential influences from extraneous sources are somewhat immaterial

[4] For the early morning 6am to 7am period the lowest 10th percentile L_{90}(1 hour) noise levels have been adopted as an appropriate basis for assessment of intrusive noise criteria.

2.2 RELEVANT NOISE CRITERIA

The relevant noise criteria for the assessment of noise impacts from the proposed development are taken from the *NSW Industrial Noise Policy*.

The NSW *Industrial Noise Policy* provides specific policy objectives:

- *to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses; and*
- *to use the criteria as the basis for deriving project specific noise levels*

The appropriate noise criteria are established by means of a comparison between a 'Rating Background Level ("RBL") plus 5 dB(A)' 'Intrusiveness Criterion' and 'Amenity Criteria' levels, with the lower level being adopted as the basis for deriving project specific noise levels.

From the noise datalogger measurements, the RBLs measured at Noise Datalogger Locations 1 and 2 were 30 dB(A) for the 7am to 6pm period. For the early morning 6am to 7am and early evening 6pm to 7pm periods the minimum RBL of 30 dB(A) has been adopted for assessment of intrusive noise criteria in accordance with the NSW Industrial Noise Policy. This is consistent with the 7am to 6pm RBL.

On this basis, the **relevant 'Intrusiveness Criterion' level** for assessment of noise from the proposed quarrying activity is **L_{Aeq} 35 dB(A)** for the proposed operating hours 6am to 7pm.

From Table 2.1 of the *Industrial Noise Policy*, the appropriate 'Amenity Criteria' are as follows for "Residential receiver in a Rural area":

Time of Day	*Recommended L_{Aeq} Noise Level, dB(A)*	
	Acceptable	*Recommended Maximum*
Day (7am to 6pm)	*50*	*55*
Evening (6pm to 10pm)	*45*	*50*
Nighttime (10pm to 7am)	*40*	*45*

As the 'Intrusiveness Criterion' levels are lower than the 'Amenity Criteria' the more stringent 'Intrusiveness Criterion' level of **L_{Aeq} 35 dB(A)** is applied to the assessment of noise emissions from the proposed quarrying activities.

2.3 QUARRY NOISE MODELLING METHODOLOGY

To enable assessment of noise from the proposed quarrying operations a detailed noise model has been established using the SoundPLAN 7.3 software applying the CONCAWE noise propagation algorithms. The CONCAWE noise propagation method / algorithms were applied to the modelling to allow assessment of noise propagation under specific meteorological conditions e.g. wind directions.

This model is an accepted regulatory model that allows input of site-specific terrain data and source noise data as sound power level spectra.

Modelling has been undertaken based upon the layouts for the 'Initial Pit' and 'Final Pit' operations as per the 3D CAD plans provided by Groundwork Plus (refer **Attachment 1**).

The model layouts and the source locations for the 'Initial Pit' and 'Final Pit' operations are shown on the drawings included in **Attachment 2**.

The source noise data was derived from measurements conducted by MWA Environmental at comparable and representative existing extractive industry facilities. The modelled sound power level data is provided in **Attachment 3**.

As discussed in **Section 1.4**, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise emissions from the Petersen's Quarry during the life of the project.

2.4 TOPOGRAPHIC DATA

The model was established over an area of approximately 4km by 3km centred on the subject land. Digital elevation data for the locality and the subject land, including representations of the 'Initial Pit' and 'Final Pit' landforms was supplied by Groundwork Plus and integrated into the noise model.

2.5 METEOROLOGICAL CONDITIONS

Site-specific meteorological conditions have been assessed based upon the meteorological modelling undertaken for the dispersion modelling (refer **Section 4.3.2**).

Analysis of the relevant meteorological parameters at the site during the operating hours 6am to 7pm for the purposes of noise assessment including stability classes and wind roses is provided in **Attachment 4**.

The analysis demonstrates that:

- Temperature inversion conditions, as Pasquill Gifford F-Class Stability, occur for approximately 6 percent of operating hours in the year; and
- Wind speeds of up to 3 m/s from directions within a 45 degree sector centred on the nearest residences to the north, south and east[5] occur for less than 30 percent of operating hours during any season.

On the basis of the objective meteorological analysis in accordance with the *NSW Industrial Noise Policy*, temperature inversions and winds of up to 3 m/s from source to the nearest receivers are not assessed to be significant conditions for the purposes of this noise assessment.

2.6 QUARRY NOISE MODELLING

2.6.1 NOISE SOURCES

The following noise sources were represented in the model:

Table 4: Noise Sources Used in SoundPLAN 7.3 Modelling

NOISE SOURCE	LOCATION
Primary (Jaw) Crusher	Existing Petersons Quarry Pit
3x Cone Crushers	
Primary Screen	
Secondary Screen	
Tertiary Screen	
Quaternary Screen	
Rock Drill	Lot 401 on DP633427 Resource Area
Rock Pick	
Excavator Loading Shot Rock	
Haul Trucks	Pit to Plant and Plant to Western Stockpiles routes
Loader at Southern Stockpiles	Southern Stockpiles
Loader at Western Stockpiles	Western Stockpiles
Product Trucks	50/50 split Seelems Road Entry and Petersons Quarry Road Entry routes

[5] Noting that the nearest receptors are directly to the north, south and east of the extraction and processing noise sources

The above-listed sources are the key noise sources which are expected to operate at the quarry on a regular basis. Other plant items and vehicles may be required to be used at the quarry at times but should not increase overall noise emissions above the level of the above modelled noise sources operating simultaneously.

The operating Sound Power Levels ("SWLs") of key processing and mobile equipment have been taken from source noise surveys conducted at comparable and representative existing extractive industry operations.

A +5 dB(A) impulse adjustment to the Rock Pick SWL was applied by MWA Environmental to address the noise character of this source.

The modelled SWLs are summarised in **Table 5** below.

Table 5: Sound Power Levels - $L_{Aeq,T}$ - dB(A)

SOURCE	MODELLED SWL $L_{Aeq,T}$ - dB(A)	SOURCE REPRESENTATION
Primary Crusher	113	Point Source
Screen 1 & Cone Crusher 1	110	Point Source
Cone Crusher 2	109	Point Source
Crusher 3	109	Point Source
Screen 2	107	Point Source
Screen 3	105	Point Source
Screen 4	105	Point Source
Pit to Plant Haul Road (Dump Trucks) 5 loads per hour	75/m	Line Source
Plant to Western Stockpiles (Dump Trucks) 2.5 loads per hour	72/m	Line Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Excavator Loading Truck[6] (1 hour work cycle)	110	Point Source
Rock Drill[7]	110	Point Source
Rock Pick	118[8]	Point Source
Access Road (7 loads per hour via each entry)	66/m	2x Line Sources

[6] Truck tray with impact absorptive lining

[7] Proprietary quietened rock drill

[8] Including +5dBA impulse adjustment

2.6.2 NOISE CONTROL MEASURES

Based upon an iterative noise modelling process, it has been determined that the following noise control measures are required to comply with the relevant noise limits:

1. The proposed Stockpile Area pads are relatively open and will require **earth bunds and/or acoustic barriers to the following locations**:
    a. **Northern perimeter of the Western Stockpile Area** to a minimum height of 6 metres above the RL21m pad level ('**Screen 1**')
    b. **Southern perimeter of the Southern Stockpile Area** to a minimum height of 4 metres above the RL40m pad level ('**Screen 2**')
    c. **Northern perimeter of the Southern Stockpile Area** to a minimum height of 4 metres above the RL40m pad level ('**Screen 3**')
2. The **northern perimeter of the extraction area** will require an **earth bund and/or acoustic barrier** to a minimum height of 6 metres above the natural ground level at the northern perimeter of the Extraction Area ('**Screen 4**').
3. Wherever practicable **materials should be stockpiled at locations that shield noise from internal traffic routes and truck loading areas** from the nearest residences i.e.:
    a. Maintain stockpiles along the northern perimeter of the Western Stockpile Area and stock / reclaim from the southern side whenever practicable
    b. Maintain stockpiles along the southern and eastern perimeters of the Southern Stockpile Area and stock / reclaim from the northern and western sides whenever practicable
4. An **acoustic barrier and/or earth mound to a minimum height of 4 metres above the access road off Seelems Road** shall be constructed ('**Screen 5**) for a length of 200 metres from the site entry point.
5. The **processing plant shall be operated at the most shielded location available** (e.g. at the southeastern corner of the existing Petersons Quarry pit at the RL18m bench) to the extent practicable. If not practicable then appropriate acoustic screening shall be installed to the crushers, screens and any other processing equipment as necessary to comply with the relevant noise limits. Commissioning phase testing is recommended to confirm acceptable siting and/or acoustic treatment of the processing plant.
6. **Trays of all dump trucks that handle shot rock[9] and oversize material are to be lined** with an appropriate **absorptive material**.
7. The **rock pick should be operated at the most shielded location practically available** within the pit to provide acoustic shielding to the north and east.
8. Drilling should be undertaken using a proprietary **quietened drill rig** e.g. Atlas Copco SmartRig ROC D9C.

[9] i.e. pit to plant haulage

9. Extraction sequencing should be designed such that the **drill rig is shielded to the north by retained topography of minimum height 5 metres** above the drilling pad level and **supplemented with earth mounding and/or acoustic barriers as necessary** to achieve the overall physical shielding.
10. The **internal traffic routes at the northeastern perimeter to be shielded by topographic cut, earth bund and/or acoustic barrier** directly to the northeast of the traffic routes to a minimum height of 4 metres above the adjacent traffic route ('**Screen 6**). It is noted that the northwestern section of 'Screen 6' is not required once the internal traffic route is directed through the extraction area (pit) as the retained topography will achieve the required shielding.
11. All **internal roads for road haulage and off-road trucks** should be **constructed and maintained to avoid excessive noise** associated with uneven surfaces and potholes.
12. It is recommended that mobile plant (e.g. front-end loaders, dozers, haul trucks, excavators) be fitted with **broadband reversing alarms** to mitigate potential nuisance from tonal characteristics of traditional beeper alarms.

The acoustic 'Screen' locations are shown on **Figure 5**. The acoustic 'Screens' may be constructed of any combination of earth bunding, acoustic barrier[10] and/or additional topographic cut to achieve the necessary total height.

Based upon the modelling and assessment undertaken by MWA Environmental, all of the above noise control measures are necessary to comply with the relevant noise criteria at surrounding sensitive receptors. The relative importance of each measure is difficult to articulate given that the noise reduction achieve by each measure varies for each noise source and for each receptor location. Whilst each measure in isolation may achieve an incremental reduction in overall noise from the quarry at different receptor locations the cumulative effect of all recommended noise mitigation measures has been assessed to be sufficient to comply with the relevant noise criteria at all receptors. Previous experience with hard road quarrying indicates that critical noise sources to mitigate to avoid nuisance are:

- Crushing and screening plant; and
- Heavy mobile equipment operating at exposed locations (e.g. rock drills, dump trucks).

It is understood that the landowner of Lot 401 also owns Lot 4 on DP6339 to the north containing the residence R7 (refer **Figure 2**). If the applicant is able to reach a commercial arrangement with the landowner such that R7 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1a, 3a and 9 are not required.

If the applicant is able to reach a commercial arrangement with the landowner of Lot 12 DP6339 to the south, such that R1 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1b, 3b and 4 are not required.

[10] An acoustic barrier should be constructed as gap-free (less than 1% leakage) and of materials achieving a minimum surface density of 12.5kg/m^2

In addition to the above specific noise control measures, all fixed and mobile plant and equipment operated at the site should be selected and maintained to minimise noise emissions.

2.6.3 NOISE MODELLING RESULTS

The results of the SoundPLAN 7.3 modelling for the 'Initial Pit' and 'Final Pit' operation scenario are provided in **Attachment 5** as contours of predicted resultant noise levels on a cadastral base showing the locations of the representative surrounding residences (refer **Figure 2**).

The predicted resultant noise levels at the representative receptor locations are summarised in **Table 6** below.

Table 6: Summary of Model Results for Receptors – dB(A)
'Initial Pit' and 'Final Pit' Scenarios

RECEPTOR	PREDICTED L_{Aeq} NOISE LEVEL - dB(A)		*NOISE CRITERION* L_{Aeq} - *dB(A)*
	INITIAL PIT	FINAL PIT	
R1	35	35	*35*
R2	35	35	*35*
R3	33	34	*35*
R4	28	28	*35*
R5	27	27	*35*
R6	35	35	*35*
R7	35	35	*35*
R8	24	27	*35*
R9	23	24	*35*

The model-predicted quarry noise levels at the industrial facility (concrete panel manufacturer) on Lot 407 on DP1166287 to the southeast range 41 to 47 dB(A) L_{Aeq} with the noise control measures recommended in **Section 2.6.2**. This is noted to be compliant with the NSW Industrial Noise Policy 'amenity criteria' for 'Industrial Premises' which are an 'Acceptable' level of 70 dB(A) L_{Aeq} and a 'Recommended Maximum' level of 75 dB(A) $L_{Aeq.}$

2.6.4 OUTCOMES OF QUARRY NOISE MODELLING

On the basis of the noise assessment conducted, the predictions demonstrate that, subject to the implementation of the noise mitigation measures specified in **Section 2.6.2,** the proposed quarrying activities can comply with the relevant noise criteria at surrounding sensitive receptors and the industrial facility on Lot 407 on DP1166287. Detailed consideration should be given to the requirement to shield and/or acoustically treat the processing plant and to the most practical methods of achieving the acoustic shielding required through the use of topographic cut, earth bunds and/or barriers at various locations.

3.0 ROAD TRAFFIC NOISE ASSESSMENT

3.1 RELEVANT NOISE CRITERIA

The relevant criteria for the assessment of noise associated with the haulage of materials from the proposed development to the Pacific Highway at Woodburn are specified in the *NSW Road Noise Policy* (Department of Environment, Climate Change and Water NSW, 2011).

The *NSW Road Noise Policy* road traffic noise assessment criteria for residential land uses are as follows with the relevant criteria being those for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*":

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 5. Existing residences affected by noise from **redevelopment** of existing local roads 6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

Coraki-Woodburn Road, Queen Elizabeth Drive and Casino-Coraki Road are sub-arterial category roads and thus the relevant assessment criteria for residences affected by noise associated with these roadways are:

Day (7am to 10pm): **L_{Aeq} (15 hour) 60 dB(A)**

Night (10pm to 7am): **L_{Aeq} (9 hour) 55 dB(A)**

Seelems Road, Petersons Quarry Road and Lagoon Road are local category roads and thus the relevant assessment criteria are generally:

Day (7am to 10pm): **L_{Aeq} (1 hour) 55 dB(A)**

Night (10pm to 7am): **L_{Aeq} (1 hour) 50 dB(A)**

Given the proximity of the 228 Lagoon Road residence to both a local road and the sub-arterial road network, the sub-arterial category assessment criteria have been applied. The residence at 200 Lagoon Road, to the south of the Seelems Road entry, is the only dwelling assessed as being in proximity to the local road category haulage route.

For circumstances where the existing 'background' road traffic noise levels are close to, or exceed, the nominated assessment criteria, the *NSW Road Noise Policy* provides for an assessment of land use development impacts against a 'Relative Increase' criteria. The *NSW Road Noise Policy* states:

> *"In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person"*

Fundamentally, the 'Relative Increase' criteria acknowledges that if a land use development will result in an exceedance of the relevant road traffic noise assessment criteria but causes an increase of less than 2dB, the overall impact on noise amenity is minor and is unlikely to warrant mitigation works.

MWA Environmental has assessed the road traffic noise levels at residences within 100 metres of the haulage route to the Pacific Highway against the criteria of the NSW *Road Noise Policy*.

3.2 ROAD TRAFFIC NOISE MONITORING

MWA Environmental conducted road traffic noise monitoring over a 24 hour period at three locations adjacent to the haulage route from the site to the Pacific Highway over 12 to 13 August 2015.

The free-field noise monitoring locations were selected as representative of the following distinct route characteristics:

Location 1 - Lagoon Road:	Representative of houses along the local road network adjacent to the site.
	26.5m from Lagoon Road
	168m from Casino-Coraki Road
Location 2 – Queen Elizabeth Drive:	Representative of residences along the 60km/h zone through Coraki township.
	17m from Queen Elizabeth Drive
Location 3 – Coraki-Woodburn Road:	Representative of residences along the main 100km/h sub-arterial network.
	17m from Coraki-Woodburn Road

The noise monitoring locations are shown on **Figure 6**.

Prevailing meteorological conditions during the monitoring period were generally fine with several brief periods of light rainfall. Wind conditions were calm to light northerly during the mornings of 12 and 13 August 2015 and moderate to strong winds on the afternoon of 12 August 2015. Winds were relatively light during the evening and night period on 12 August 2015. Whilst the period of elevated wind speeds on the afternoon of 12 August 2015 would have affected the measured noise levels the overall impact is considered to be acceptable considering the purpose of the monitoring and proximity of the monitoring locations to the dominant road traffic noise source.

The noise monitoring was conducted using Rion NL-21 and Rion NL-42 noise datalogger units which were pre-calibrated to a reference signal of 94 dB at 1kHz. No calibration drift was observed post-measurement.

The measured AM Peak L_{Aeq} (1 hour) (7am to 10pm), L_{Aeq} (1 hour) (6am to 7am), L_{Aeq} (15 hour) (7am to 10pm) and L_{Aeq} (9 hour) (10pm to 7am) noise levels for each location are summarised in **Table 7** below.

Table 7: Summary of Measured Road Traffic Noise Levels – dB(A)

DATE	STATISTICAL PERIOD	MEASURED L_{Aeq} NOISE LEVEL - dB(A)		
		LOCATION 1	LOCATION 2	LOCATION 3
12 to 13 August 2015	AM Peak L_{Aeq} (1 hour) (7am to 10pm)	50.6	56.7	58.9
	L_{Aeq} (1 hour) (6am to 7am)	48.5	57.4	58.0
	L_{Aeq} (15 hour) (7am to 10pm)	48.6	56.2	58.0
	L_{Aeq} (9 hour) (10pm to 7am)	40.7	52.6	55.0

Traffic counts were undertaken over the period 11 to 17 August 2015 at three locations adjacent to the noise monitoring locations (refer **Figure 6**) to coincide with the traffic noise monitoring for the purposes of model validation and assessment of the 'background' traffic volumes over each assessment period.

The measured traffic volumes, heavy vehicle percentage and average vehicle speeds for the 12 to 13 August 2015 noise monitoring periods are summarised in **Table 8** below.

Table 8: Summary of Traffic Volumes and Parameters 12 to 13 August 2015

DATE	STATISTICAL PERIOD	TRAFFIC VOLUME (vehicles) (HEAVY VEHICLE COMPONENT (%)) [AVERAGE SPEED (km/h)]		
		LOCATION 1	LOCATION 2	LOCATION 3
12 to 13 August 2015	AM Peak 1 hour (7am to 10pm)	19 (31.6%) [66km/h]	156 (15.4%) [59km/h]	118 (15.3%) [93km/h]
	1 hour (6am to 7am)	9 (0%) [62km/h]	112 (8.9%) [62km/h]	82 (12.2%) [94km/h]
	Average 1 hour (7am to 10pm)	10vph (20.3%) [57km/h]	108 (14.9%) [61km/h]	82 (16.1%) [92km/h]
	Average 1 hour (10pm to 7am)	4 (5.9%) [64km/h]	38 (14.6%) [67km/h]	28 (17.5%) [93km/h]

3.3 DESIGN TRAFFIC VOLUMES

The *Coraki Quarry Traffic Impact and Pavement Assessment Report* (MRCagney Pty Ltd, July 2015) has determined that the development will generate an average of 7 heavy vehicles per hour (i.e. loads per hour) which relates to 14 (two-way) vehicle movements per hour along the haulage route during the operating hours 6am to 7pm. This traffic volume have been applied as the design traffic volume for the purposes of this traffic noise assessment with a 100 percent heavy vehicle percentage.

Background traffic[11] was derived from the 11 to 17 August 2015 traffic count data provided by AusTraffic with the volumes assessed for various road sections based upon the most representative count location, as follows:

Location 1: Representative of Lagoon Road from Petersons Quarry Road to Casino-Coraki Road.

Location 2: Representative of Casino-Coraki Road between Lagoon Road and Queen Elizabeth Drive, Queen Elizabeth Drive and Coraki-Woodburn Road between Coraki and Myall Creek Road.

Location 3: Representative of Coraki-Woodburn Road between Myall Creek Road and the Pacific Highway.

[11] Background traffic is assessed as the haulage route traffic in the absence of traffic associated with the proposed quarry

The modelled background traffic volumes are summarised in **Table 9** below based upon the average volumes measured over the count period 11 to 17 August 2015, excluding Sunday.

Table 9: Summary of Background Traffic Volumes and Parameters Design Scenario Modelling

STATISTICAL PERIOD	TRAFFIC VOLUME (vehicles) (HEAVY VEHICLE COMPONENT (%)) [AVERAGE SPEED (km/h)]		
	LOCATION 1	LOCATION 2	LOCATION 3
AM Peak 1 hour (7am to 10pm)	20 (39%) [61km/h]	145 (15.8%) [60km/h]	116 (16.6%) [93km/h]
1 hour (6am to 7am)	12 (8.6%) [69km/h]	145 (15.8%) [60km/h]	98 (19.6%) [95km/h]
Average 1 hour (7am to 10pm)	9vph (19.7%) [57km/h]	106 (11.6%) [61km/h]	85 (13.3%) [93km/h]
Average 1 hour (10pm to 7am)	4 (10.4%) [51km/h]	41 (26.6%) [66km/h]	31 (31.6%) [92km/h]

3.4 TRAFFIC NOISE MODELLING

3.4.1 DESCRIPTION OF MODEL

Traffic noise modelling has been conducted using the SoundPLAN 7.3 software applying the accepted CoRTN traffic noise prediction methodology.

Site specific topographic information was input to the model for a domain extending from the quarry access to the Pacific Highway based upon NSW Government Land & Property Information 10 metre topographic contours. The road centreline was digitised from review of NSW Globe imagery.

Residential dwellings identified as being within 100 metres of the haulage route (refer **Figure 3**) were input to the model as discrete receptor. For the section of the haulage route through the township of Coraki, a limited number of dwelling locations were nominated for the purposes of the assessment on the basis that the selected receptors are representative of the dwellings nearest to this section of the haulage route. Other residential dwellings through the Coraki township along Queen Elizabeth Drive are similarly or less exposed to road traffic noise.

Based upon the traffic counts undertaken, average traffic speeds are below the posted speed limits due to the characteristics of the roads. The measured average traffic speeds have been applied to the appropriate road sections for the purposes of the modelling.

3.4.2 MODEL VALIDATION

The model was setup to represent the AM Peak Hour traffic as counted on 12 August 2015. Noise monitoring Locations 1 to 3 (refer **Figure 6**) were represented as discrete receptors in the model. Model predicted AM Peak Hour noise levels at the monitoring location is summarised in **Table 10** below.

Table 10: Summary of Predicted AM Peak Hour Noise Levels - Validation Model for 12 August 2015

Location	Measured		Measured L_{10} - L_{eq} Adjustment	Model-Predicted		Model Error L_{10} 1 hour
	L_{A10} 1 hour	L_{Aeq} 1 hour		L_{10} 1 hour	L_{Aeq} 1 hour	
Location 1 – Lagoon Road	51.5	50.6	*-0.9*	51.5	50.9	*0*
Location 2 – Queen Elizabeth Drive	59.9	56.7	*-3.2*	59.9	56.7	*0*
Location 3 – Coraki-Woodburn Road	60	58.9	*-1.1*	61.9	60.8	*+1.9*

The model was setup to represent the 15 hour (7am to 10pm) traffic as counted on 12 August 2015. Noise monitoring Locations 1 to 3 (refer **Figure 6**) were represented as discrete receptors in the model. Model predicted 15 hour (7am to 10pm) noise levels at each monitoring location are summarised in **Table 11** below.

Table 11: Summary of Predicted 15 hour (7am to 10pm) Noise Levels - Validation Model for 12 August 2015

Location	Measured		Measured L_{10} - L_{eq} Adjustment	Model-Predicted		Model Error L_{10} 15 hour
	L_{A10} 15 hour	L_{Aeq} 15 hour		L_{10} 15 hour	L_{Aeq} 15 hour	
Location 1 – Lagoon Road	50.3	48.6	*-1.7*	47.3	45.6	*-3*
Location 2 – Queen Elizabeth Drive	58.8	56.2	*-2.6*	58.2	55.6	*-0.6*
Location 3 – Coraki-Woodburn Road	59.2	58.0	*-1.2*	60.0	58.8	*+0.8*

Based upon the validation modelling, it is considered that the model is reasonably predicting traffic noise levels along the haulage route. The apparent under prediction of road traffic noise at Location 1 over the 7am to 10pm period is likely due to the greater relative influence of strong winds during the 12 August 2015 afternoon period at this monitoring location which is subject to less dominant road traffic noise as compared to Locations 2 & 3.

The validated model is considered suitable for the purpose of assessing the design scenario road traffic noise levels at residences within 100 metres of the haulage route to the Pacific Highway.

3.4.3 DESIGN SCENARIO PREDICTED NOISE LEVELS

The model was setup to represent the design scenario traffic as per **Section 3.3** above for the following assessment periods:

- 15 Hour (7am to 10pm)
- 9 Hour (10pm to 7am)
- AM Peak Hour (7am to 10pm) – relevant to 200 Lagoon Road only
- Night Peak Hour (6am to 7am) - relevant to 200 Lagoon Road only

Residential dwellings within 100 metres of haulage route (refer **Figure 3**) were represented as discrete receptors in the model. It is noted that the nominated dwelling receptor locations through the Coraki township are representative of dwelling nearest to the roadway along this section of the haulage route. Other residential dwellings through the township of Coraki are similarly or less exposed to road traffic noise compared to the nominated representative receptors.

Model predicted L_{Aeq} 15 Hour (7am to 10pm) and L_{Aeq} 9 Hour (10pm to 7am) noise levels (including façade reflection) at each residential dwelling in proximity to a sub-arterial category road are summarised in **Table 12** below.

Table 12: Summary of Model Predicted 15 Hour (7am to 10pm) & 9 Hour (10pm to 7am) Noise Levels

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (15 hour) Average		L_{Aeq} (9 hour) Average	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R1	54.9	2.1	50.6	0.4
R2	56.6	2.1	52.3	0.5
R3	60.1	1.6	54.8	0.4
R4	54.1	2.2	49.8	0.4
R5	58.9	1.8	54.1	0.4
R6	60.4	1.5	55.1	0.4
R7	52	2.1	47.6	0.4
R8	52.4	2.1	47.7	0.5
R9	59.1	1.7	54.3	0.5
R10	56.2	7.8	47.3	4.8
R11	59.9	1.6	54.7	0.4
R12	58.6	1.9	53.9	0.4
R13	60.3	1.6	55	0.4
R14	Refer **Table 13** below			
R15	56.8	2.1	52.4	0.5
R16	59.8	1.6	54.7	0.5
R17	59.1	1.9	54.3	0.4
R18	58.1	1.9	53.8	0.4
R19	49.7	2	45.9	0.5
R20	62.7	1.3	56.7	0.4
R21	59.2	1.7	54.3	0.5
R22	61.6	1.6	55.8	0.6
R23	52.1	2	47.3	0.6
R24	56.2	2	51.2	0.6
R25	63.2	1.5	57.1	0.7
R26	64.2	1.3	57.7	0.6
R27	58.3	2.1	53.5	0.7
R28	49.3	2.1	45.6	0.4
R29	56	1.7	51.3	0.4
R30	59.9	2	54.9	0.6
R31	59	2	54	0.6
R32	61.2	1.7	55.6	0.6
R33	64.6	1.2	58	0.6
R34	61	1.7	55.6	0.7
R35	52.7	2	47.9	0.6
R36	57.8	2	52.9	0.6
R37	62.6	1.5	56.7	0.6
R38	63	1.5	56.9	0.6
R39	61.6	1.7	56	0.6
R40	60.3	1.8	55.1	0.6
R41	52	2.3	47.2	0.7
R42	56.9	2.1	52	0.7
R43	54.8	2.1	50	0.7
R44	56	2.1	51.1	0.6
CRITERION	***60dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***	***55dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***

Model predicted L_{Aeq} 1 Hour (7am to 10pm) and L_{Aeq} 1 Hour (10pm to 7am) noise levels (including façade reflection) at the 200 Lagoon Road dwelling in proximity to a local category road are summarised in **Table 13** below.

Table 13: Summary of Model Predicted 1 Hour (7am to 10pm) & 1 Hour (10pm to 7am) Noise Levels

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (1 hour) 7am to 10pm		L_{Aeq} (1 hour) Average 10pm to 7am	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R14	43.4	3.9	41.1	7.4
CRITERION	***55dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***	***50dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***

3.4.4 OUTCOMES OF TRAFFIC NOISE MODELLING

Based upon the road traffic noise modelling conducted it has been determined that:

1. For 14 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 60 dB(A) L_{Aeq} (15 hour) (7am to 10pm) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
2. For 12 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (9 hour) (10pm to 7am) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
3. For the 200 Lagoon Road residence, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (1 hour) (7am to 10pm) and 50 dB(A) L_{Aeq} (1 hour) (10pm to 7am) assessment criteria specified in the NSW Road Noise Policy for "*existing residences affected by additional traffic on existing local roads generated by land use developments*".
4. For residences where the cumulative L_{Aeq} (15 hour) (7am to 10pm) noise level post-development is predicted to exceed the 60 dB(A) assessment criteria, the increase as a result of the development does not exceed 2dB(A). This is considered to be a minor change in accordance with the NSW *Road Noise Policy* and impacts are unlikely to warrant mitigation works, particularly considering the purpose and limited operational life of the proposed development.

4.0 QUARRY DUST ASSESSMENT

4.1 AMBIENT DUST CONCENTRATIONS

Ambient air quality monitoring data was sourced from the NSW Office of Environment and Heritage. Routine ambient particulate monitoring is not undertaken in close proximity to Coraki. The monitoring station selected for representative ambient concentrations is Wyong, located on the central coast. A summary of the ambient particulate data applied to this assessment is provided in **Table 14** below.

Table 14: Ambient Particulate Data Applied to Assessment

POLLUTANT	AVERAGING TIME	AMBIENT ($\mu g/m^3$)*	SOURCE
TSP	Annual Average	30.1	Conservative assumption of double Wyong Year 2014 PM_{10} Annual Average
PM_{10}	24 Hour Average	17.2	70th percentile Wyong Year 2014 PM_{10} 24 hour average
	Annual Average	15.1	Wyong Year 2014 PM_{10} Annual Average
$PM_{2.5}$	24 Hour Average	6.2	70th percentile Wyong Year 2014 $PM_{2.5}$ 24 hour average
	Annual Average	5.5	Wyong Year 2014 $PM_{2.5}$ Annual Average
Dust Deposition	Annual Average	40 mg/m^2/day 1.2 g/m^2/month	Assumption based upon typical data

** unless stated otherwise*

In selecting the Wyong monitoring station as the most representative yet conservative basis for assessing ambient particulate concentrations at the Coraki site, consideration was also given to the alternative sites summarised in **Table 15** below.

Table 15: Summary of Alternative Ambient Monitoring Sites

Pollutant	PM_{10}					$PM_{2.5}$	
Location	**Wyong**	**Tamworth**	**Bathurst**	**Mountain Creek**	**Springwood**	**Wyong**	**Springwood**
Distance from Coraki	500km	320km	600km	260km	160km	500km	160km
Site Description	"Central Coast"	"Rural Monitoring Site"	"Rural Monitoring Site"	"South East QLD"	"South East QLD"	"Central Coast"	"South East QLD"
Climatic and Land use Character	Similar coastal climate, larger population centre, more dense transport	More arid climate, larger population centre	More arid climate, larger population centre	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport
Statistic	**Adopted**	**2010-2014 Period Data**				**Adopted**	**2010-2014 Period Data**
70th percentile	**17.2**	16.8	14.5	15.9	14.7	**6.2**	5.3
Annual Average	**15.1**	14.7	12.7	14.3	13.4	**5.5**	4.7

In assessing the above alternative ambient monitoring sites, Wyong was considered the most appropriate dataset based upon:

- the most consistent climatic conditions to Coraki; and
- the adopted ambient concentrations from the Wyong dataset are higher (more conservative) than the alternative station averages.

4.2 RELEVANT DUST GUIDELINES

This assessment has also addressed the particulate air quality objectives specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005).*

The adopted assessment criteria for particulate emissions associated with the proposed quarrying activities are summarised in **Table 16** below.

Table 16: Applicable Particulate Objectives

POLLUTANT	AVERAGING PERIOD	GUIDELINE	SOURCE
TSP	Annual Average	90 µg/m^3	NSW Approved Methods
PM_{10}	24 Hour Average (6th highest)	50 µg/m^3	Air NEPM
	Annual Average	30 µg/m^3	NSW Approved Methods
$PM_{2.5}$	24 Hour Average	25 µg/m^3	Air NEPM
	Annual Average	8 µg/m^3	Air NEPM
Dust Deposition	Annual Average (increment)	2 g/m^2/month	NSW Approved Methods
	Annual Average (Total Cumulative)	4 g/m^2/month	NSW Approved Methods

4.3 DUST MODELLING

4.3.1 DUST MODELLING METHODOLOGY

To enable assessment of dust concentrations and deposition rates from the proposed quarrying operations, detailed dispersion modelling has been conducted using the CALMET / CALPUFF modelling system.

The CALMET / CALPUFF modelling system considers 3-dimensional unsteady state meteorology and is suitable for modelling pollutant transport on a regional scale and for complex terrain and coastal zones. The CALMET / CALPUFF modelling system simulates the effects of spatially and time varying meteorology on pollutant transport within the model domain, including chemical transformation and removal. CALPUFF considers emissions as a series of puffs that, if emitted at a sufficient frequency, simulate a continuous emission. This representation of the plume as a series of puffs allows the pollutant transport to vary spatially across the model domain in accordance with the 3-dimensional meteorological field.

A site-specific 3-dimensional prognostic meteorological dataset generated using TAPM was processed using the CALMET program to provide meteorological inputs in a form suitable for the CALPUFF dispersion model. The terrain and land use resolution was refined to a 200 metre grid for the CALMET / CALPUFF modelling to ensure a reasonable representation of the terrain at the locality. CALMET prepares 3-dimensional meteorological data for each hour of the CALPUFF run based upon the 3-dimensional prognostic dataset generated using TAPM.

The CALMET / CALPUFF model was set up to model dispersion within a 10 km x 10 km area surrounding the subject site. The topography of the subject site and surrounding area was sourced from NASA Shuttle Radar Topography Mission (SRTM3) digital elevation data at a resolution of 200 metres. The CALPUFF model was then nested by a factor of four to a finer receptor grid of 50 metres over the modelling domain. The CALPUFF sampling domain was limited to a 3.2 km x 2.4 km area encompassing the nearest sensitive receptor locations.

Emissions estimation and CALPUFF dispersion modelling has been undertaken for the Final Extraction Stage. The assessment of the Final Extraction Stage is deemed the worst-case as this stage has the longest onsite vehicle paths for haulage between pit and plant and from plant to the northern stockpile area. The size of the active pit area and stockpile areas for the Final Extraction Stage is also larger than earlier stages, with these exposed areas subject to wind erosion. The outcome of this is that potential particulate emissions from the quarry are highest during the Final Extraction Stage.

Product trucks are equally distributed between accessing the northern stockpile via Seelems Road and the southern stockpile via Quarry Road. Haulage of material via dump truck and product trucks is a major contribution to total particulate emissions generated from the site.

The assessment has conservatively assumed an extraction and production rate at the proposed maximum limit of 1 million tonnes per annum.

As discussed in **Section 1.4**, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative dust emissions from the Petersen's Quarry during the life of the project.

Dust concentrations and deposition rates have been assessed at representative discrete receptors as shown on **Figure 2**. Gridded receptor modelling has also been undertaken to produce contours of the predicted dust concentrations and deposition rates over the model domain.

The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were added to the ambient concentrations presented in **Table 14** above to assess the cumulative dust exposure at surrounding receptors.

In order to assess the potential dust deposition from the quarry it was necessary to model a particle size distribution. Whilst the actual particle size distribution of various sources and materials does vary, it is considered reasonable to apply a generalised particle size distribution for the purposes of this modelling. The modelled particle size distribution was derived from the following data included in the USEPA AP42 Chapter 13.2.4 *Aggregate handling and Storage Piles*[12].

[12] USEPA (2006) Compilation of Air Pollutant Emission Factors – Volume 1: Stationary Point and Area Sources, AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles, United States Environmental Protection Agency.

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 µm taken from Reference 14.

A detailed summary of the particle size distributions input to the TSP, PM_{10} and $PM_{2.5}$ models is provided as **Attachment 6**.

4.3.2 METEOROLOGICAL DATA

No site-specific meteorological data was available for this assessment. In the absence of site specific data, following accepted methodology for assessment, the TAPM software was utilised to develop a prognostic meteorological model which generated a year of representative hourly meteorological data for the locality.

TAPM has been used to predict meteorological parameters specific to the area surrounding the subject site including temperature, wind speed, wind direction and stability classification. The model accesses databases of surface characteristics (terrain height, soil and vegetation) and synoptic weather analyses provided by CSIRO to carry out these analyses. TAPM is able to process the output data to produce meteorological data files suitable for input to the CALMET / CALPUFF modelling system i.e. a 3-dimensional grid of hourly varying meteorological parameters over a full year.

Technical discussion of the model algorithms, inputs and model validation studies are provided in the Part 1: Technical Paper (Hurley, 2002) and Part 2: Summary of Verification Studies (Hurley *et al*, 2002)[13,14].

The centre coordinates for the model grid were Latitude -28º58'30" and Longitude 153º16'. The following nested model grids were applied to the TAPM modelling:

40 x 30 km grid (total area 1200 km x 1200 km)
40 x 10 km grid (total area 400 km x 400 km)
40 x 3 km grid (total area 120 km x 1204 km)
40 x 1 km grid (total area 40 km x 40 km)

Twenty-five vertical grid levels were modelled.

The TAPM model was set up to generate a site-specific meteorological data file for the locality, based upon synoptic analysis data for the representative Year 2010, as provided by CSIRO.

[13] Hurley, P.J. (2002) The Air Pollution Model (TAPM) Version 2: User Manual. Aspendale: CSIRO Atmospheric Research Internal Paper.

[14] Hurley, P.J. (2002) The Air Pollution Model (TAPM) Version 2: Part 1: Technical Description. Aspendale: CSIRO Atmospheric Research Technical Paper.

The nearest Bureau of Meteorology (BoM) stations are located at Lismore and Casino. Lismore is located north of Coraki, however review of the area surrounding Lismore indicates elevated terrain to the east and west. No significantly elevated terrain is located surrounding Coraki. Lismore observation data was included as nudging observations in TAPM with a 5 kilometre radius of influence due to the proximity of surrounding terrain. Casino is located further inland than Coraki and is not located in proximity to any elevated terrain. Casino observation data was included as nudging observations in TAPM with a 20 kilometre radius of influence with the station being more representative of the prevailing meteorology of the surrounding region.

The TAPM output was processed using the CALTAPM software to produce a 3-dimensional data file suitable for input to the diagnostic CALMET model as an 'initial guess field'. The CALMET model further resolved the prognostic meteorology to a finer terrain, land use and soil type resolution of 200 metres over a 10 x 10 km area covering the subject site and surrounding region for the purpose of dispersion modelling.

Analysis of the CALMET derived meteorology for the subject land including a wind rose, wind frequency graph, monthly average temperatures graph and tabulated stability class analysis is contained in **Attachment 7**.

4.3.3 DUST EMISSION SOURCES

The following sources were represented in the CALPUFF Model:

- Haul Routes (unpaved) as a series of area sources;
- Access Roads (unpaved) as a series of area sources;
- Access Roads (paved) as a series of area sources;
- Wind Erosion from stockpiles and unsealed areas as area sources;
- Drilling as an area source;
- Loading Truck at Pit as an area source;
- Main Processing Plant operation as an area source;
- Loading to Stockpiles as an area source; and
- Loading from Stockpiles to trucks as an area source.

Dust emissions from each of these sources have been represented in the CALPUFF model as area sources with appropriate locations, sizes and initial dispersion parameters to represent the releases.

Emissions rates for each of the above sources have been calculated using published emission factors from the following references:

- NPI *Emission Estimation Technique Manual for Mining v3.1*, Environment Australia (2012);
- USEPA AP42 Chapter 13.2.2 *Unpaved Roads* (2006);
- USEPA AP42 Chapter 11.19.2 *Crushed Stone Processing and Pulverized Mineral Processing* (2004); and
- USEPA AP42 Chapter 13.2.4 *Aggregate Handling and Storage Piles* (2006).

Emission rates have been estimated based upon extraction and production rate at the currently approved limit of 1 million tonnes per annum and distributed for each source based upon the proposed operating hours.

In accordance with the method presented in the NPI *Emission Estimation Technique Manual for Mining v3.1*, wind erosion emissions have only been represented when wind speed is greater than a 5.4m/s threshold.

A summary of the emission rate estimation techniques, emission factors and emission rates for the quarrying operations are included as **Attachment 8**.

Also included in **Attachment 8** is a summary of the calculated particulate emission rates for each major source group based upon the adopted emission factors and including the control measures recommended in **Section 4.3.4** below.

The emission estimations and prior experience demonstrate that the key particulate emission sources at a quarry are:

- Vehicles operating on unsealed roadways (product truck routes and pit-to-plant haulage); and
- Crushing and screening plant including conveyor drop points.

The management of particulate emissions from these two key emission sources will be critical and specific recommendations for dust control measures are recommended in **Section 4.3.4** below.

4.3.4 DUST CONTROL MEASURES

It is recommended that the following dust control measures are implemented at the quarry:

- Watering of all haul roads and access roads at a rate of at least 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
- Sealing (e.g. asphalt) part of the access road off Seelems Road for a minimum length of 200 metres west from the Seelems Road entry point;
- Enclosure and/or use of effective water sprays to crushers and screens within the permanent processing plant;

- Effective water misting sprays to permanent processing plant at transfer points including load-out points from elevated storage bins if utilised;
- Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
- Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

The above dust control measures have been considered in dust emission estimation calculations presented in this report.

All of the above dust control measures are recommended as appropriate to manage emissions from the proposed quarry but, as noted above, the most critical dust management measures relate to:

- The watering of unsealed roads;
- Sealing of the section of access road adjacent the Seelems Road entry points; and
- Effective water misting sprays to permanent processing plant.

The recommended dust control measures are proven and practical methods of effectively managing particulate emissions from quarrying activities. Subject to compliance with the relevant air quality objectives, there is no requirement for the implementation of more complex, costly and/or operationally challenging methods.

4.3.5 DUST MODELLING RESULTS

Summaries of the model-predicted dust concentrations and deposition rates at the selected representative receptors (refer **Figure 2**) for the Final Extraction Stage are provided in **Table 17** below.

The predicted concentrations at the representative receptors include the ambient concentrations presented in **Table 14** above.

Other residential dwellings within the model domain (refer **Figure 2**) are no more affected than the selected representative receptors.

Table 17: Model-Predicted Particulate Exposure including ambient

RECEPTOR	PM_{10}			$PM_{2.5}$		TSP	DUST DEPOSITION	
	µg/m³			µg/m³		µg/m³	g/m²/month	
	Highest 24-hour average	6th Highest 24-hour average	Annual Average	Maximum 24-hour average	Annual Average	Annual Average	Annual Average (development contribution)	Annual Average (cumulative)
R1	49.9	46.7	19.9	10.3	6.1	40.2	0.29	1.49
R2	39.5	35.0	18.2	8.8	5.9	36.3	0.16	1.36
R3	42.7	40.1	18.1	9.3	5.8	35.7	0.13	1.33
R4	39.0	35.8	17.6	8.8	5.8	34.7	0.10	1.30
R5	35.7	31.4	17.0	8.3	5.7	33.6	0.08	1.28
R6	43.9	33.0	16.9	9.3	5.7	33.1	0.06	1.26
R7	56.0[15]	43.0	19.1	10.6	6.0	37.0	0.15	1.35
R8	34.5	21.8	15.6	8.4	5.6	30.9	0.02	1.22
R9	28.6	22.0	15.6	7.6	5.6	30.9	0.02	1.22
Included Ambient	17.2	17.2	15.1	6.2	5.5	30.1	(isolation)	1.2
Air Quality Objective	**n/a**	**50**	**30**	**25**	**8**	**90**	**2**	**4**
Compliance?	**n/a**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Maximum Development Contribution	**n/a**	**29.5 µg/m³ (59% of objective)**	**4.8 µg/m³ (16% of objective)**	**4.4 µg/m³ (18% of objective)**	**0.6 µg/m³ (8% of objective)**	**10.1 µg/m³ (11% of objective)**	**n/a**	**0.29 µg/m³ (7% of objective)**

[15] 38.8 µg/m³ contribution from proposed development to the highest predicted 24-hour average PM_{10}. Total of two (2) 24 hour average periods predicted above 50 µg/m³ including ambient concentrations based upon Wyong data which is likely to be conservative for Coraki.

The results of the gridded receptor modelling for each scenario are presented in **Attachment 9** as contours of predicted particulate concentrations and deposition rates over an aerial photograph base. The plotted concentrations / deposition rates include the ambient concentrations specified in **Table 14**.

The modelling conducted demonstrates that, with the recommended dust management measures (refer **Section 4.3.4**), the proposed quarrying activities can comply with the relevant air quality objectives at all surrounding residences. On this basis, with the implementation of appropriate dust management there will be no requirement to consider reductions in the duration, intensity or nature of activities on the site which would inhibit the ability of the project to achieve the objective of servicing the Pacific highway upgrade project.

The overall contributions of the quarry to the local airshed for the expected 5 to 7 year life of the project are also summarised in **Table 17** above. MWA Environmental notes that for the annual average objectives the highest overall development contributions at any receptor range 7% to 16% of the air quality objectives. This is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 24 hour average $PM_{2.5}$ concentration at any receptor relates to an increment of 18% of the air quality objective. Again, this is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 6th highest PM_{10} 24 hour average concentration at any receptor relates to an increment of 59% of the air quality objective. Whilst a significant contribution to the airshed capacity in terms of the peak 24 hour periods, the overall impact is considered to be acceptable considering that:

- In this rural locality it is unlikely that significant cumulative impacts at residential receptors would occur during the same 24 hour periods when specific wind alignments generate peak impacts occur from the quarry at a particular receptor.
- The limited 5 to 7 year expected life of the project dictates that project contributions to the aished capacity will not persist over an extended project life.
- The limited 5 to 7 year expected life of the project reduces the likelihood that any new land uses with the potential to generate significant cumulative impacts will occur during the project life.
- Annual average PM_{10} contributions remain low at 16% of the air quality objective.

5.0 CONCLUSION

MWA Environmental was commissioned by Quarry Solutions Pty Ltd to undertake a Noise and Dust Assessment for the proposed Coraki Quarry. The assessment has been conducted as supporting documentation for the Environmental Impact Statement prepared by Groundwork Plus in accordance with the Secretary's Environmental Assessment Requirements issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015.

The noise assessment has been based upon detailed noise monitoring and computer noise modelling of the proposed quarrying activities and haulage of materials on between the site and the Pacific Highway. The dust assessment has been based upon detailed meteorological and dust dispersion modelling.

Based upon an iterative noise modelling process, it has been determined that a range of noise control measures (refer **Section 2.6.2**) are required to comply with the relevant noise limits at surrounding sensitive receptors and the industrial facility on Lot 407 on DP1166287, including but not limited to:

- acoustic screening by way of cut, earth bunds and/or barriers to various locations;
- use of a proprietary quietened rock drill; and
- operation of processing plant at the most shielded location and/or implementation of acoustic treatments as necessary to comply with the relevant noise limits.

There may be the potential to reduce the scope of noise mitigation measures if appropriate commercial arrangements are made with the landowners of Lot 4 on DP6339 to the north and/or Lot 12 DP6339 to the south.

The assessment has considered the potential road traffic noise levels at residences within 100 metres of the haulage route between the site and the Pacific Highway at Woodburn.

The assessment has determined that:

- The relevant NSW *Road Noise Policy* assessment criteria for existing residences affected by additional traffic generated by land use developments are predicted to be satisfied with the exception of a number of residences along the sub-arterial road network between Lagoon Road and Woodburn; and
- For residences where the cumulative L_{Aeq} (15 hour) (7am to 10pm) noise level post-development is predicted to exceed the 60 dB(A) assessment criteria, the increase as a result of the development does not exceed 2dB(A). This is considered to be a minor change in accordance with the NSW *Road Noise Policy* and impacts are unlikely to warrant mitigation works, especially considering the purpose and limited operational life of the proposed development.

Detailed computer dust dispersion modelling of the proposed quarrying activities has demonstrated that compliance with the relevant air quality objectives can be achieved at surrounding sensitive receptors with appropriate dust management controls.

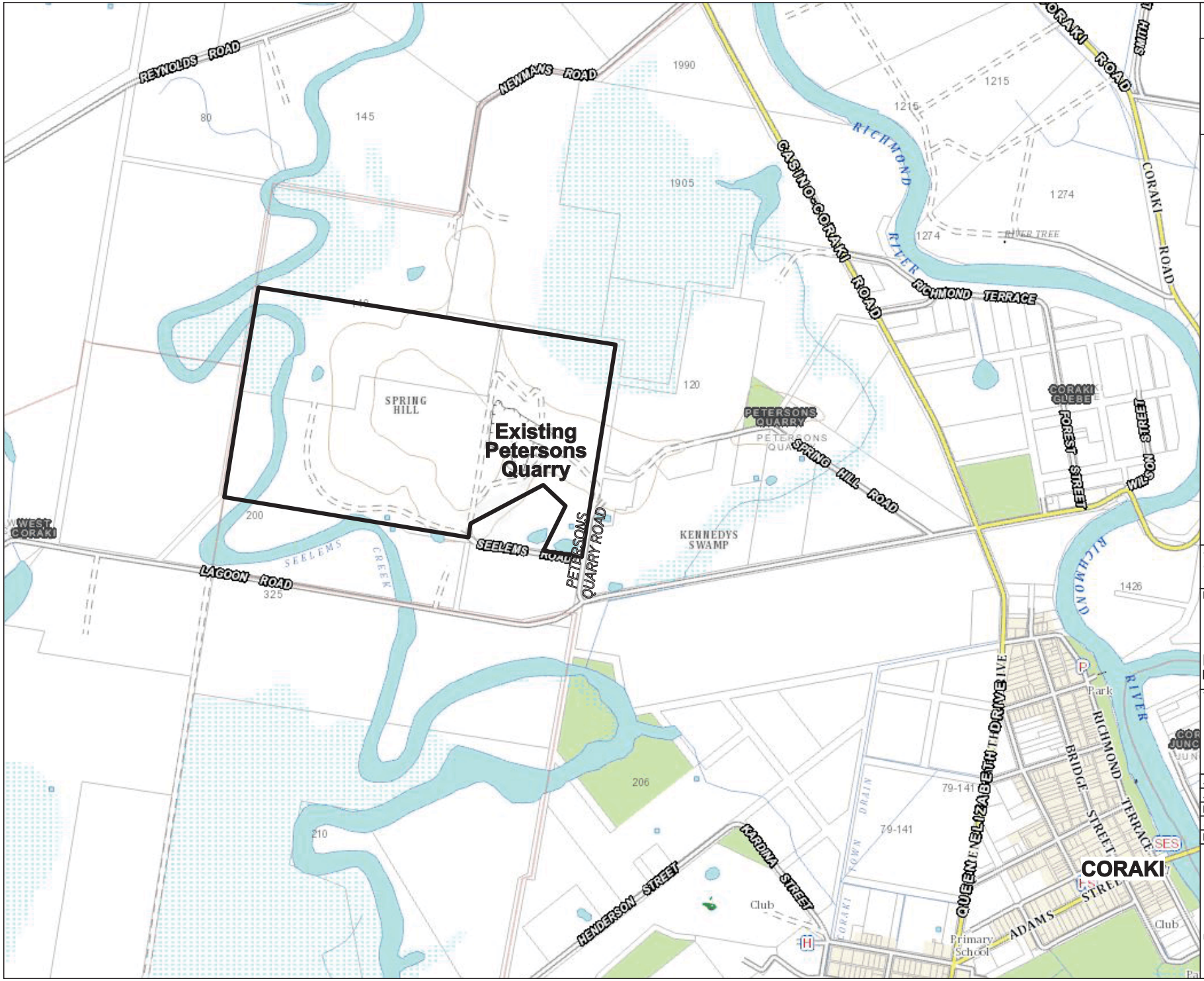
The dust control measures recommended for the quarry to achieve compliance with the regulatory guidelines are:

- Watering of all haul roads and access roads at a rate of at least 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
- Sealing (e.g. asphalt) 200 metres of the access road off Seelems Road;
- Enclosure and/or use of effective water sprays to crushers and screens within the permanent processing plant;
- Effective water misting sprays to permanent processing plant at transfer points including load-out points from elevated storage bins if utilised;
- Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
- Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

In summary, the noise and dust impact assessment has concluded that, with appropriate management measures and physical emission controls, the proposed quarrying activities can comply with the relevant noise amenity criteria and air quality objectives at the surrounding sensitive land uses.

MWA Environmental
4 November 2015

FIGURES



LEGEND

SITE BOUNDARY

DRAWING REFERENCE

NSW GOVERNMENT LPI SIX MAPS

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

N

0 200 400 600m

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
SITE LOCATION

JOB	CORAKI	**FIGURE 1**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:18,000 (A4)	**15-041-1**
REV.		

mwa ENVIRONMENTAL

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LEGEND

SITE BOUNDARY

R9 SURROUNDING RESIDENCES (R1-R9)

DRAWING REFERENCE

GROUNDWATER PLUS SITE LOCATION PLAN 1837.DRG.002, 13/04/15.

0 200 400 600m

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
AERIAL PHOTOGRAPH SHOWING SURROUNDING RESIDENCES

JOB	CORAKI	**FIGURE 2**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:20,000 (A4)	**15-041-2**
REV.		

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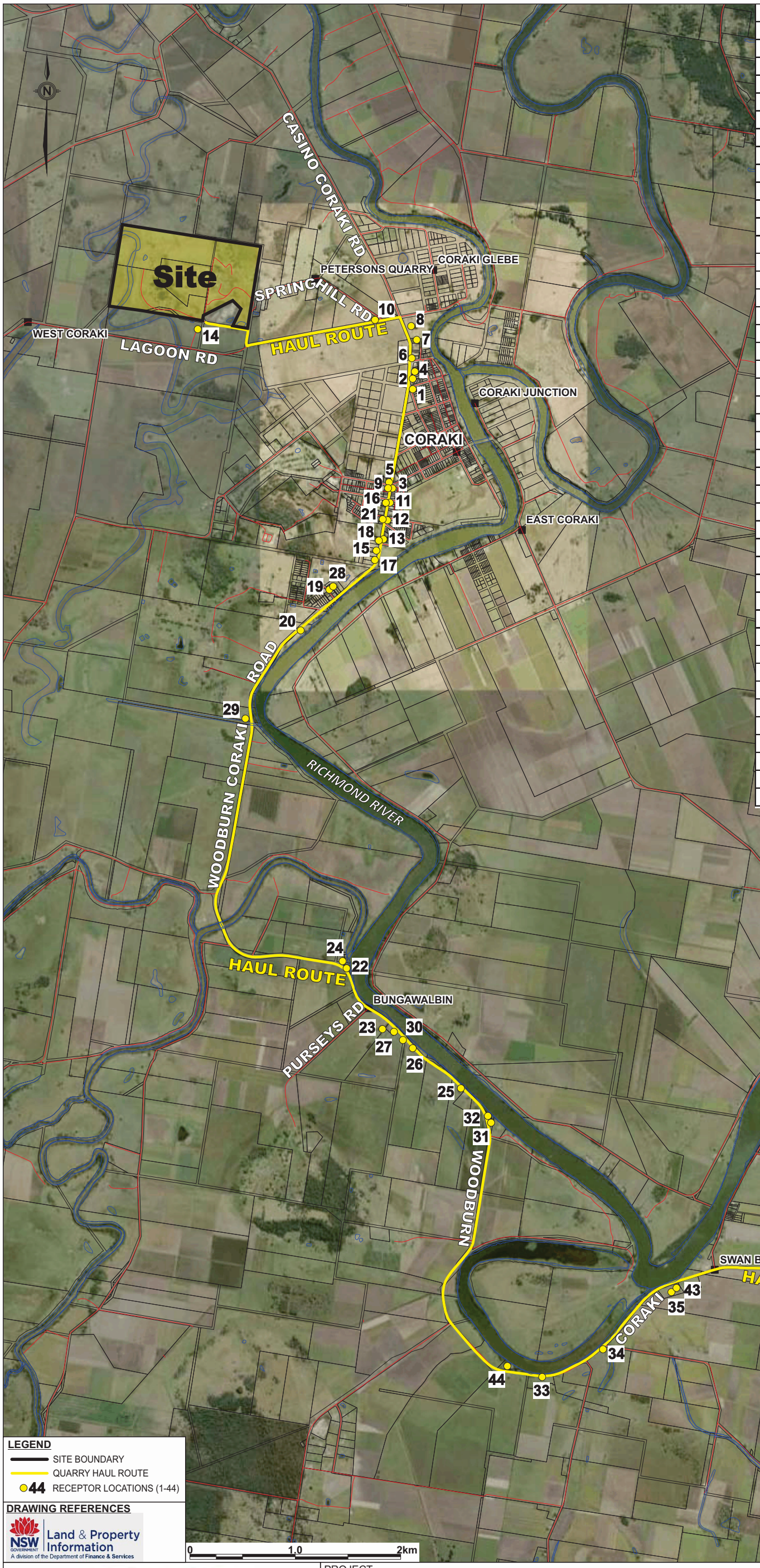

RECEPTOR	ADDRESS
1	21 MINTO STREET CORAKI 2471
2	84 QUEEN ELIZABETH DRIVE CORAKI 2471
3	34 QUEEN ELIZABETH DRIVE CORAKI 2471
4	92-94 QUEEN ELIZABETH DRIVE CORAKI 2471
5	4 UNION STREET CORAKI 2471
6	106 QUEEN ELIZABETH DRIVE CORAKI 2471
7	1760 CASINO-CORAKI ROAD CORAKI 2471
8	1780 CASINO CORAKI RD CORAKI NSW 2471
9	7 UNION STREET CORAKI 2471
10	228 LAGOON ROAD CORAKI 2471
11	24 QUEEN ELIZABETH DRIVE CORAKI 2471
12	10 QUEEN ELIZABETH DRIVE CORAKI 2471
13	14 EAGAR STREET CORAKI 2471
14	200 LAGOON ROAD CORAKI 2471
15	13-19 QUEEN ELIZABETH DRIVE CORAKI 2471
16	1 SURRY STREET CORAKI 2471
17	1-11 QUEEN ELIZABETH DRIVE CORAKI 2471
18	21-23 QUEEN ELIZABETH DRIVE CORAKI 2471
19	4-6 PURVES STREET CORAKI 2471
20	1460 WOODBURN-CORAKI ROAD CORAKI 2471
21	37 DONALDSON STREET CORAKI 2471
22	LOT 12 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
23	965 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
24	1030 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
25	863 WOODBURN-CORAKI ROAD SWAN BAY 2471
26	925 WOODBURN-CORAKI ROAD SWAN BAY 2471
27	955 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
28	1515 WOODBURN-CORAKI ROAD CORAKI 2471
29	1375 WOODBURN-CORAKI ROAD CORAKI 2471
30	945 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
31	820 WOODBURN-CORAKI ROAD SWAN BAY 2471
32	830 CORAKI WOODBURN RD SWAN BAY NSW 2471
33	525 WOODBURN-CORAKI ROAD SWAN BAY 2471
34	455 WOODBURN-CORAKI ROAD SWAN BAY 2471
35	365 WOODBURN-CORAKI ROAD SWAN BAY 2471
36	2 FLETTS LANE SWAN BAY 2471
37	165 WOODBURN-CORAKI ROAD SWAN BAY 2471
38	155 WOODBURN-CORAKI ROAD SWAN BAY 2471
39	65 WOODBURN-CORAKI ROAD WOODBURN 2472
40	35 WOODBURN-CORAKI ROAD WOODBURN 2472
41	20 WOODBURN-CORAKI ROAD WOODBURN 2472 - SCHOOL
42	30 WOODBURN-CORAKI ROAD WOODBURN 2472
43	340 WOODBURN-CORAKI ROAD SWAN BAY 2471
44	550 WOODBURN-CORAKI ROAD SWAN BAY 2471

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PROJECT
CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

TITLE
QUARRY HAULAGE ROUTE AND RECEPTOR LOCATIONS

JOB	CORAKI
JOB NO.	15-041
DATE	23/09/15
SCALE	1:40,000 (A3)

FIGURE 3

DRAWING NUMBER
15-041-3

LEGEND

SITE BOUNDARY

D2 NOISE DATALOGGER LOCATIONS (D1-D2)

DRAWING REFERENCE

GROUNDWATER PLUS SITE LOCATION PLAN 1837.DRG.002, 13/04/15.

0 100 200 300 400 500m

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
NOISE MONITORING LOCATIONS

JOB	CORAKI	FIGURE 4
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:15,000 (A4)	15-041-4
REV.		

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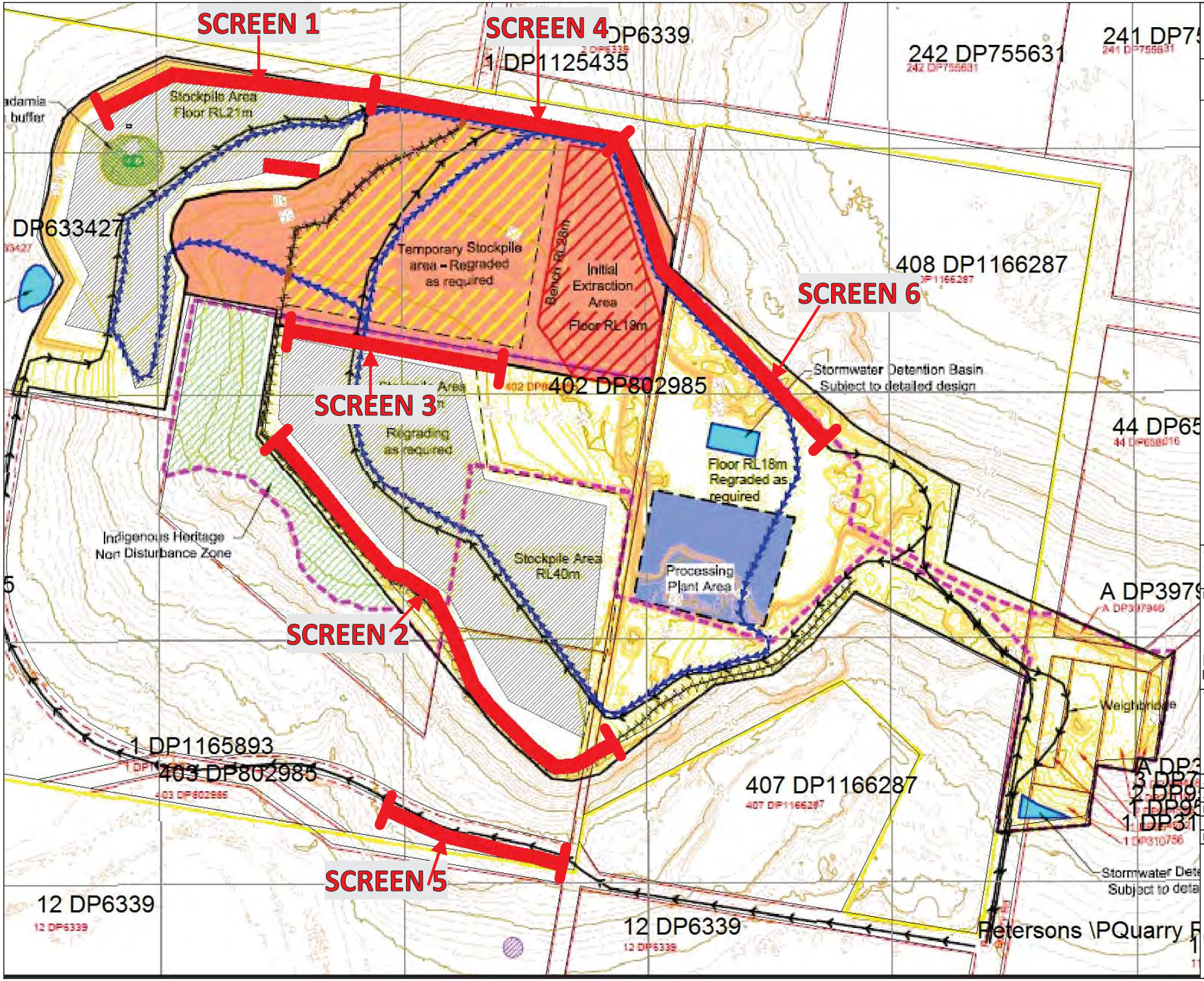

LEGEND

SITE BOUNDARY

ACOUSTIC SCREENS

DRAWING REFERENCE

0 100 200 300 400 500m

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
ACOUSTIC SCREENING

JOB	CORAKI	FIGURE 5
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:15,000 (A4)	15-041-5
REV.		

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PROJECT
CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

TITLE
ROAD TRAFFIC NOISE MONITORING LOCATIONS

JOB	CORAKI
JOB NO.	15-041
DATE	23/09/15
SCALE	1:40,000 (A3)

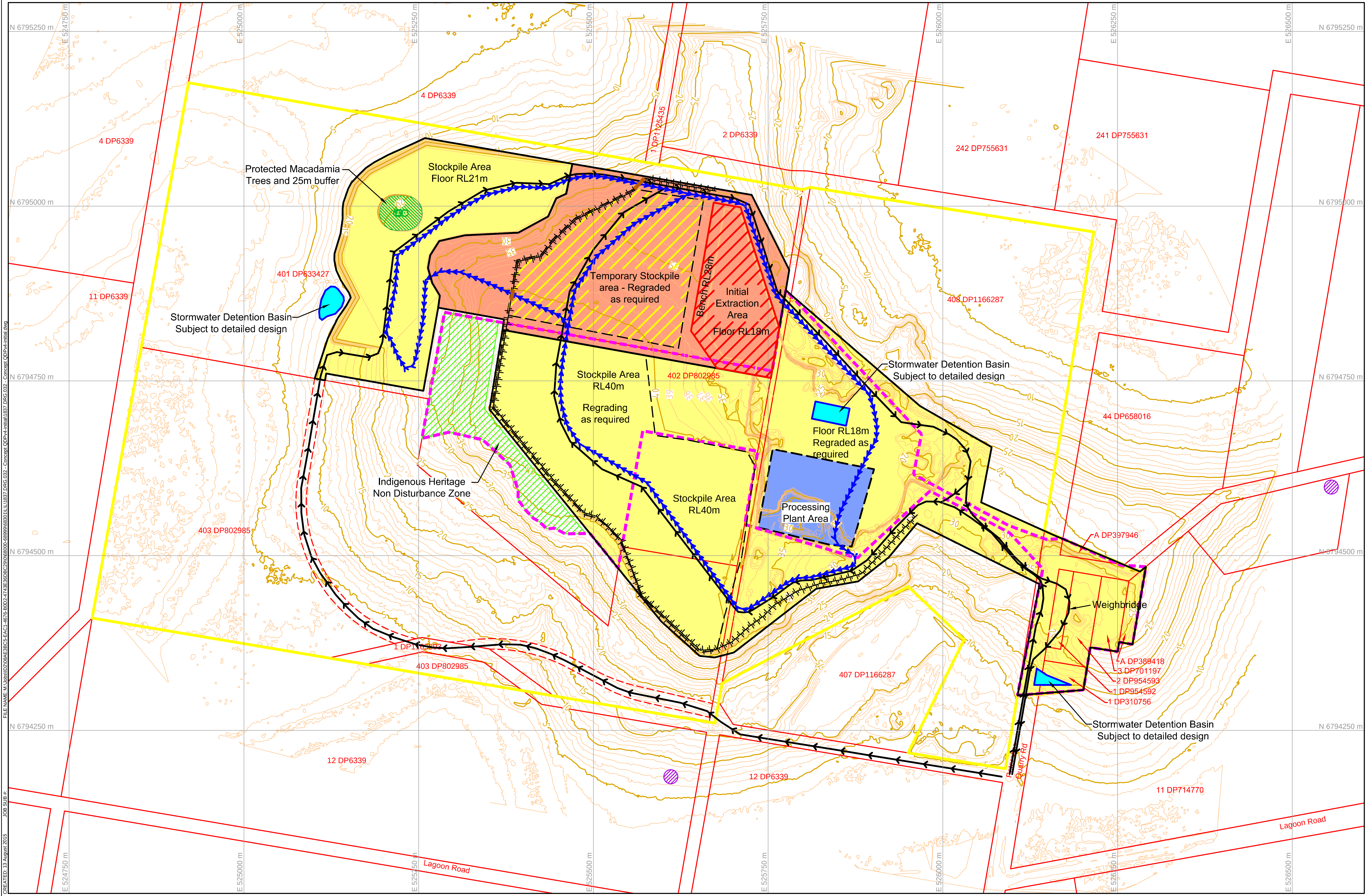
FIGURE 6

DRAWING NUMBER
15-041-6

ATTACHMENT 1

Groundwork Plus Plans

Initial Pit
Final Pit



FILE NAME: M:\Jobs\D2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\6000-6999\6880\1\L\1837.DRG.032 - Concept QDPv4-initial.dwg

JOB SUB #:

CREATED: 13 August 2015

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:

- Site Boundary
- Cadastral Boundary
- Approved Petersons Quarry Footprint
- Nearby Sensitive Receptor
- On Road Truck Movement
- Off Road Truck Movement
- Rollover Bund
- Perimeter Bund

Stockpile Area = 33.23 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT: Coraki Quarry

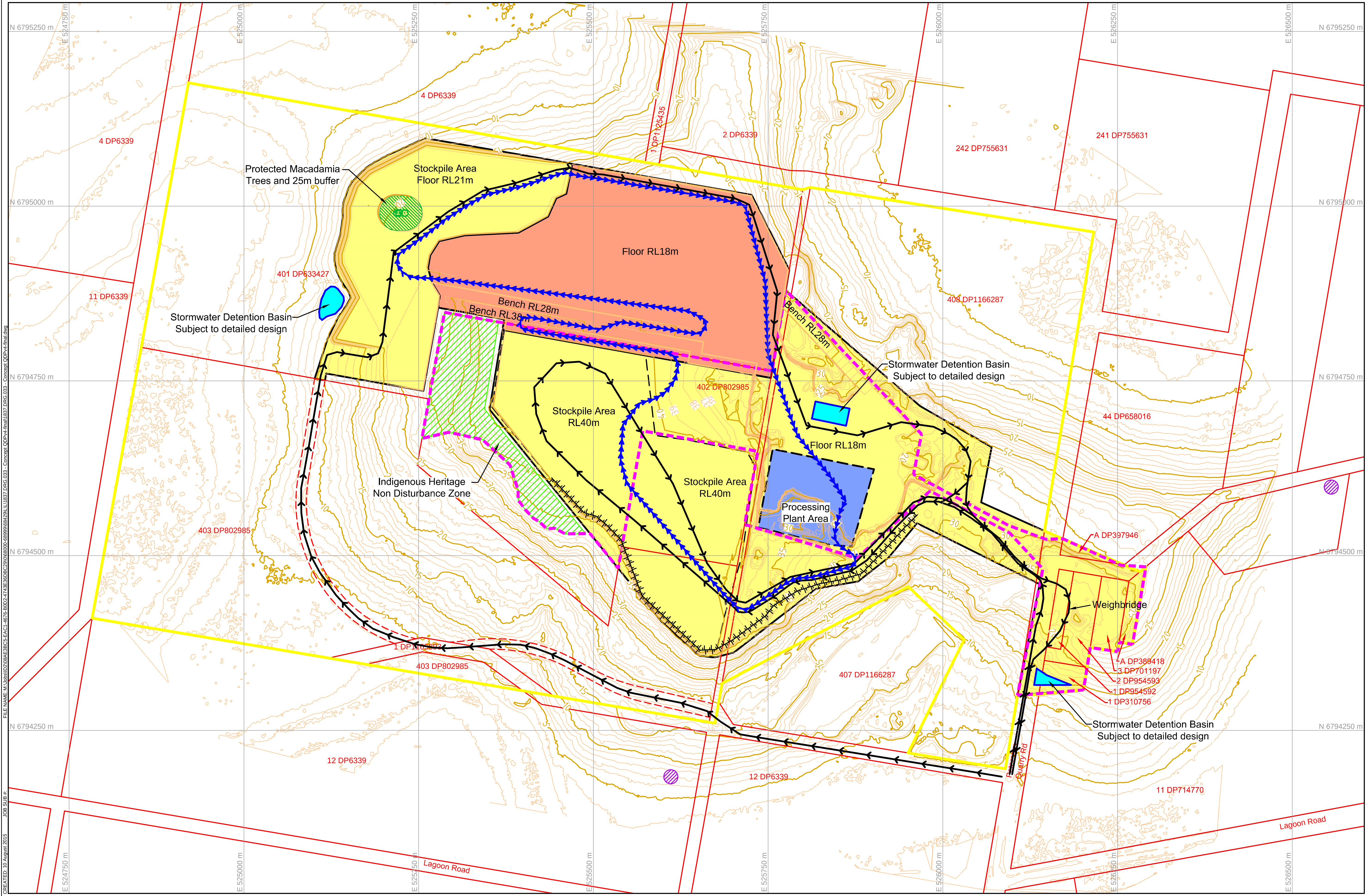
CLIENT: Quarry Solutions Pty Ltd

TITLE: Conceptual Quarry Development Plan
Initial Extraction Stage

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE:	DRAWING NUMBER:	REVISION:
1:5,000 When Printed On A3 (0 – 100)	1837.032	

DATE: 13 August 2015	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE
PRINTED: 13 August 2015	CHECKED: JL	MGA / AHD / 56



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary
- Approved Petersons Quarry Footprint
- Nearby Sensitive Receptor
- On Road Truck Movement
- Off Road Truck Movement
- Perimeter Bund

Stockpile Area = 28.91 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT: Coraki Quarry

CLIENT: Quarry Solutions Pty Ltd

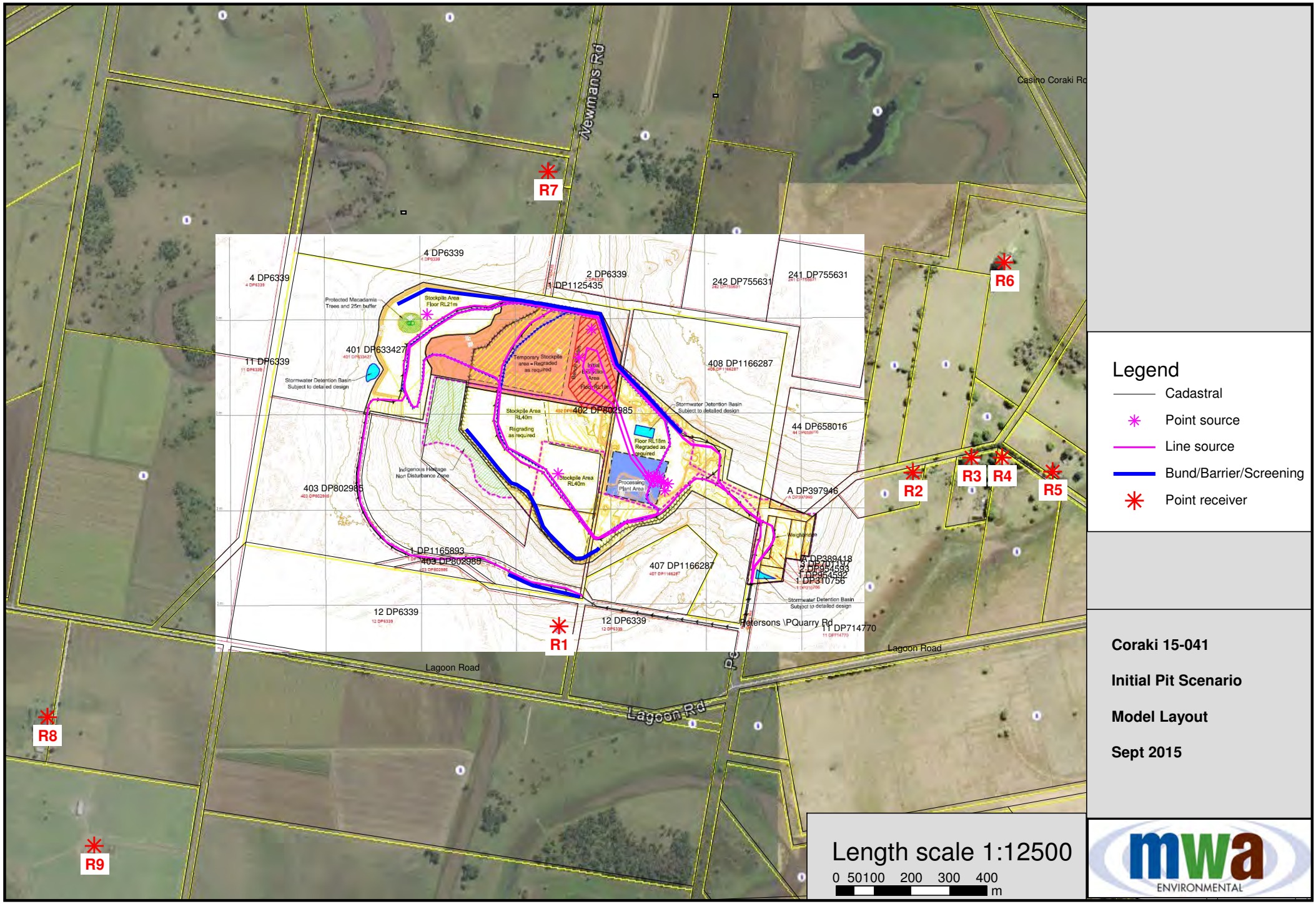
TITLE: Conceptual Quarry Development Plan
Final Extraction Stage

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:5,000 When Printed On A3 (0 – 100)
DRAWING NUMBER: 1837.033
REVISION:
DATE: 13 August 2015
DRAWN: LT
PRINTED: 13 August 2015
CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

ATTACHMENT 2

SoundPLAN Model Layouts



Legend

- Cadastral
- Point source
- Line source
- Bund/Barrier/Screening
- Point receiver

Coraki 15-041

Initial Pit Scenario

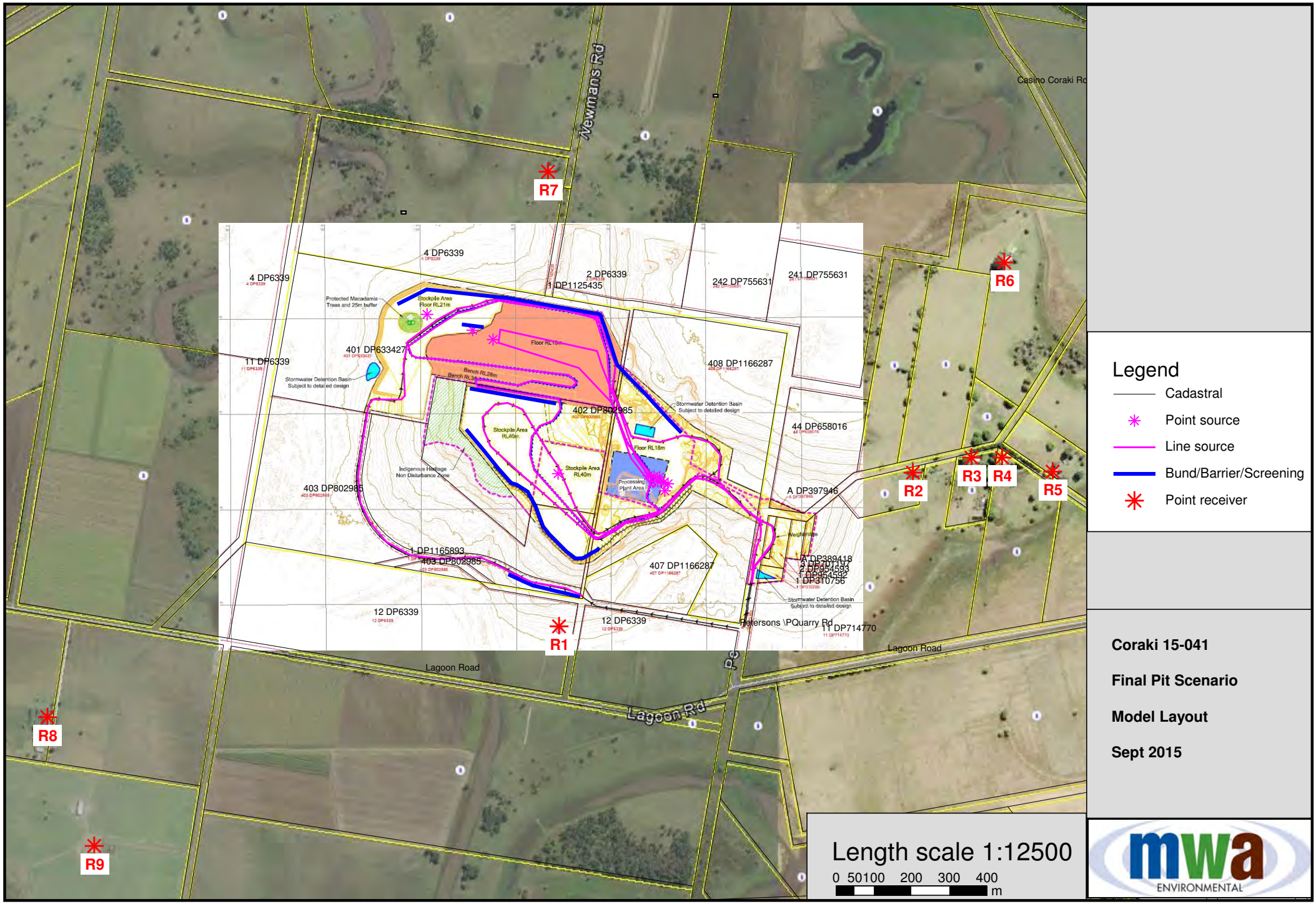
Model Layout

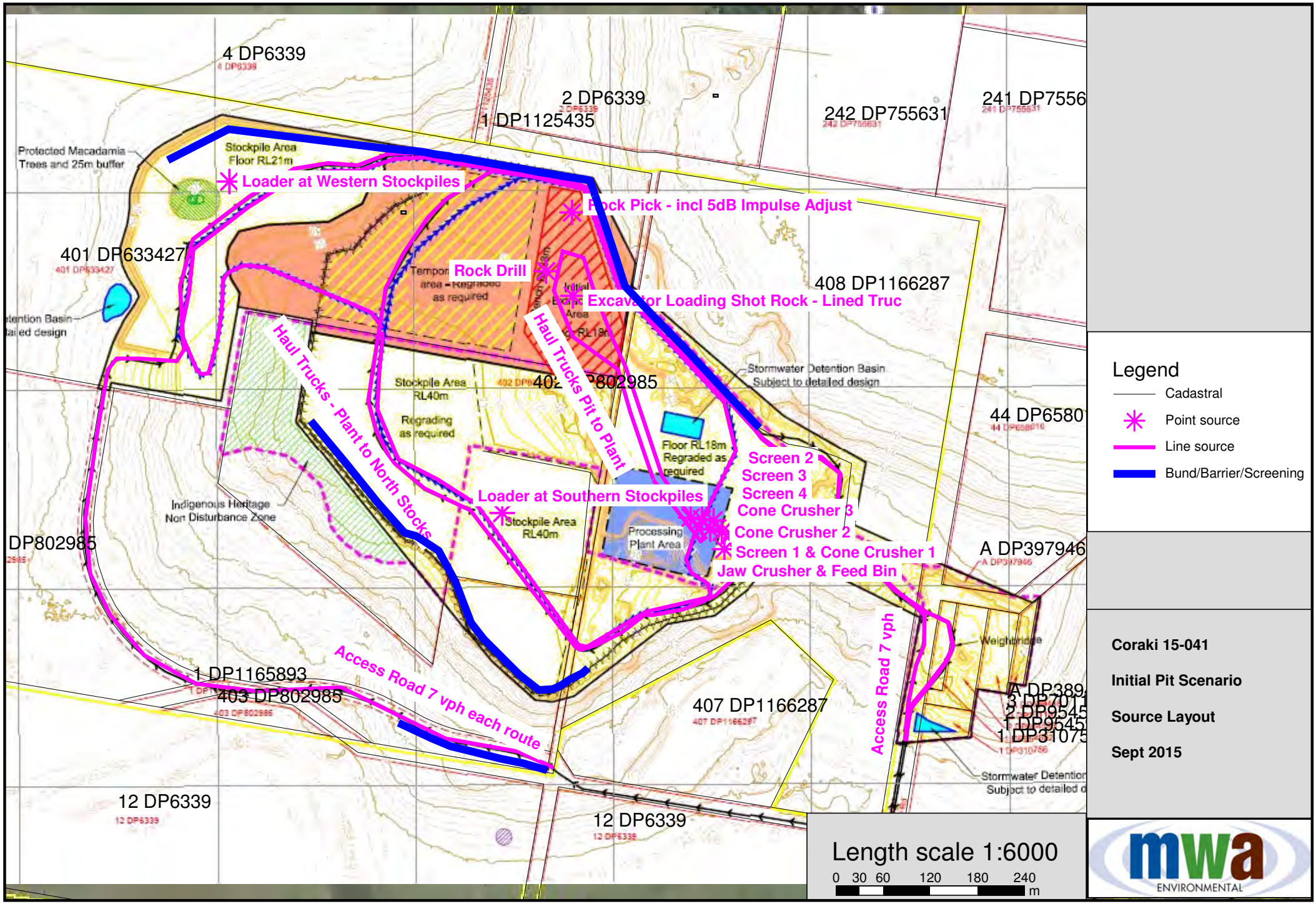
Sept 2015

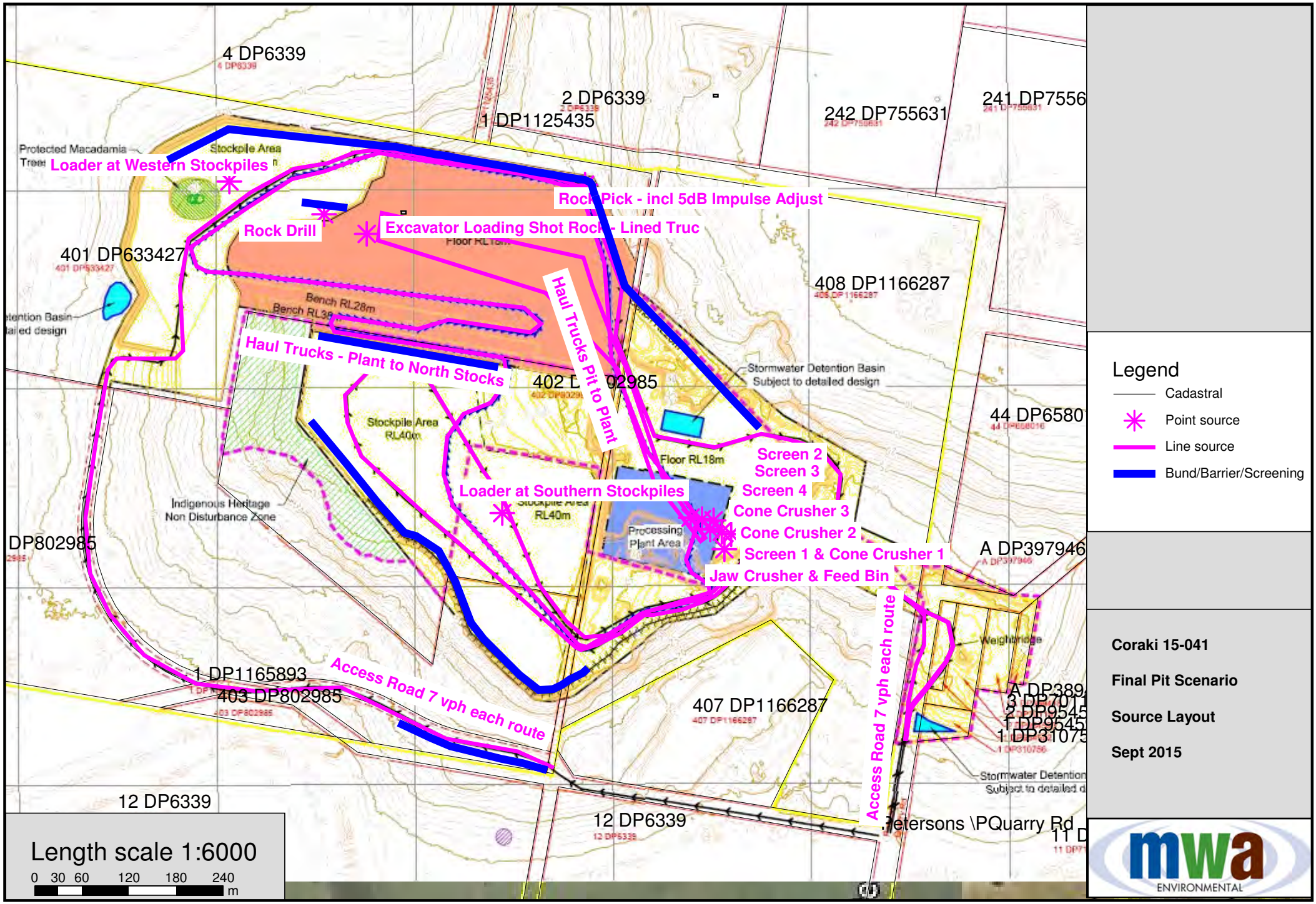
Length scale 1:12500

0 50100 200 300 400 m

mwa ENVIRONMENTAL


Newmans Rd
Casino Coraki Rd
R7
R6
R3
R4
R2
R5
R1
R8
R9
4 DP6339
2 DP6339
1 DP1125435
242 DP755631
241 DP755631
11 DP6339
401 DP633427
408 DP1166287
402 DP802985
44 DP658016
403 DP802985
A DP397946
1 DP1165893
407 DP1166287
12 DP6339
Hansons \PQuarry Rd
11 DP714770
Lagoon Road
Lagoon Rd
Protected Macadamia Trees and 25m buffer
Stockpile Area Floor RL21m
Stormwater Detention Basin Subject to detailed design
Bench RL28m
Bench RL33m
Stockpile Area RL40m
Floor RL18m
Indigenous Heritage Non Disturbance Zone
Processing Plant Area
Weighbridge
Legend
Cadastral
Point source
Line source
Bund/Barrier/Screening
Point receiver
Coraki 15-041
Final Pit Scenario
Model Layout
Sept 2015
Length scale 1:12500
0 50100 200 300 400
m
mwa
ENVIRONMENTAL


4 DP6339
2 DP6339
1 DP1125435
242 DP755631
241 DP7556
Protected Macadamia Trees and 25m buffer
Stockpile Area Floor RL21m
Loader at Western Stockpiles
Rock Pick - incl 5dB Impulse Adjust
401 DP633427
Rock Drill
Excavator Loading Shot Rock - Lined Truc
408 DP1166287
Haul Trucks - Plant to North Stocks
Haul Trucks Pit to Plant
Stockpile Area RL40m
Regrading as required
Stormwater Detention Basin Subject to detailed design
44 DP6580
Floor RL18m Regraded as required
Screen 2
Screen 3
Screen 4
Cone Crusher 3
Cone Crusher 2
Screen 1 & Cone Crusher 1
Jaw Crusher & Feed Bin
Loader at Southern Stockpiles
Stockpile Area RL40m
Processing Plant Area
Indigenous Heritage Non Disturbance Zone
DP802985
A DP397946
Weighbridge
Access Road 7 vph each route
Access Road 7 vph
1 DP1165893
403 DP802985
407 DP1166287
12 DP6339
12 DP6339
Length scale 1:6000
0 30 60 120 180 240 m
Legend
Cadastral
Point source
Line source
Bund/Barrier/Screening
Coraki 15-041
Initial Pit Scenario
Source Layout
Sept 2015
mwa ENVIRONMENTAL


Loader at Western Stockpiles
Rock Drill
Rock Pick - incl 5dB Impulse Adjust
Excavator Loading Shot Rock - Lined Truc
Haul Trucks Pit to Plant
Haul Trucks - Plant to North Stocks
Loader at Southern Stockpiles
Screen 2
Screen 3
Screen 4
Cone Crusher 3
Cone Crusher 2
Screen 1 & Cone Crusher 1
Jaw Crusher & Feed Bin
Access Road 7 vph each route
Access Road 7 vph each route
Stockpile Area
Stockpile Area RL40m
Bench RL28m
Floor RL18m
Processing Plant Area
Stormwater Detention Basin
Subject to detailed design
Indigenous Heritage Non Disturbance Zone
Protected Macadamia Tree
Weighbridge
4 DP6339
2 DP6339
1 DP1125435
242 DP755631
241 DP7556
401 DP633427
408 DP1166287
44 DP6580
A DP397946
DP802985
1 DP1165893
403 DP802985
407 DP1166287
12 DP6339
12 DP6339
Petersons \PQuarry Rd
Length scale 1:6000
0 30 60 120 180 240 m
Legend
Cadastral
Point source
Line source
Bund/Barrier/Screening
Coraki 15-041
Final Pit Scenario
Source Layout
Sept 2015
mwa ENVIRONMENTAL

ATTACHMENT 3

Modelled Sound Power Levels

No.	Element name	Unit	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz	Sum
2	%Access Road 7vph	dB(A)/meter		47.1	51.1	55.1	58.1	61.1	59.1	54.1	49.1		65.5
3	% Loader 15 min Load Cycle	dB(A)/unit		64.1	85.6	91.8	88.5	93.1	92.7	90.6	82.0		104.0
			52.3	77.8	86.6	88.8	94.2	93.2	91.4	86.0	79.0		
			57.9	85.5	92.8	84.9	95.7	92.7	91.1	83.4			
4	% Exc Loading Lined Truck with OS - 15min Work Cycle	dB(A)/unit	58.0	80.7	85.6	93.0	95.0	98.4	100.6	98.0	90.8	73.7	110.2
			75.3	84.6	84.5	91.8	99.2	99.7	99.7	97.9	86.6	70.3	
			72.3	81.3	89.5	92.1	100.3	101.0	99.5	93.8	80.3	60.0	
12	% SWL Jaw Crusher & Feed Bin	dB(A)/unit	66.7	82.9	89.6	95.6	99.8	99.2	99.1	97.9	104.5	73.6	112.7
			74.1	90.7	93.5	97.2	100.7	99.6	98.9	100.6	100.5	63.3	
			77.8	91.3	95.6	97.8	100.5	99.2	98.8	103.6	86.5	58.2	
13	% SWL S1 and CC1	dB(A)/unit	69.4	75.8	87.5	96.1	96.9	98.0	99.3	96.8	87.1	70.9	110.2
			79.5	83.7	89.2	95.1	99.5	100.8	99.9	93.4	82.6	63.9	
			74.9	95.4	95.9	94.1	98.8	100.5	98.2	90.1	77.2	55.4	
14	% SWL S2	dB(A)/unit	77.1	75.4	79.5	92.4	97.5	95.7	94.0	91.5	87.4	75.2	106.7
			87.3	77.9	85.3	93.8	97.2	95.3	93.2	90.4	84.8	68.3	
			77.8	86.5	90.0	95.2	96.6	95.6	92.4	89.1	81.6	56.3	
15	% SWL CC2	dB(A)/unit	74.4	77.2	82.6	91.1	95.3	98.6	96.6	94.2	91.6	77.8	108.6
			84.7	79.2	85.6	92.4	99.8	98.8	96.7	93.4	90.1	67.7	
			75.4	86.3	88.5	92.7	99.2	98.7	95.4	92.7	86.2	58.5	
17	% SWL Mobile Screen	dB(A)/unit	69.6	73.6	77.9	90.9	95.6	90.9	89.9	87.9	80.9	66.8	104.8
			80.0	80.3	80.0	92.8	97.3	97.4	91.4	85.7	76.5	61.6	
			74.3	83.1	83.3	90.9	93.4	94.6	87.9	85.1	71.6	56.0	
19	%Haul Truck (Cat 777C) Driveby Lmax	dB(A)/unit	78.6	91.7	99.2	105.1	106.7	108.5	109.3	103.5	99.7		114.4
28	% Quietened Rock Drill Leq	dB(A)/unit	68.7	95.7	91.7	95.4	101.6	102.9	104.6	100.9	97.8		109.5
29	% Rock Pick LAeq +5dB Impulse	dB(A)/unit	58.9	74.0	96.6	99.3	99.5	106.0	107.7	106.5	99.3	85.6	118.0
			62.7	78.7	94.9	97.6	105.7	108.5	110.1	102.1	96.0	78.8	
			71.1	86.6	99.6	97.0	107.6	108.4	108.2	101.9	91.3	74.4	

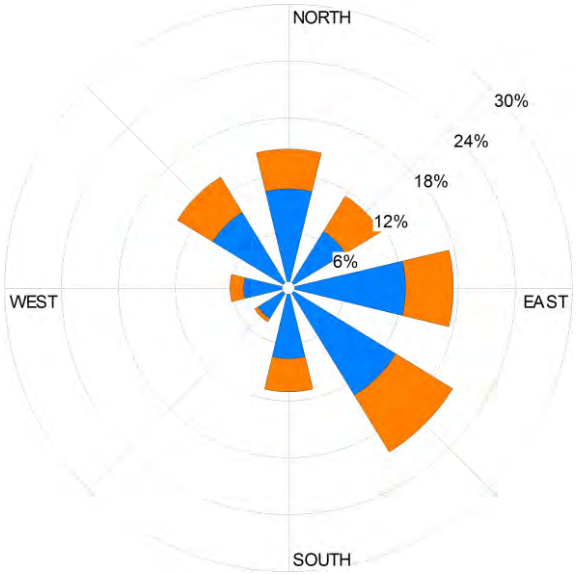
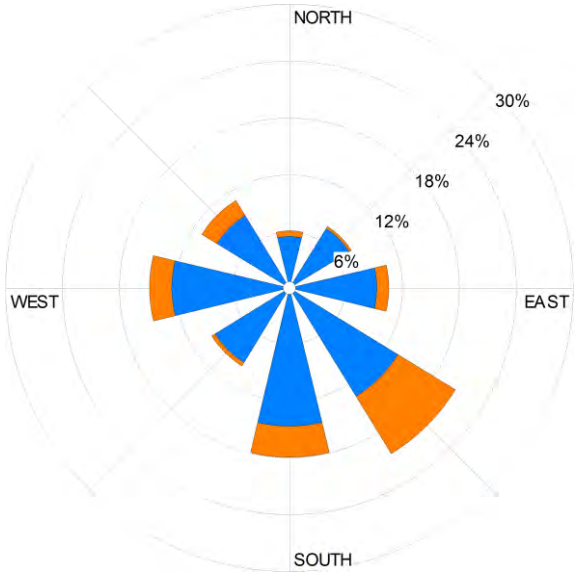
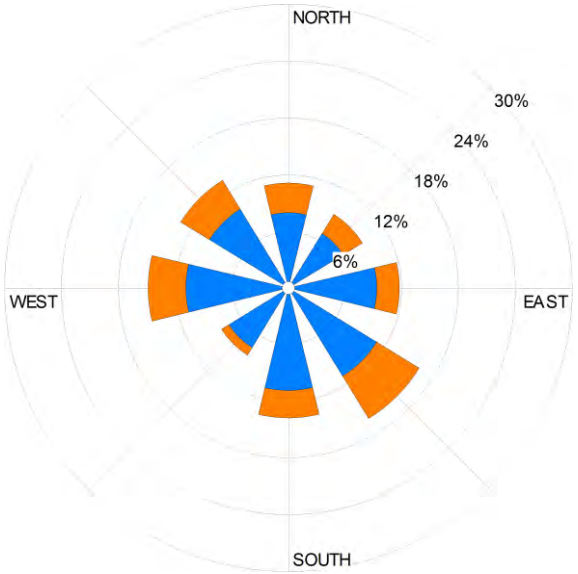
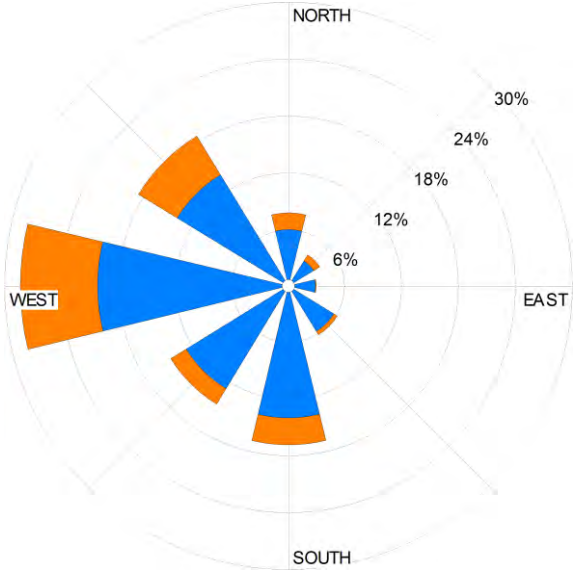
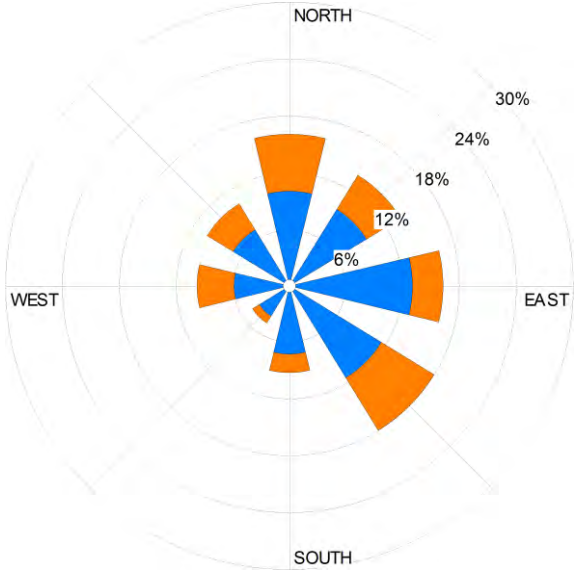
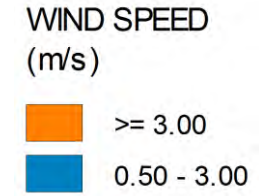
ATTACHMENT 4

Analysis of Meteorological Conditions for Noise Assessment

Stability Classes for the period 6am to 7pm

Stability Class		Annual		Summer		Autumn		Winter		Spring	
		Counts	%	Counts	%	Counts	%	Counts	%	Counts	%
A	1	106	2%	50	4%	15	1%	3	0.3%	38	3%
B	2	555	12%	171	15%	117	10%	113	9%	154	13%
C	3	810	17%	194	17%	191	16%	243	20%	182	15%
D	4	2920	62%	747	64%	767	64%	666	56%	740	63%
E	5	74	2%	0	0%	14	1%	35	3%	25	2%
F	6	280	6%	8	1%	92	8%	136	11%	44	4%
Sum		4745	100%	1170	100%	1196	100%	1196	100%	1183	100%

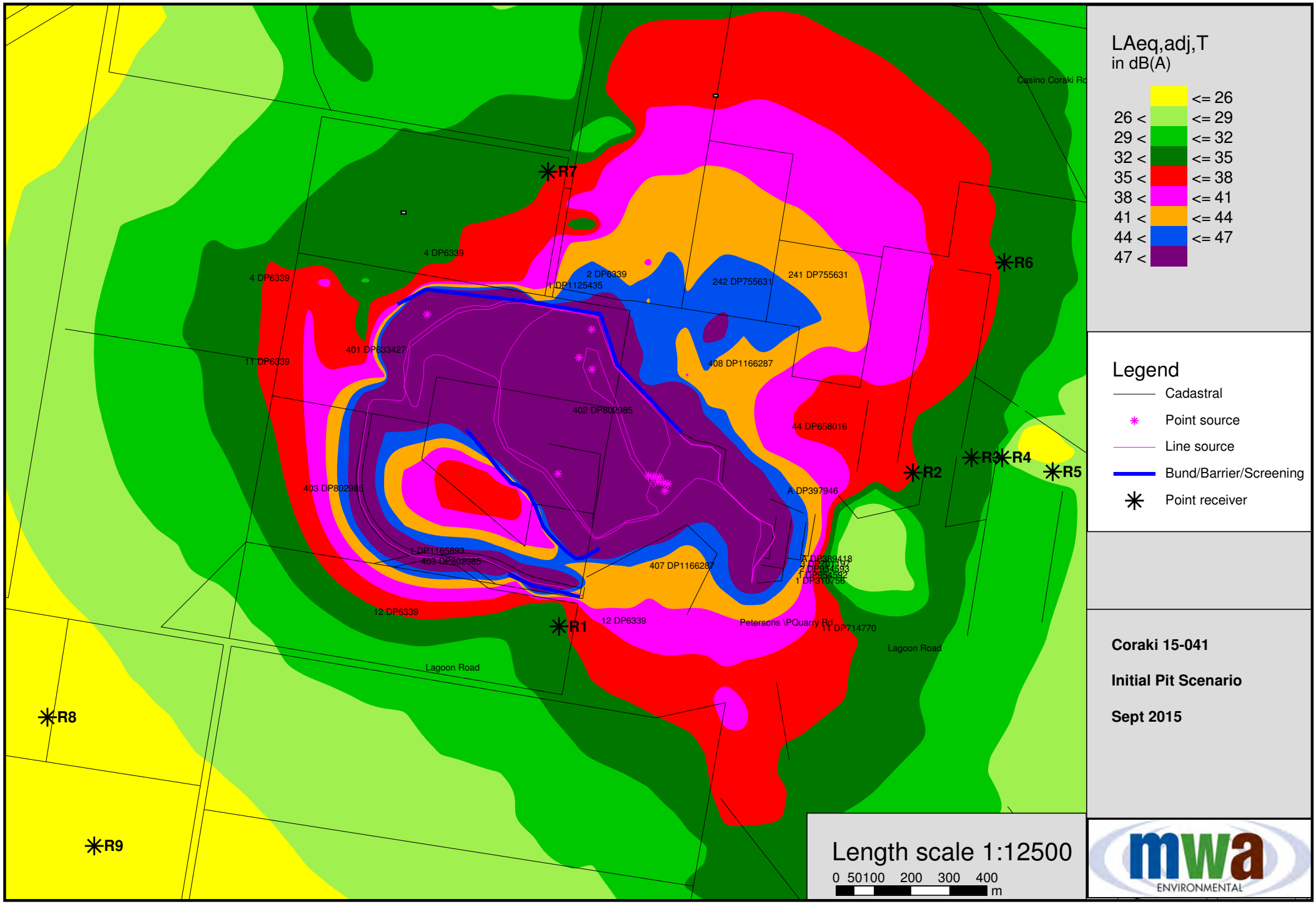
Wind roses for the period 6am to 7pm

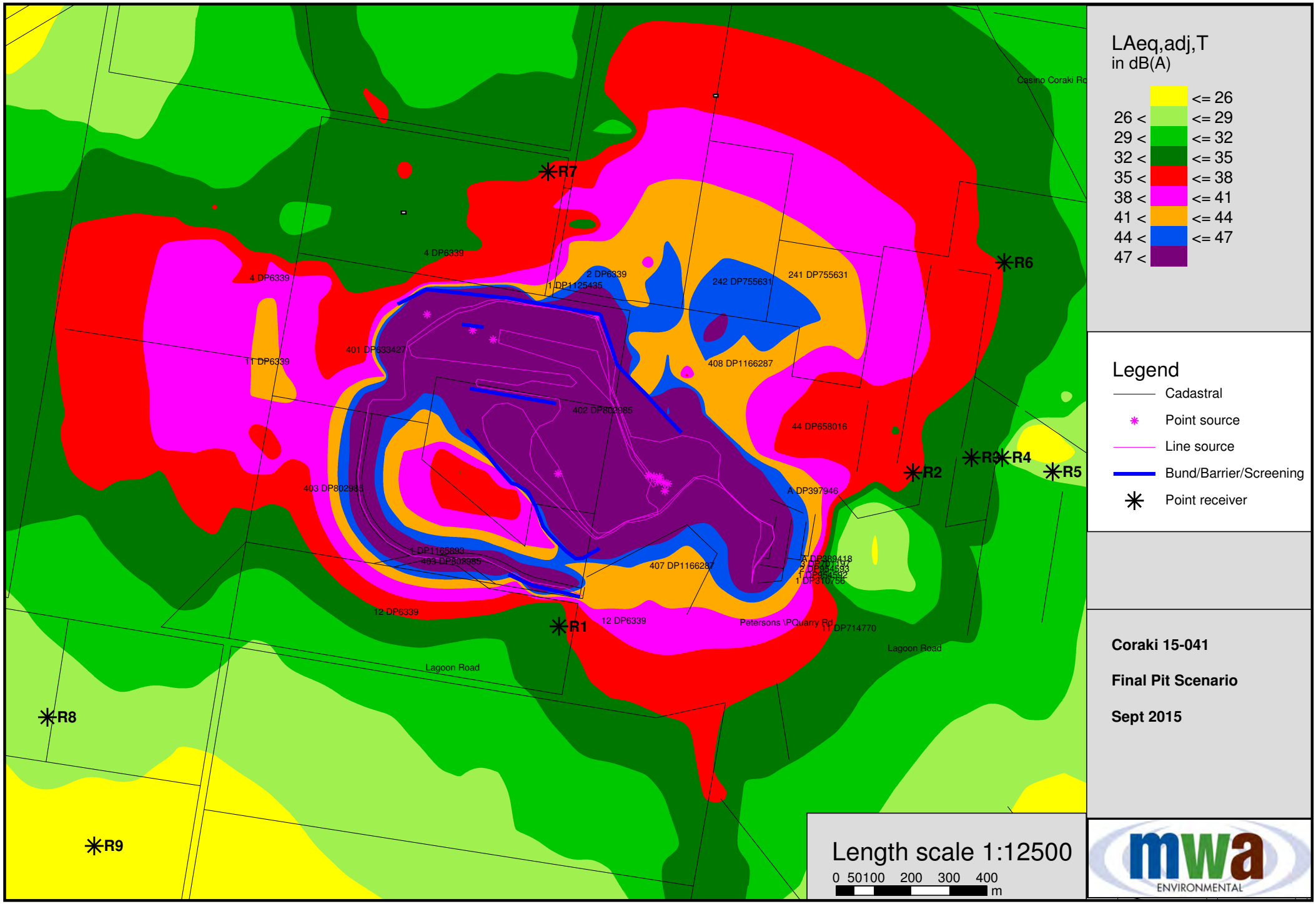
Summer	Autumn	Annual
		
Calms 0.77%	Calms 1.84%	Calms 1.41%
Winter	**Spring**	**Key**
		
Calms 0.92%	Calms 2.11%	

ATTACHMENT 5

Predicted Quarry Noise Levels

Initial Pit
Final Pit


LAeq,adj,T
in dB(A)
<= 26
26 < <= 29
29 < <= 32
32 < <= 35
35 < <= 38
38 < <= 41
41 < <= 44
44 < <= 47
47 <
Legend
Cadastral
Point source
Line source
Bund/Barrier/Screening
Point receiver
Coraki 15-041
Initial Pit Scenario
Sept 2015
Length scale 1:12500
0 50100 200 300 400
m
mwa
ENVIRONMENTAL
R1
R2
R3
R4
R5
R6
R7
R8
R9
Casino Coraki Rd
Lagoon Road
Petersons \PQuarry Rd
4 DP6339
2 DP6339
1 DP1125435
242 DP755631
241 DP755631
401 DP633427
11 DP6339
408 DP1166287
402 DP802985
44 DP658016
403 DP802985
A DP397946
1 DP1165893
403 DP802985
407 DP1166287
1 DP310755
12 DP6339
11 DP714770


LAeq,adj,T
in dB(A)
<= 26
26 < <= 29
29 < <= 32
32 < <= 35
35 < <= 38
38 < <= 41
41 < <= 44
44 < <= 47
47 <
Legend
Cadastral
Point source
Line source
Bund/Barrier/Screening
Point receiver
Coraki 15-041
Final Pit Scenario
Sept 2015
Length scale 1:12500
0 50100 200 300 400
m
ENVIRONMENTAL
R1
R2
R3
R4
R5
R6
R7
R8
R9
Casino Coraki Rd
Lagoon Road
Petersons \PQuarry Rd
4 DP6339
2 DP6339
1 DP1125435
242 DP755631
241 DP755631
401 DP633427
11 DP6339
408 DP1166287
402 DP802985
44 DP658016
403 DP802985
A DP397946
1 DP1165893
403 DP802985
407 DP1166287
1 DP310755
12 DP6339
11 DP714770

ATTACHMENT 6

Modelled Particle Size Distribution

PARTICLE SIZE DISTRIBUTION

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 μm	< 15 μm	< 10 μm	< 5 μm	< 2.5 μm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 μm taken from Reference 14.

TSP

FRACTION #	1	2	3	4	5	6
PARTICLE SIZE (MICRONS)	>30	<30	<15	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**40**	**22.5**	**12.5**	**7.5**	**3.75**	**1.25**
% OF TOTAL	**0.26**	**0.26**	**0.13**	**0.15**	**0.147**	**0.053**
STANDARD DEVIATION	**0**	**0**	**0**	**0**	**0**	**0**

PM10

FRACTION #	4	5	6
PARTICLE SIZE (MICRONS)	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**7.5**	**3.75**	**1.25**
% OF TOTAL	0.15	0.147	0.053
% OF <PM10	**0.428571**	**0.42**	**0.151429**
STANDARD DEVIATION	**0**	**0**	**0**

PM2.5

FRACTION #	6
PARTICLE SIZE (MICRONS)	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**1.25**
% OF TOTAL	0.053
% OF <PM2.5	**100**
STANDARD DEVIATION	**0**

ATTACHMENT 7

Analysis of CALMET-Generated Site Meteorological Data

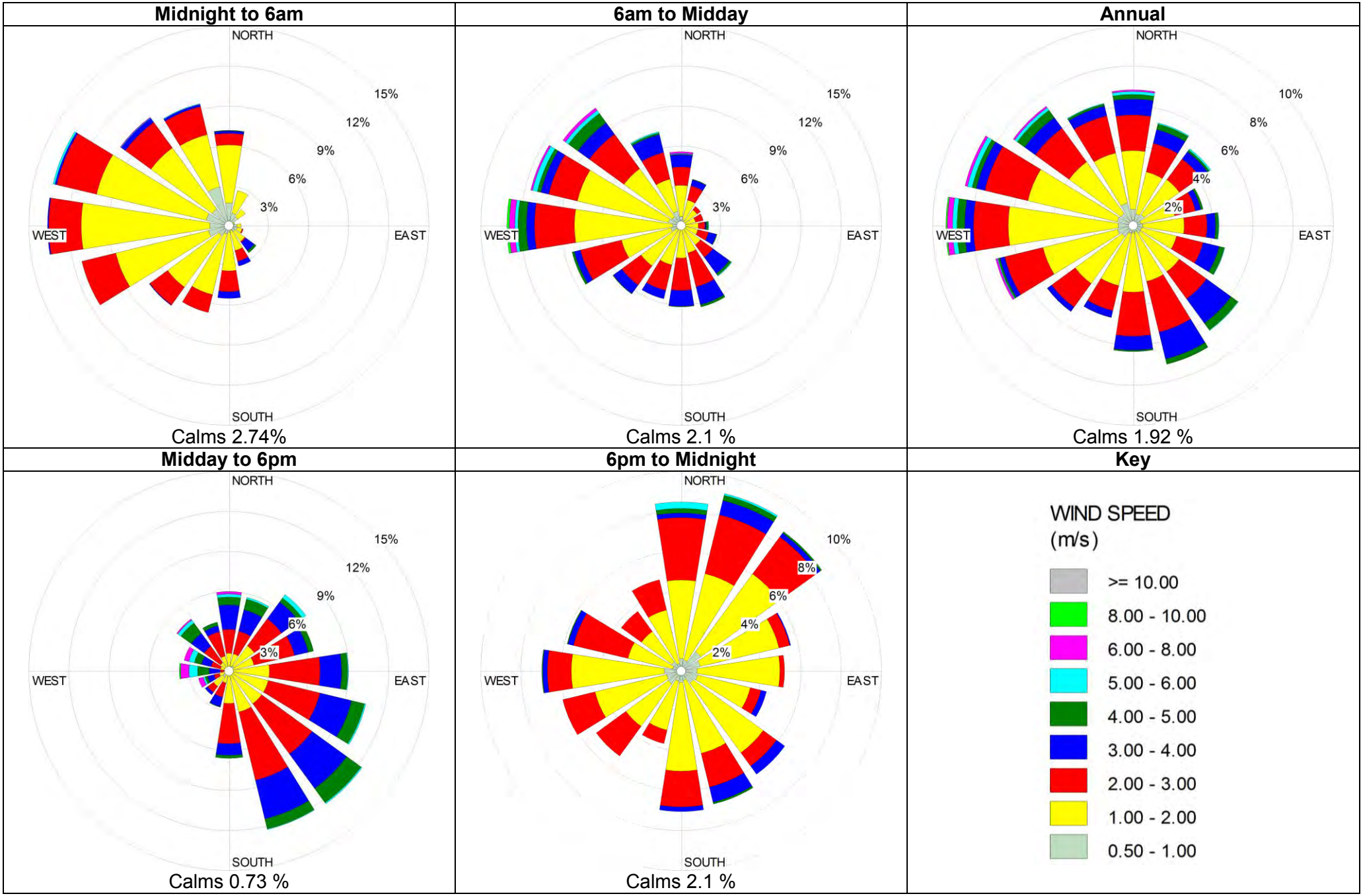


Figure A7.1 Diurnal wind roses for the Site as generated by CALMET

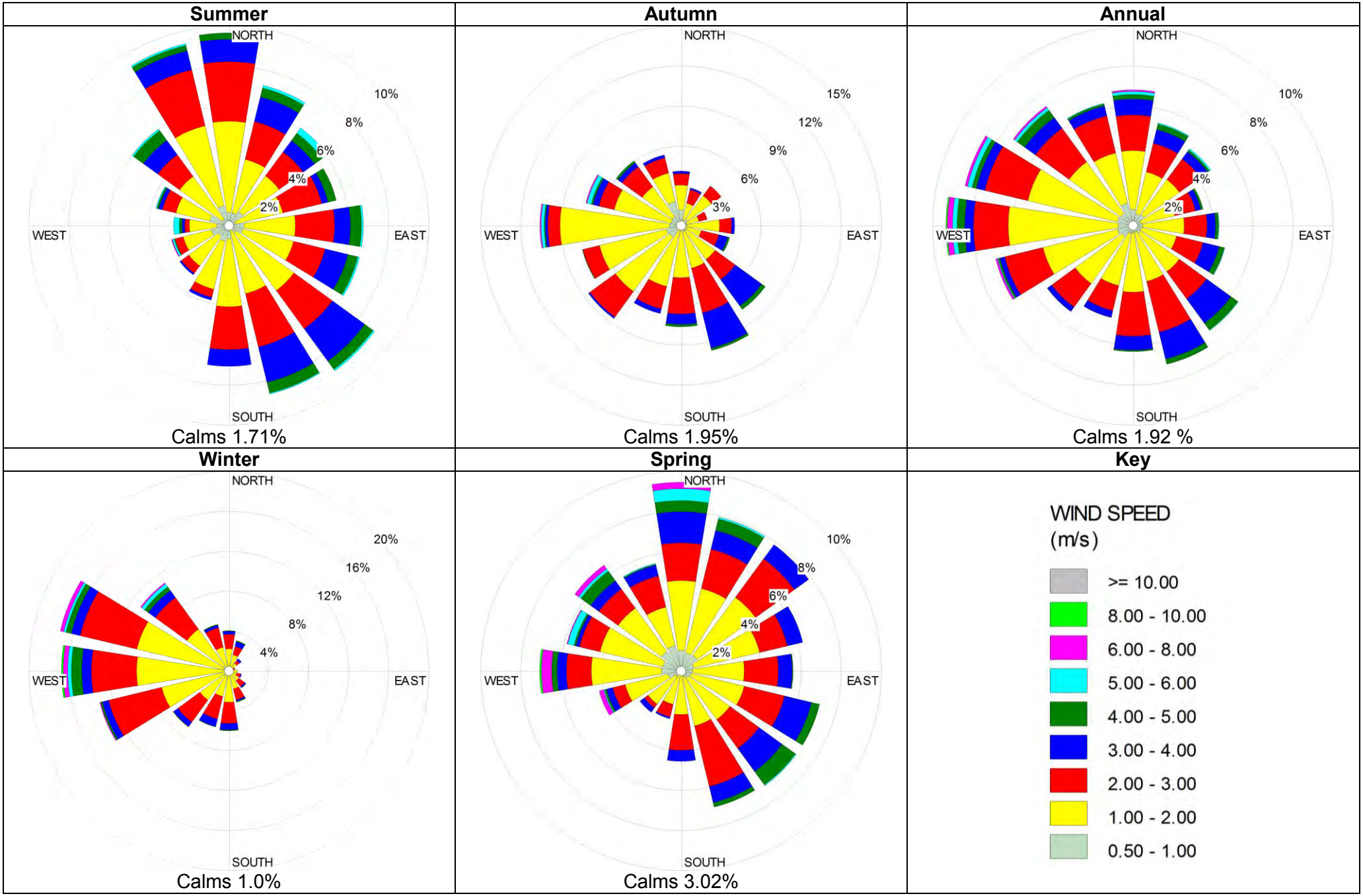


Figure A7.2 Seasonal wind roses for the Site as generated by CALMET

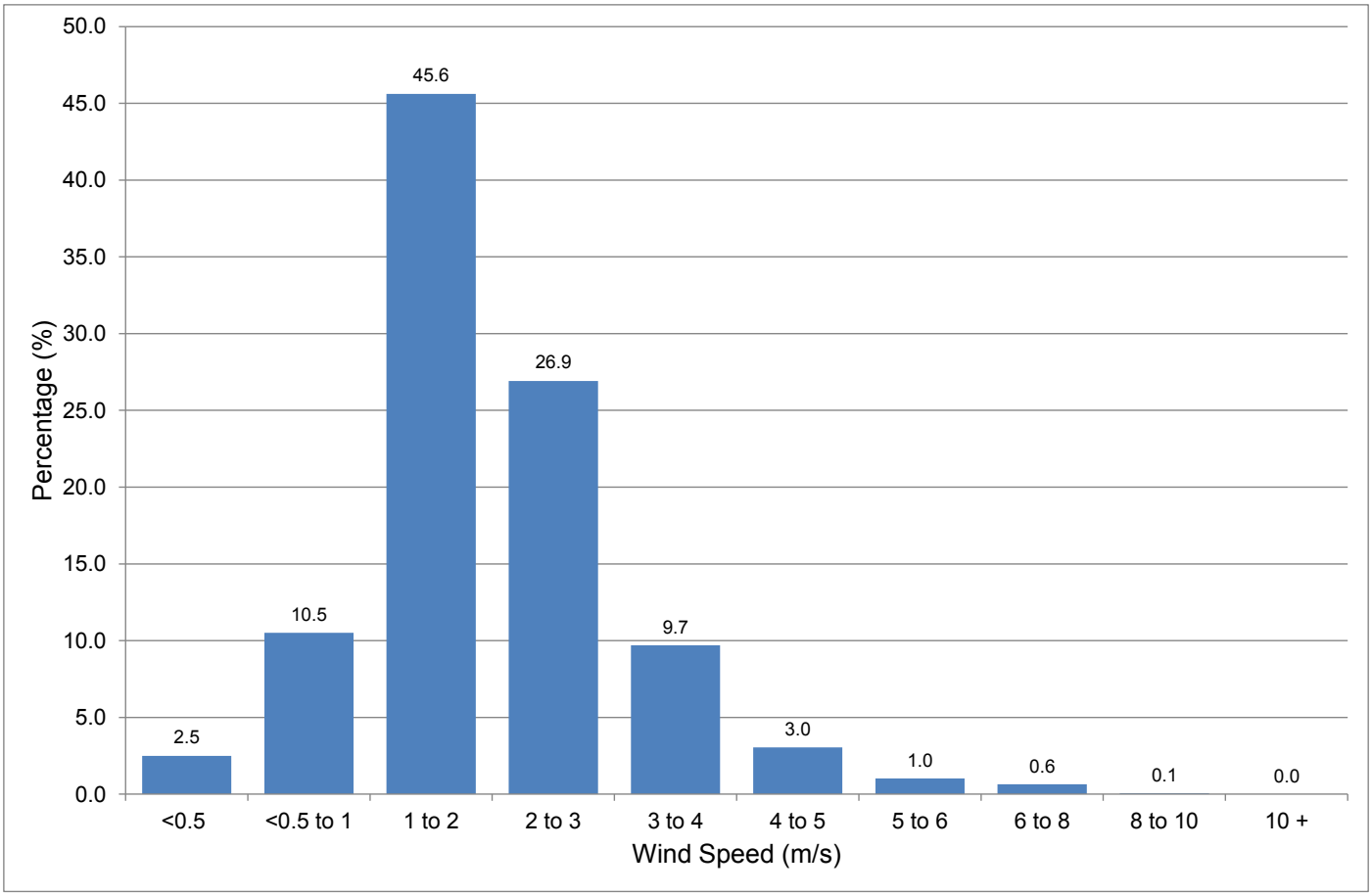


Figure A7.3 Wind frequency graph for the Site as generated by CALMET

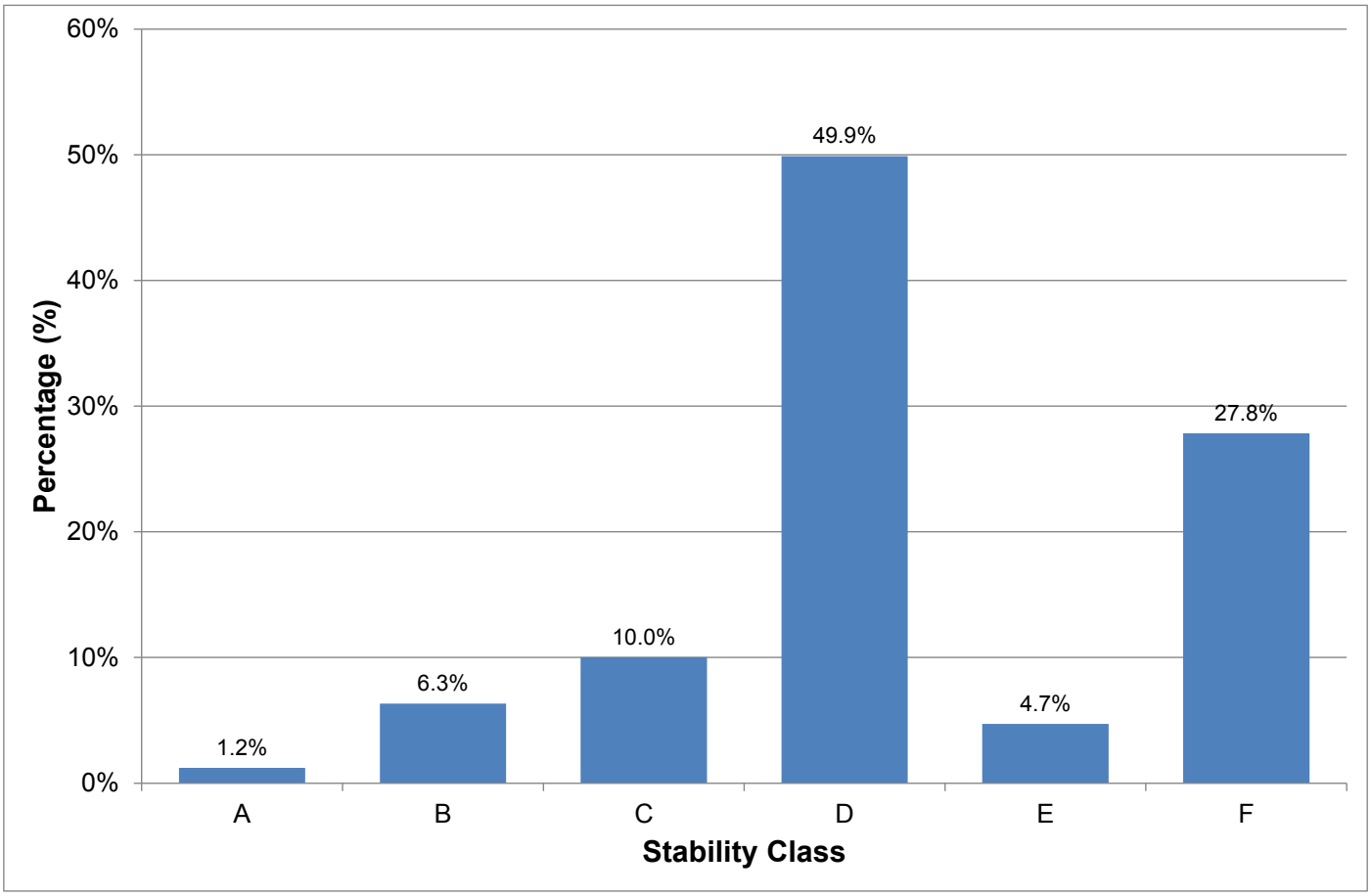


Figure A7.4 Stability Class Histograms for the Site as generated by CALMET

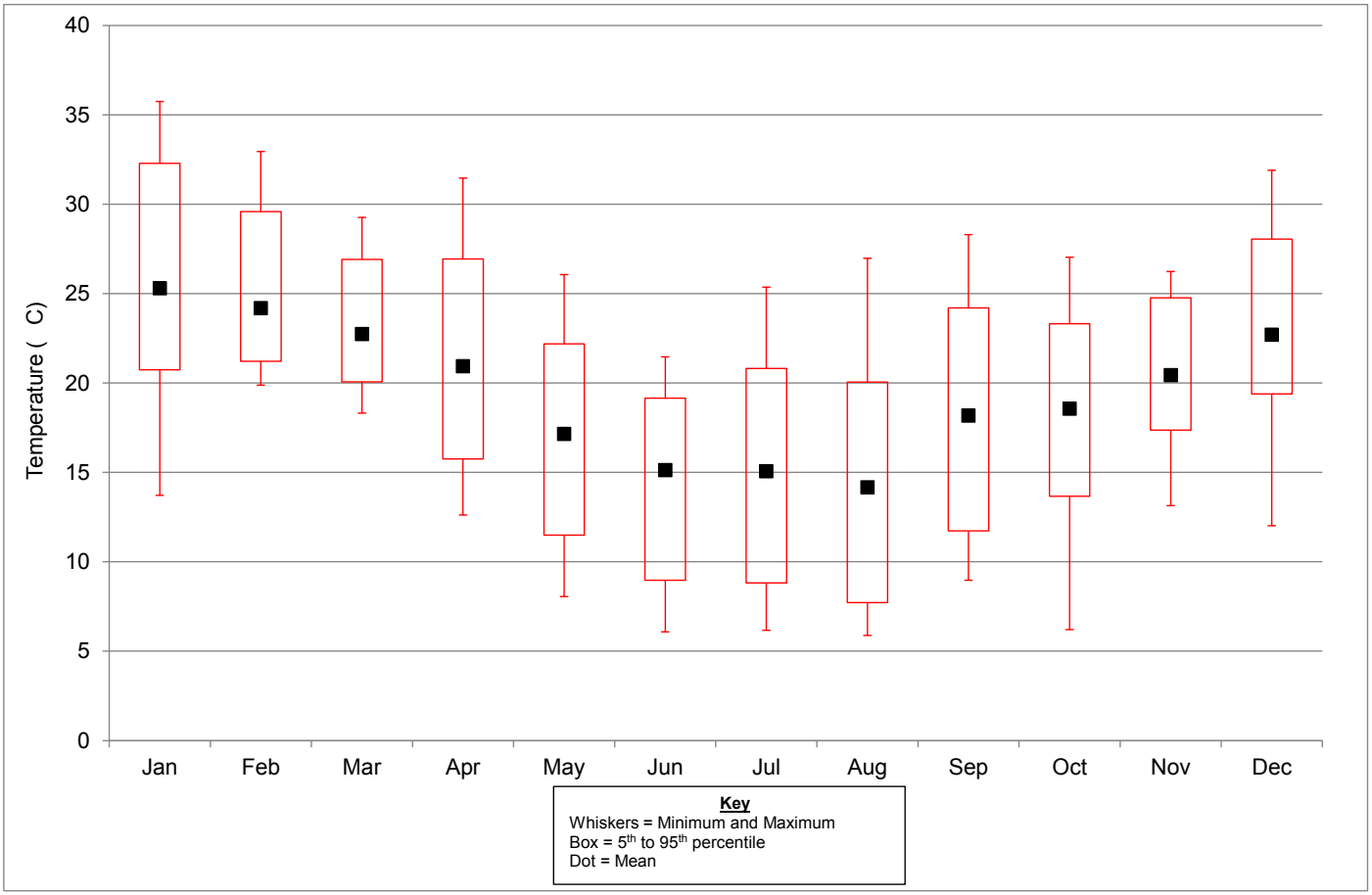


Figure A7.5 Box and Whisker plot of monthly temperature for the Site as generated by CALMET

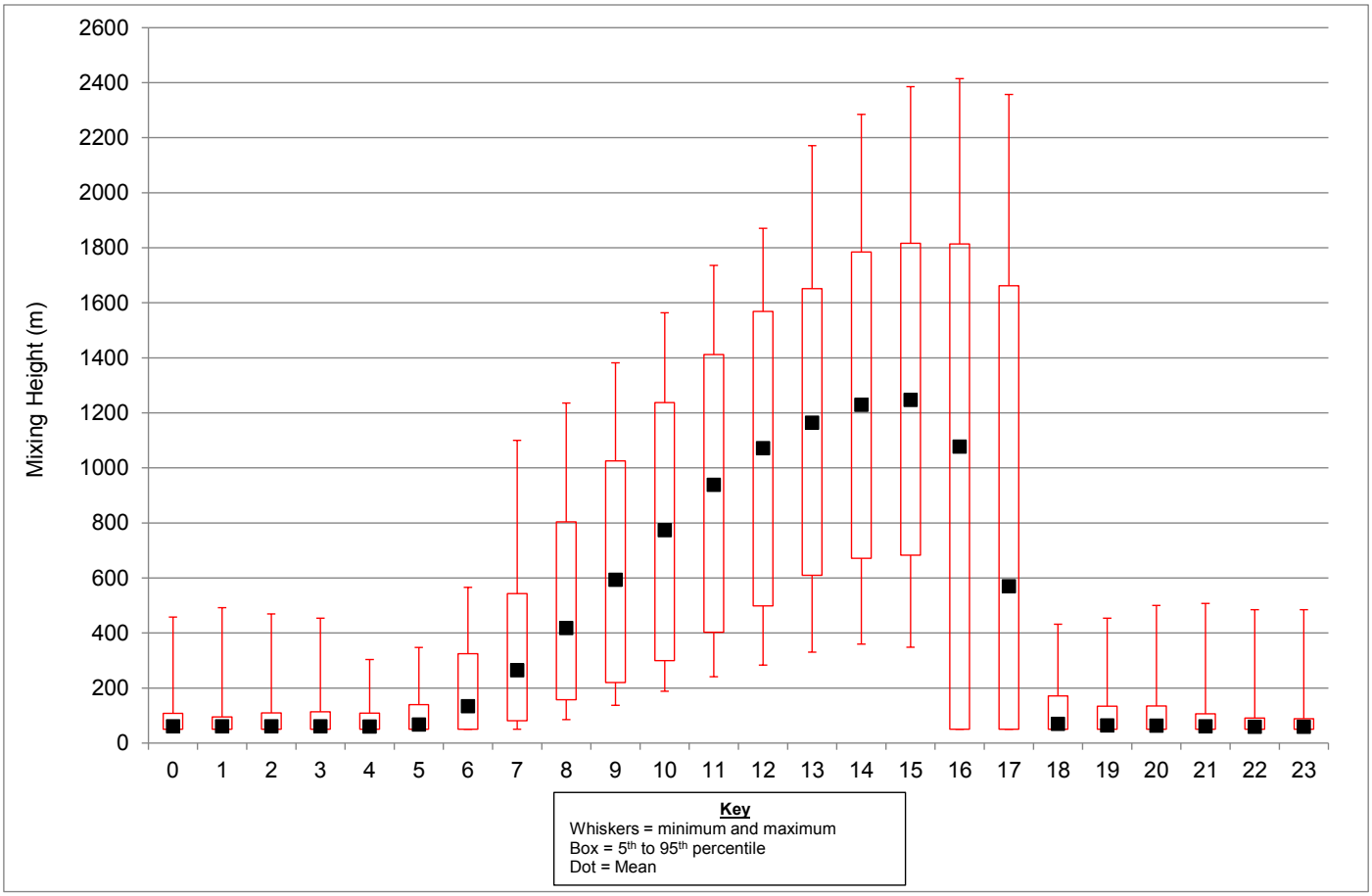


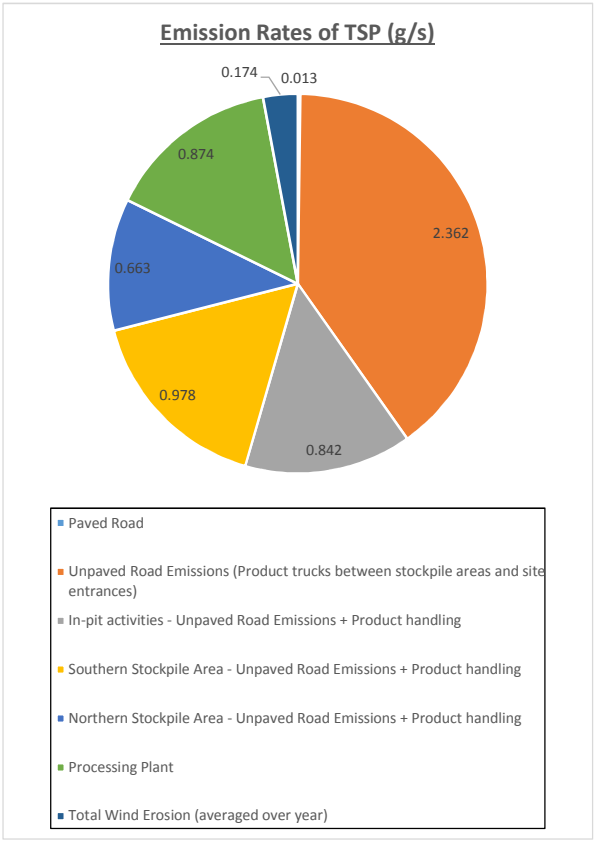
Figure A7.6 Box and Whisker plot of diurnal mixing height for the Site as generated by CALMET

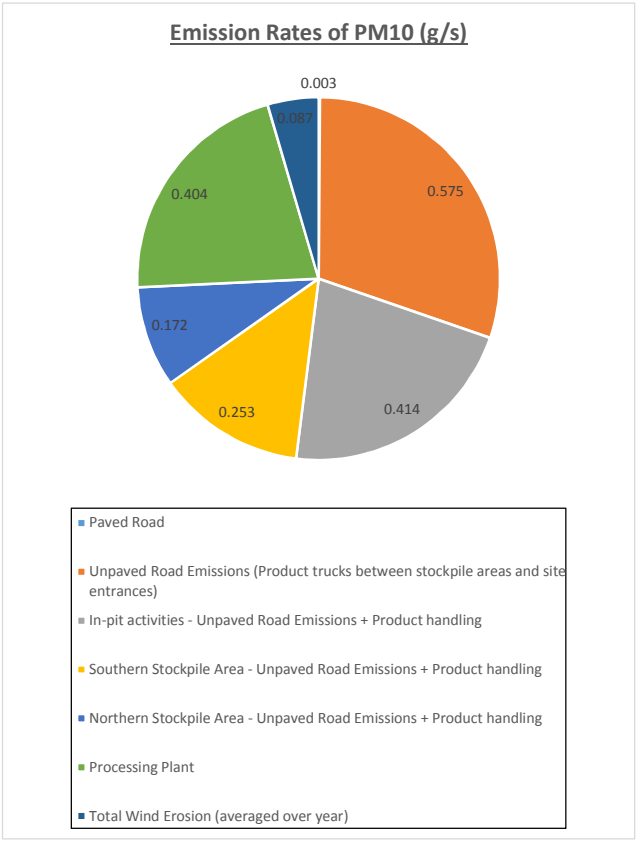
ATTACHMENT 8

Summary of Emission Factors, Control Efficiencies and Assumptions

CORAKI 15-041 - SUMMARY OF PARTICULATE EMISSION RATES - WITH RECOMMENDED CONTROL MEASURES

SOURCE GROUP	EMISSION RATE (g/s)		
	PM2.5	PM10	TSP
Paved Road	0.001	0.003	0.013
Unpaved Road Emissions (Product trucks between stockpile areas and site entrances)	0.058	0.575	2.362
In-pit activities - Unpaved Road Emissions + Product handling	0.045	0.414	0.842
Southern Stockpile Area - Unpaved Road Emissions + Product handling	0.026	0.253	0.978
Northern Stockpile Area - Unpaved Road Emissions + Product handling	0.018	0.172	0.663
Processing Plant	0.067	0.404	0.874
Total Wind Erosion (averaged over year)	0.013	0.087	0.174
TOTAL	**0.2**	**1.9**	**5.9**





WIND EROSION

- **Exposed Stockpile Areas, Quarry Pit and Processing Plant**

NPI Emission Estimation Technique Manual for Mining (Environment Australia, 2012)

Silt Content (s): 5 % (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1*)

PAVED ROADS

200 metres of paved road located in proximity to the residence to the south for product trucks accessing the northern stockpile area via the south western access road to the site.

USEPA AP42 Chapter 13.2.1 Paved Roads (2011)

Silt Loading (sL):8.2g/m^2 (*USEPA AP42 Chapter 13.2.1 mean quarrying*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

UNPAVED ROADS

All unpaved routes for product trucks accessing either the northern or southern stockpile areas

USEPA AP42 Chapter 13.2.2 Unpaved Roads (2006)

Haul Road Silt Content 8.3%: (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1 Average for quarry haul road*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

All unpaved routes for dump trucks

USEPA AP42 Chapter 13.2.2 Unpaved Roads (2006)

Haul Road Silt Content 8.3%: (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1 Average for quarry haul road*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

IN PIT ACTIVITIES

DRILLING BLAST HOLES (IN PIT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

LOADING TRUCKS WITH FRAGMENTED STONE (IN PIT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

PROCESSING PLANT

PROCESSING PLANT CONVEYOR TRANSFER POINTS

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Conveyor Transfer Points

LOADING TRUCKS WITH CRUSHED PRODUCT (AT STOCKPILES)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

UNLOADING FRAGMENTED STONE FROM TRUCKS (AT TIP HEAD TO PROCESSING PLANT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

Control Efficiency: 70 % (Table 4 NPI Emission Estimation Technique Manual for Mining, Environment Australia 2011)

PROCESSING PLANT PRIMARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

PROCESSING PLANT SECONDARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

PROCESSING PLANT TERTIARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT QUATERNARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT SCREENING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT FINES SCREENING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

LOADING STOCKPILES WITH CRUSHED PRODUCT

USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (2006)

Material moisture content % (M): 0.7 (mean from Table 13.2.4-1)

STOCKPILE AREAS

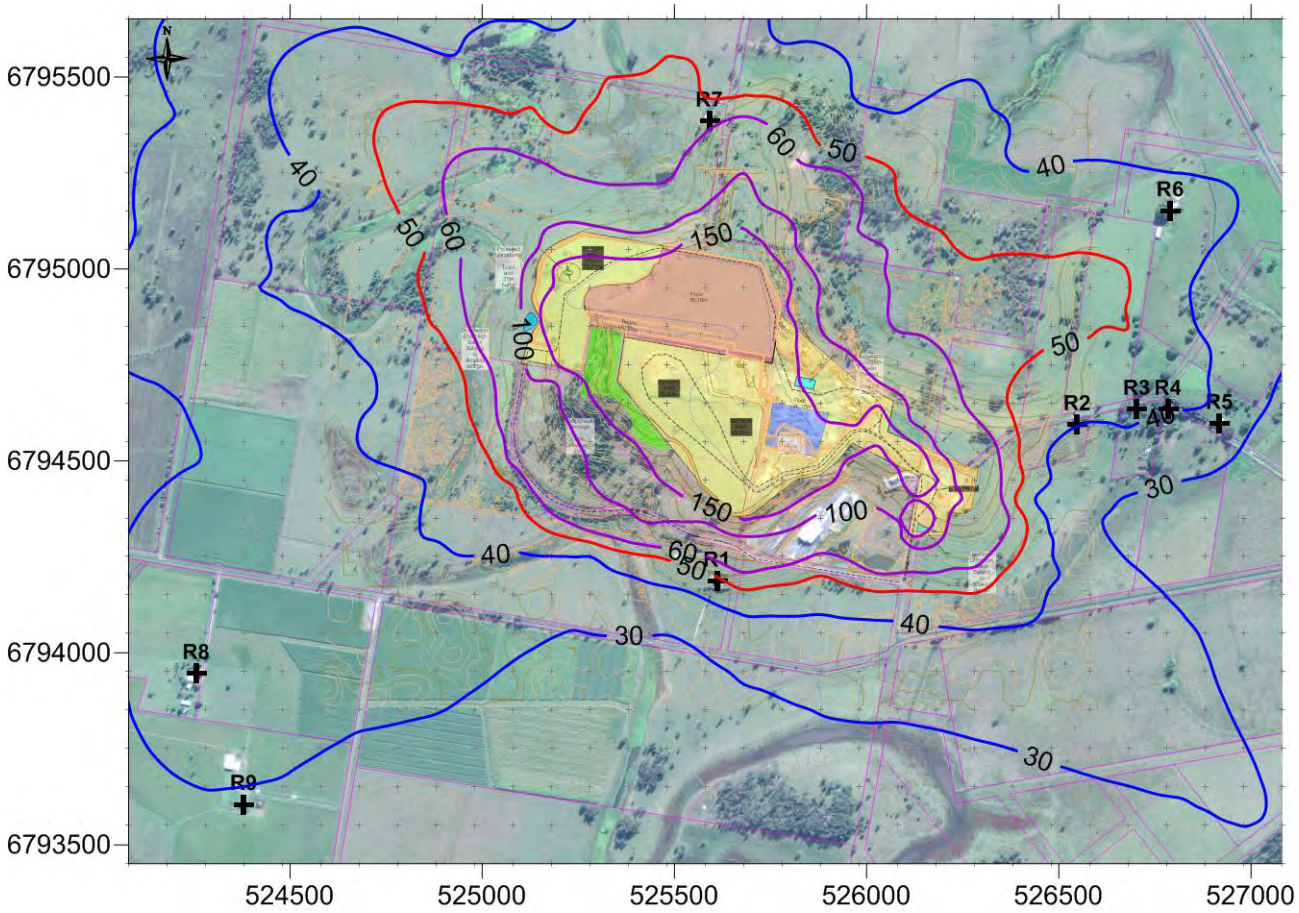
LOADING AND UNLOADING TRUCKS WITH CRUSHED PRODUCT (AT STOCKPILES)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

ATTACHMENT 9

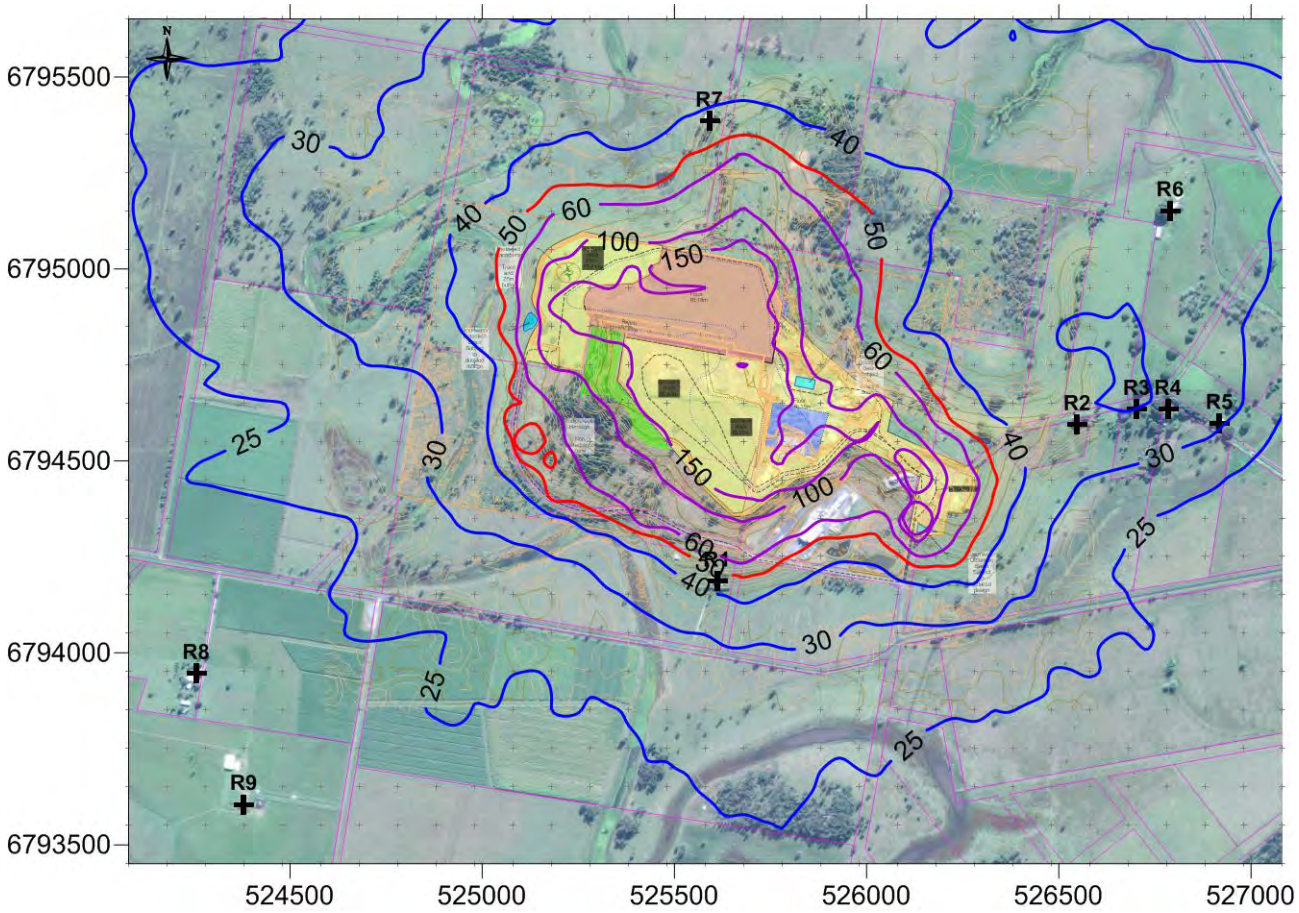
Predicted Particulate Concentrations / Deposition Rates Plots

Final Extraction Stage



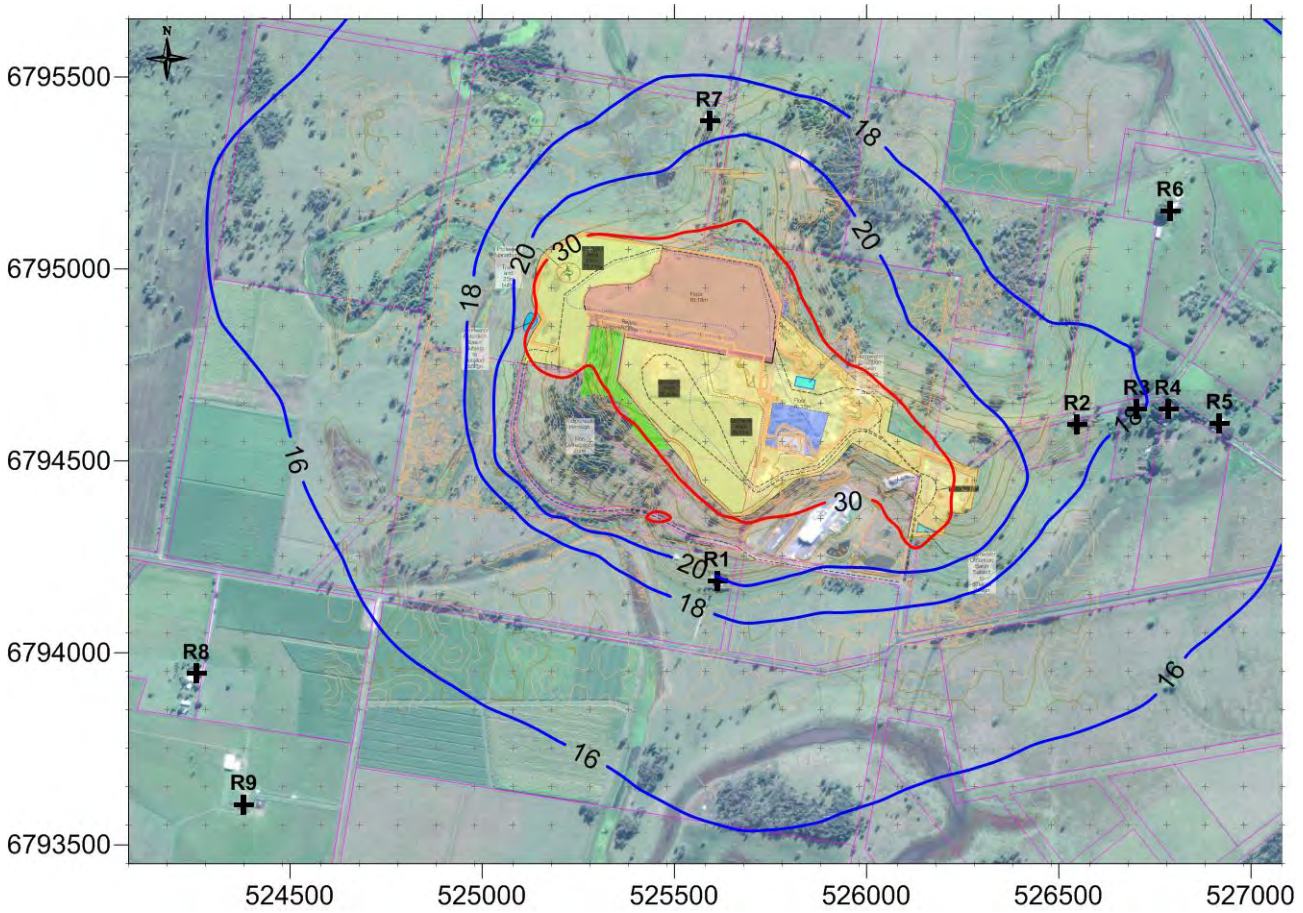
Predicted PM_{10} maximum 24-hour average concentrations

Figure A9.1	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	PM_{10}	24-hour Maximum	17.2 µg/m³	50 µg/m³	2015-09-23



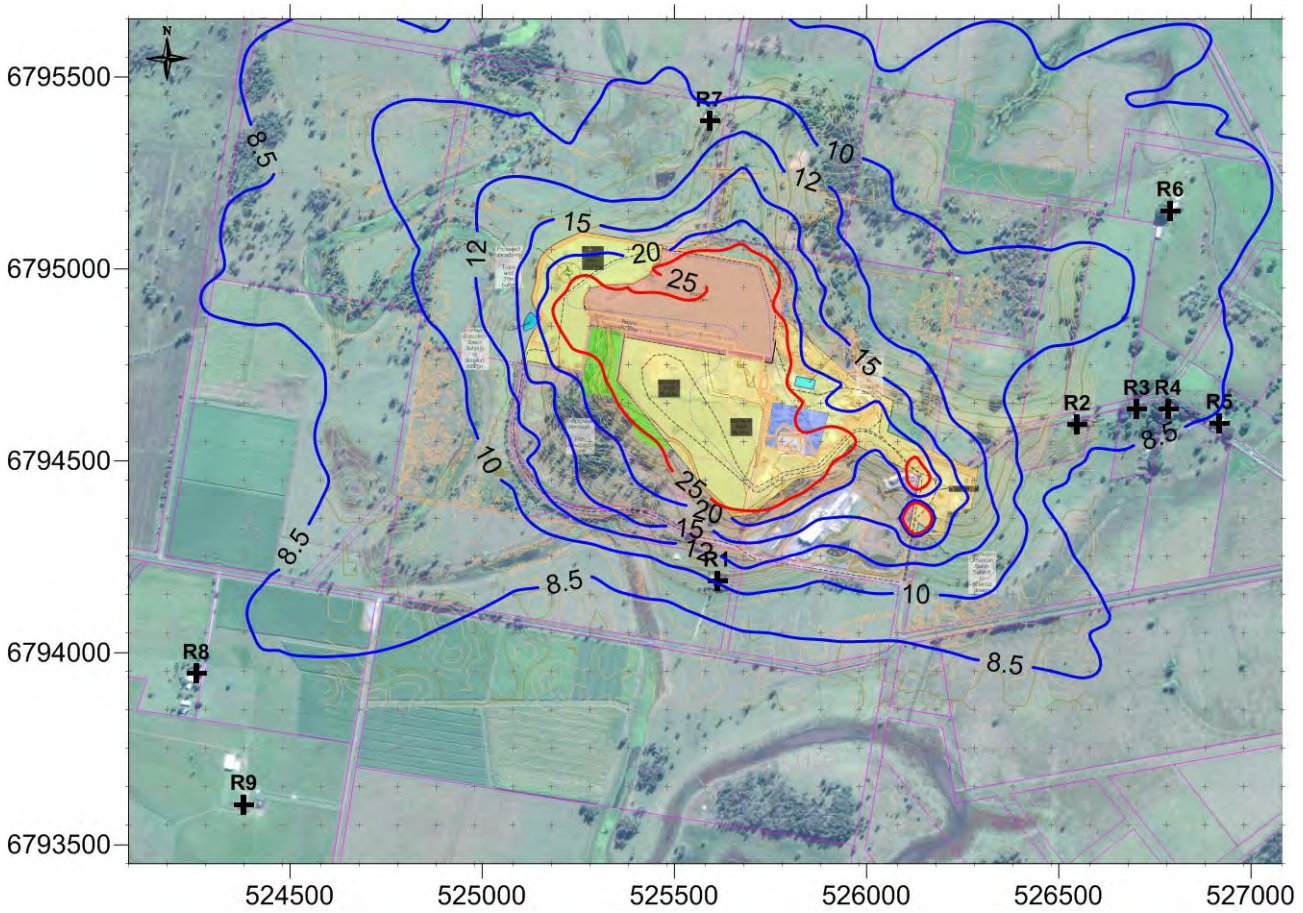
Predicted PM_{10} 6th highest 24-hour average concentrations

Figure A9.2	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	PM_{10}	24-hour 6th Highest	17.2 µg/m³	50 µg/m³	2015-09-23



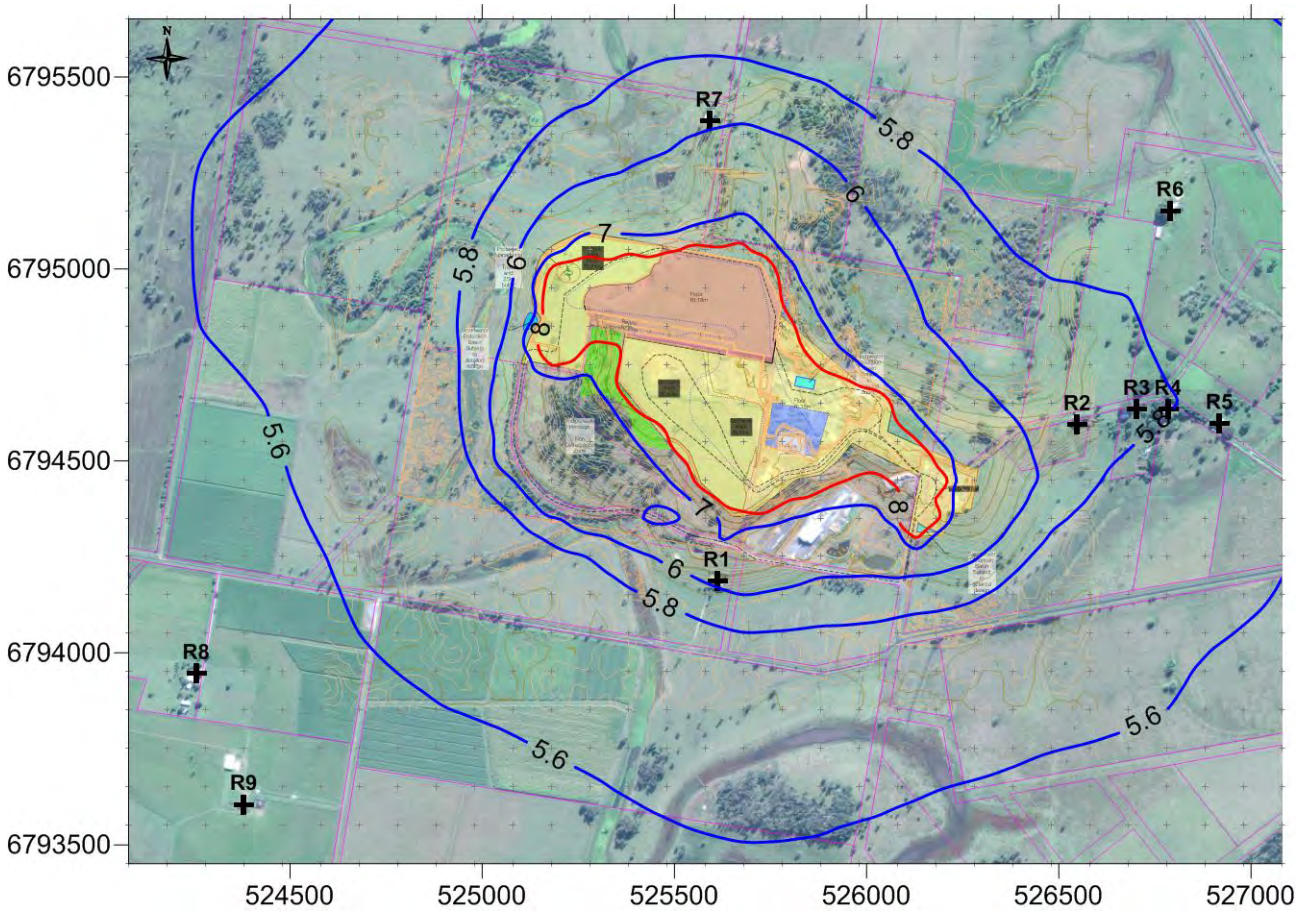
Predicted PM_{10} annual average concentrations

Figure A9.3	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	$PM_{2.5}$	Annual Average	15.1 µg/m³	30 µg/m³	2015-09-23



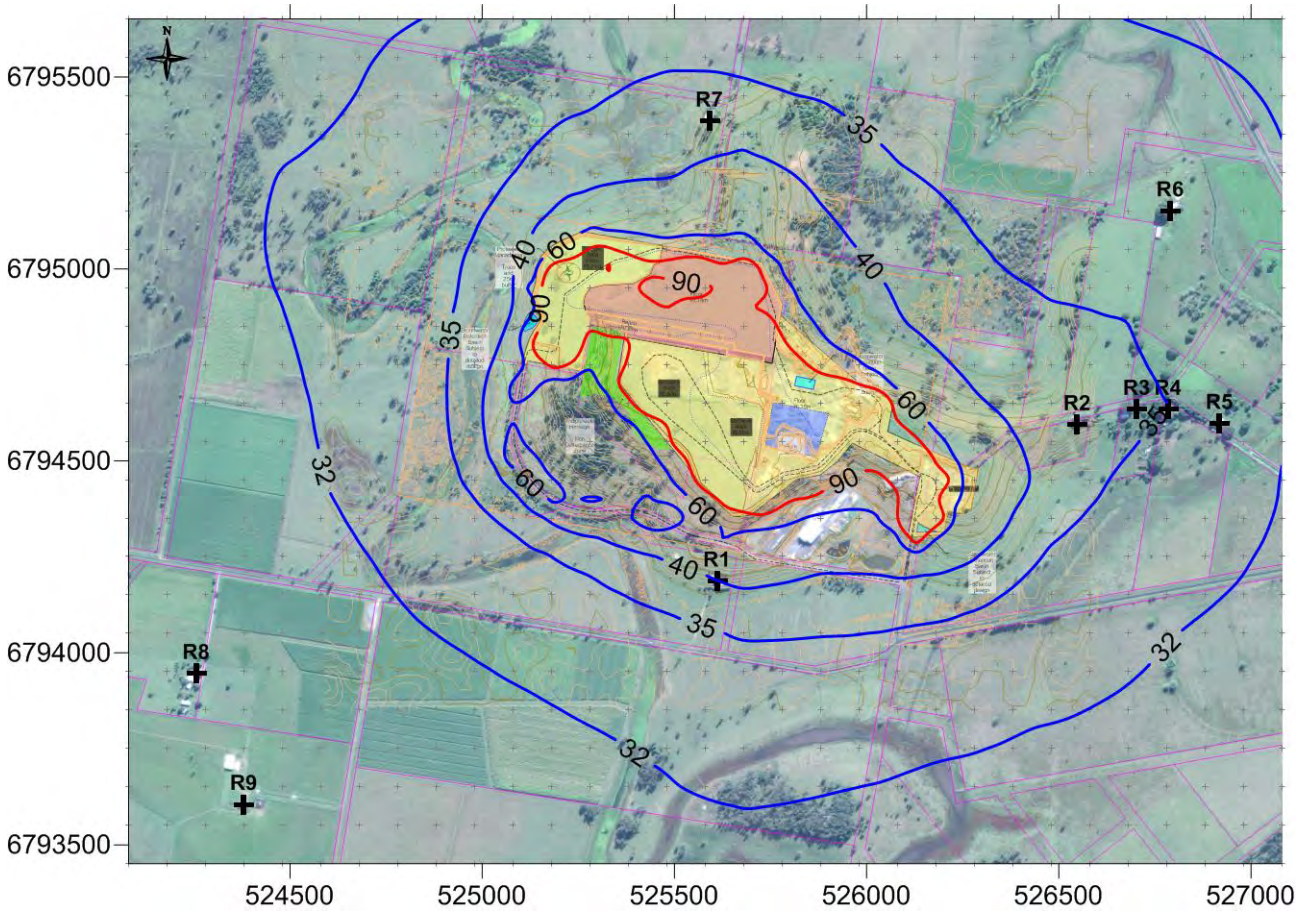
Predicted $PM_{2.5}$ maximum 24-hour average concentrations

Figure A9.4	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	$PM_{2.5}$	24-hour maximum	6.2 µg/m³	25 µg/m³	2015-09-23



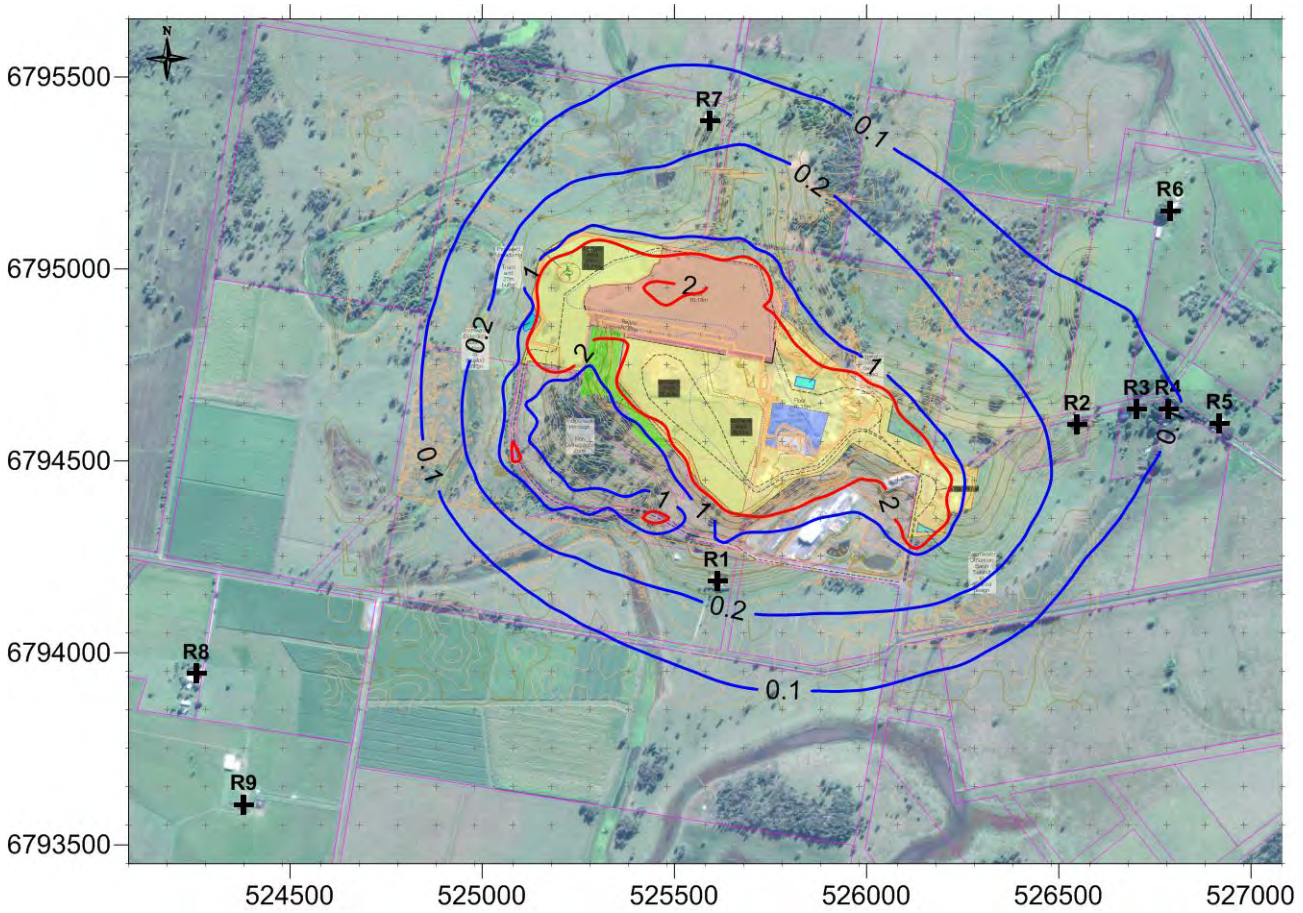
Predicted $PM_{2.5}$ annual average concentrations

Figure A9.5	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	$PM_{2.5}$	Annual Average	5.5 µg/m³	8 µg/m³	2015-09-23



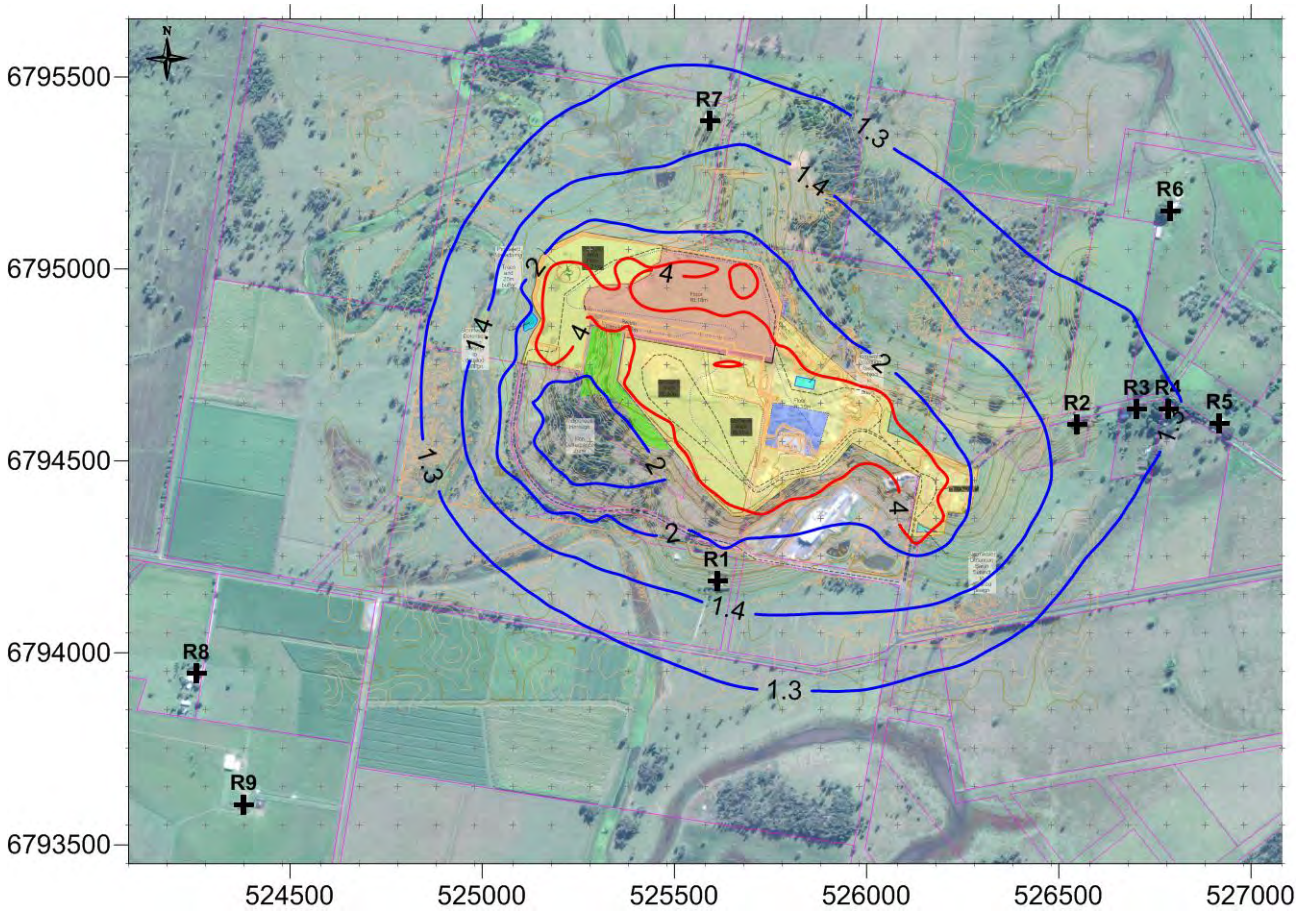
Predicted TSP annual average concentrations

Figure A9.6	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	TSP	Annual Average	30.1 µg/m³	90 µg/m³	2015-09-23



Predicted Annual Average Dust Deposition rates in Isolation

Figure A9.7	Pollutant	Averaging Period	Background Rate	Objective	Date
mwa ENVIRONMENTAL	Dust Deposition	Annual	n/a	2 mg/m^2/month	2015-09-23



Predicted Annual Average Dust Deposition rates (Cumulative)

Figure A9.8	Pollutant	Averaging Period	Background Rate	Objective	Date
mwa ENVIRONMENTAL	Dust Deposition	Annual	40 mg/m^2/day / 1.2 g/m^2/month	4 mg/m^2/month	2015-09-23