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Outline Planning Consultants Pty ltd

Faheys Pit Impact Assessment

Air Quality Assessment

70B-22-0110-TRP-39884-1

4 December 2023

Job Title:	Faheys Pit Impact Assessment		
Report Title:	Air Quality Assessment		
Document Reference:	70B-22-0110-TRP-39884-1		

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Revision History:

Rev. #	*Comments / Details of change(s) made*	*Date*	*Revised by:*
Rev. 01	Amended issue	4 Dec 23	

Executive Summary

Vipac Engineers and Scientists Ltd was engaged by Outline Planning Consultants Pty Ltd on behalf of Sheridan's Hard Rock Quarry to prepare an air quality assessment to support a development consent for the continuation and expansion of a small quarry at Tyringham on the Dorrigo Plateau known as 'Faheys Pit'. The Proponent proposes to increase the capacity of Faheys Pit to extract and to process up to 150,000 tonnes per annum of quarry material within an enlarged quarry footprint totalling 4.1ha and a total resource of about 1.8 million tonnes.

The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the increase and to provide recommendations to mitigate any potential impacts that might have an effect on any sensitive receptors.

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM10, PM2.5, and deposited dust for the proposed Project was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the Project.
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria as part of the impact assessment. Air quality controls are applied to reduce emission rates where applicable.

As summarised in Table ES-1 and Table ES-2, the results of the modelling have shown that the TSP, PM10, PM2.5 and dust deposition predictions comply with the relevant criteria and averaging periods at all sensitive receptors modelled for the Project in isolation.

TSP, dust deposition and annual average PM10 and PM2.5 predictions are also less than criteria for the Project including background at SR2 to SR5. Whilst the 24-hour average PM10 and PM2.5 predictions are above, the exceedances are driven by the elevated background adopted for the assessment, which are already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and that best management practices will be implemented to minimise emissions as far as is practical. In the absence of the elevated background therefore, we would anticipate no exceedances of the criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

However, model predictions exceed the 24 hour and annual average PM10 and PM2.5 criteria at SR1 - the sawmill residence nearby to the Project. However, an agreement exists between the Proponent and the residence such that impact assessment is not required for this location.

Emissions controls for dust abatement were included in the assessment. It should also be noted that some of the planned dust control measures are not easily quantifiable but will also still serve to reduce dust emissions. The dispersion modelling study has taken a conservative approach and have not incorporated the effectiveness of these controls in the development of the emissions inventory.

It is therefore concluded that air quality should not be a constraint to proposed quarry increase in extraction.

Table ES-1: Summary of Results – Project in Isolation

ID	Predicted Concentrations (µg/m³)					Dust deposition (g/m2/month)	Compliant
	PM10		PM2.5		TSP		
	24 h	Annual	24 h	Annual	Annual	Month	
SR1	35.89	3.28	7.81	0.68	5.58	0.72	✓
SR2	11.99	0.58	3.00	0.12	0.37	0.17	✓
SR3	4.37	0.16	1.09	0.03	0.09	0.02	✓
SR4	1.25	0.05	0.29	0.01	0.05	0.01	✓
SR5	0.54	0.03	0.14	0.01	0.03	0.01	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**2**	

Table ES-2: Summary of Results – Cumulative

ID	Predicted Concentrations (µg/m³)					Dust deposition (g/m2/month)	Compliant
	PM10		PM2.5		TSP		
	24 h	Annual	24 h	Annual	Annual	Month	
SR1	268.49	26.48	95.51	8.48	51.98	2.72	✗
SR2	244.59	23.78	90.70	7.92	46.77	2.17	✓
SR3	236.97	23.36	88.79	7.83	46.49	2.02	✓
SR4	233.85	23.25	87.99	7.81	46.45	2.01	✓
SR5	233.14	23.23	87.84	7.81	46.43	2.01	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**4**	

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1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was engaged by Outline Planning Consultants Pty Ltd on behalf of Sheridan's Hard Rock Quarry (the Proponent) to prepare an air quality assessment to support a development consent for the continuation and expansion of a small quarry at Tyringham on the Dorrigo Plateau known as 'Faheys Pit'. The Proponent proposes to increase the capacity of Faheys Pit to extract and to process up to 150,000 tonnes per annum of quarry material within an enlarged quarry footprint totalling 4.1ha and a total resource of about 1.8 million tonnes (the Project). It is also proposed to deepen the existing quarry.

The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

2 PROJECT DESCRIPTION

2.1 SITE LOCATION

The quarry comprises land within a rural property in the Clarence Valley Local Government area (LGA) comprising Lot 31 in Deposited Plan (DP) 1203488, at No.9720 Armidale Road, Tyringham NSW 2453, having an area of 11.46ha (Project Site). The internal access route to the quarry connects directly with Armidale Road. To the west of the quarry is a rural property comprising Lot 32 DP 1203488, with the Hyland State Forest located to the north. Adjoining the quarry to the east is an existing sawmill and dwelling, on Lot 2 DP 1139996, and a local council quarry pit, known as 'Ellis' Pit', on Lot 1 DP 1139996. Ellis Quarry, which has operated since 1953, is small, with a limited area, resource and limited production capacity. The approval granted (Nymboida Council DA41/95) is for a pit of up to 3ha, with a resource of up to 15,000 cubic metres and a maximum depth of 5 metres. Ellis Quarry has achieved permitted depth and limits of extraction and resource recovery. Whilst the local council quarry pit extends both into the Project Site as well as the Hyland State Forest, it does not enjoy any development consent to do so. The Project Site location, approximate quarry footprint and access route are illustrated in Figure 2-1 and Figure 2-2.

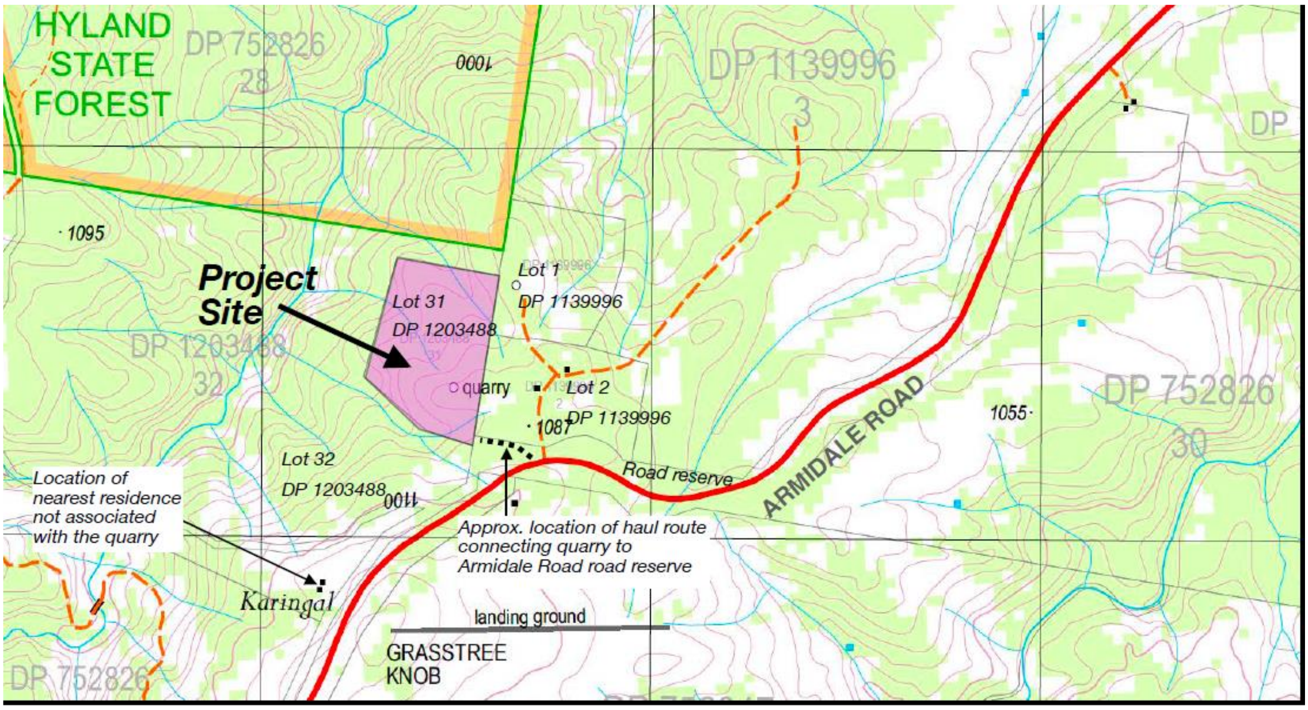


Figure 2-1: Project Site Location

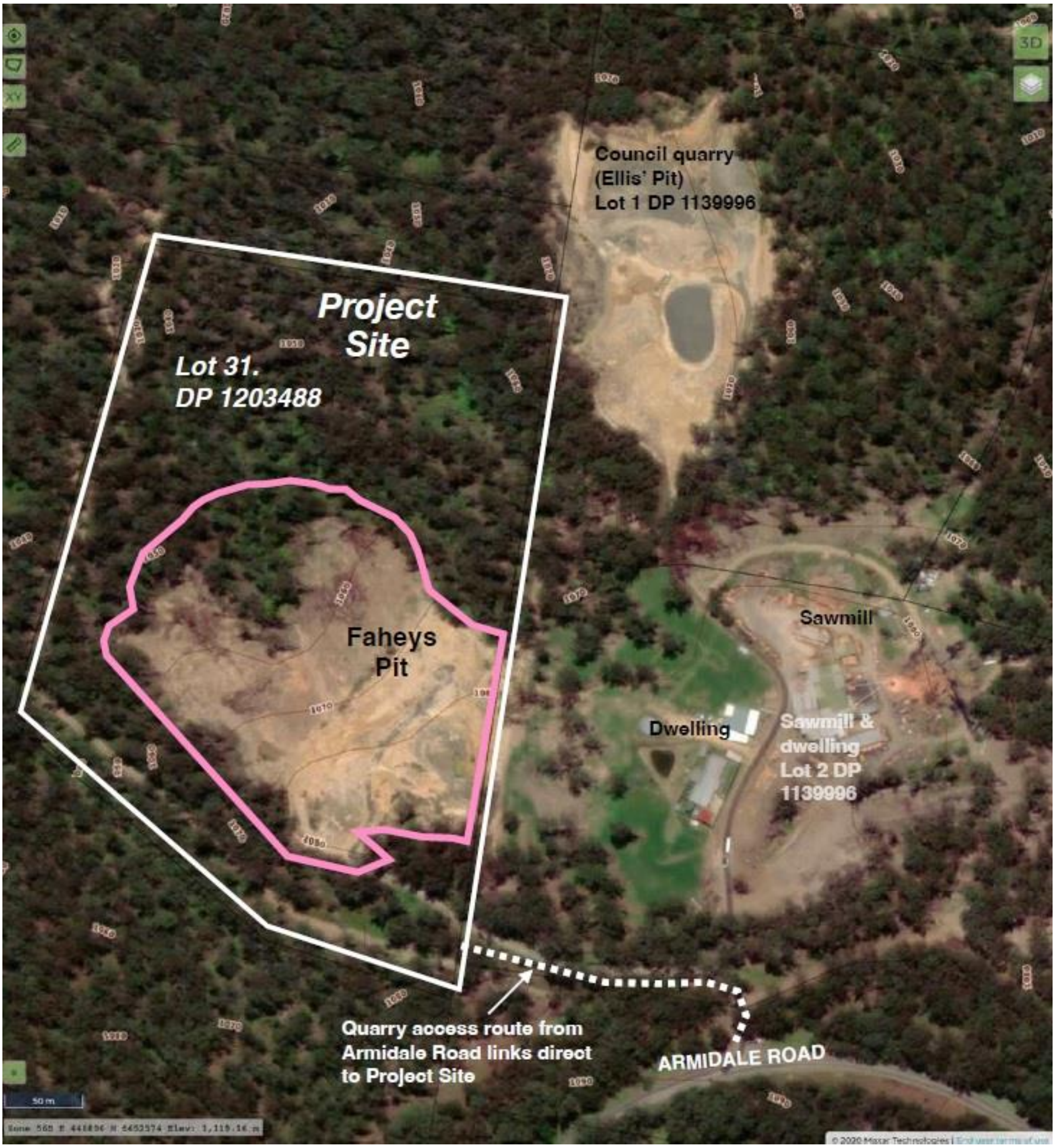


Figure 2-2: Project Site Location – Aerial

2.2 AIR SENSITIVE RECEIVERS

The locality is sparsely populated, with the nearest rural residences described in the following:

- SR1 - The sawmill adjoining Faheys Pit, on Lot 2 DP 1139996 No. 9630 Armidale Road, also has a residence located about 140m from the quarry pit on Faheys Pit, however, an agreement exists between the proponent and the residence (***Appendix C***).
- SR2 - The quarry is approximately 0.55km to the north-east of the nearest rural dwelling not associated with the quarry: 'Karingal', on Lot 32 DP 1203488 at No. 9722 Armidale Road, Tyringham.

- SR3 - The quarry is approximately 1.148km to the north-east of the next nearest rural dwelling not associated with the quarry, on Lot 18 DP 752826 at No. 134 Armidale Road, Tyringham.
- SR4 - The quarry is approximately 1.79km to the WSW of the next nearest rural dwelling not associated with the quarry, on Lot 30 DP 752826 at No. 9435 Armidale Road, Tyringham.
- SR5 - The quarry is approximately 2.03km to the south-west of the next nearest rural dwelling not associated with the quarry: 'Ring Tree', on Lot 3 DP 1139996 at No. 9408 Armidale Road, Tyringham.

The locations of the nearest potentially affected air sensitive receivers to the quarry are shown in Figure 2-3.

Figure 2-3: Sensitive Receptor Locations

2.3 QUARRY OPERATION

2.3.1 EXISTING

The current quarry operations at Faheys Pit may be summarised as follows:

- Clearing of land ahead of extraction.
- Ripping of weathered quarry resource and blasting of unweathered (hard) rock.
- Loose rock is then transported from the worked quarry face to the mobile (temporary) processing plant, where it is then crushed and screened, prior to being transported off-site.
- Transport of quarry product from the site via the internal haul route back onto Armidale Road ie. product sales out the gate.

The Project Site does not contain any existing infrastructure, such as buildings or fixed plant, save for the road access back from the quarry pit to Armidale Road. All quarry processing plant is currently brought into the site on a campaign basis, as required.

2.3.2 PROPOSED OPERATIONS

It is proposed to regularise the use of the site as a quarry at the same time as seek approval for a lateral extension of the quarry with an increased rate of extraction of up to 150,000 tonnes per annum. The ultimate size of the resource will be determined following more detailed design, however, preliminary estimates indicate an additional resource of approximately 500,000 cubic metres-equivalent to about 1.3 million tonnes (Mt). The principal objective of the proposed development is to deepen and extend the extraction area so as to extend the life of the quarry and to maximise winning of an important and valuable resource, enabling a continuation of the extraction and production of a range of road construction and allied quarry materials. The total quarry, including the land proposed for lateral extension, will have an area of approximately 4.1ha. Table 2-1 summarises the key project components.

Table 2-1: Key Project Components

Quarry component	Summary description
Extraction Method	Bulldozer used to remove weathered rock and topsoil for rehabilitation, with drill and blast used for unweathered rock.
Resource	Weathered and unweathered siltstone, rare lithofeldspathic wacke and conglomerate, comprising Moombil Siltstone geology.
Disturbance area	A lateral expansion of existing quarry to include all cleared areas, with extraction of up to about 42 metres in depth. Total quarry area approximately 4.1ha.
Processing	Crushing and screening of unweathered and weathered siltstone material. Processing plant to be brought in to the site on a campaign basis.
Annual extraction	Up to 150,000 tonnes per annum.
Transport	Access to the quarry from Armidale Road, the existing quarry haul route. It is anticipated that the quarry may generate up to 50 loaded quarry trucks per day.
Hours of operation	Limited to 7.00am to 6.00pm Monday to Friday (ie. 11 hours operation per day) and 7.00am to 1.00pm on Saturdays (ie. 6 hours operation). Hours of blasting are to be restricted to 9.00am to 3.00pm Monday to Friday.

3 POLLUTANTS OF CONCERN

The main emissions to air from quarrying operations are caused by wind-borne dust, vehicle usage, materials handling and transfers. Fugitive air emissions can be estimated using emission factors combined with site-specific information such as the silt and moisture content of material being handled.

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. The dust emissions considered in this report are particulate matter in various sizes:

- Total Suspended Particles (TSP) - Particulate matter with a diameter up to 50 microns;
- PM_{10} - Particulate matter less than 10 microns in size;
- $PM_{2.5}$ - Particulate matter less than 2.5 microns in size; and
- Dust Deposition – deposited matter that falls out of the atmosphere.

4 REGULATORY FRAMEWORK

4.1 NATIONAL LEGISLATION

4.1.1 NATIONAL ENVIRONMENT PROTECTION MEASURE FOR AMBIENT AIR QUALITY

Australia's first national ambient air quality standards were outlined in 1998 as part of the National Environment Protection Measure for Ambient Air Quality.

The Ambient Air Measure (referred to as Air NEPM) sets national standards for the key air pollutants; carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particles (PM_{10}). A revision to the Measure was issued in 2003 with the inclusion of advisory $PM_{2.5}$ standards. The Air NEPM requires the State's governments to monitor air quality and to identify potential air quality problems.

4.2 STATE LEGISLATION AND GUIDELINES

4.2.1 DEPARTMENT OF ENVIRONMENT AND CONSERVATIONS APPROVED METHODS

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW Environment Protection Authority, 2017) detail both the assessment methodology and criteria for air quality assessments. Due to the type of industry and proximity to sensitive receptors, the requirements for a Level 2 assessment have been followed.

4.3 PROJECT CRITERIA

The applicable criteria selected for this assessment are presented in Table 4-1.

Table 4-1: Project Air Quality Goals

Pollutant	Basis	Criteria	Averaging Time	Source
TSP	Human Health	90 $\mu g/m^3$	Annual	Approved Methods
PM_{10}	Human Health	50 $\mu g/m^3$	24-hour	Approved Methods
	Human Health	25 $\mu g/m^3$	Annual	Approved Methods
$PM_{2.5}$	Human Health	25 $\mu g/m^3$	24-hour	Approved Methods
	Human Health	8 $\mu g/m^3$	Annual	Approved Methods
Dust deposition	Amenity	Maximum incremental increase of 2 g/m^2/month	Annual	Approved Methods
	Amenity	Maximum total of 4 g/m^2/month	Annual	Approved Methods

5 EXISTING ENVIRONMENT

5.1 DISPERSION METEOROLOGY

5.1.1 REGIONAL METEOROLOGY

The nearest open Bureau of Meteorology (BOM) station with long term data is at Dorrigo (Site number 059140), located approximately 27 km south east of the Project site. This monitoring station has recorded data since 1996 and a summary of the climate is presented in Table 5-1.

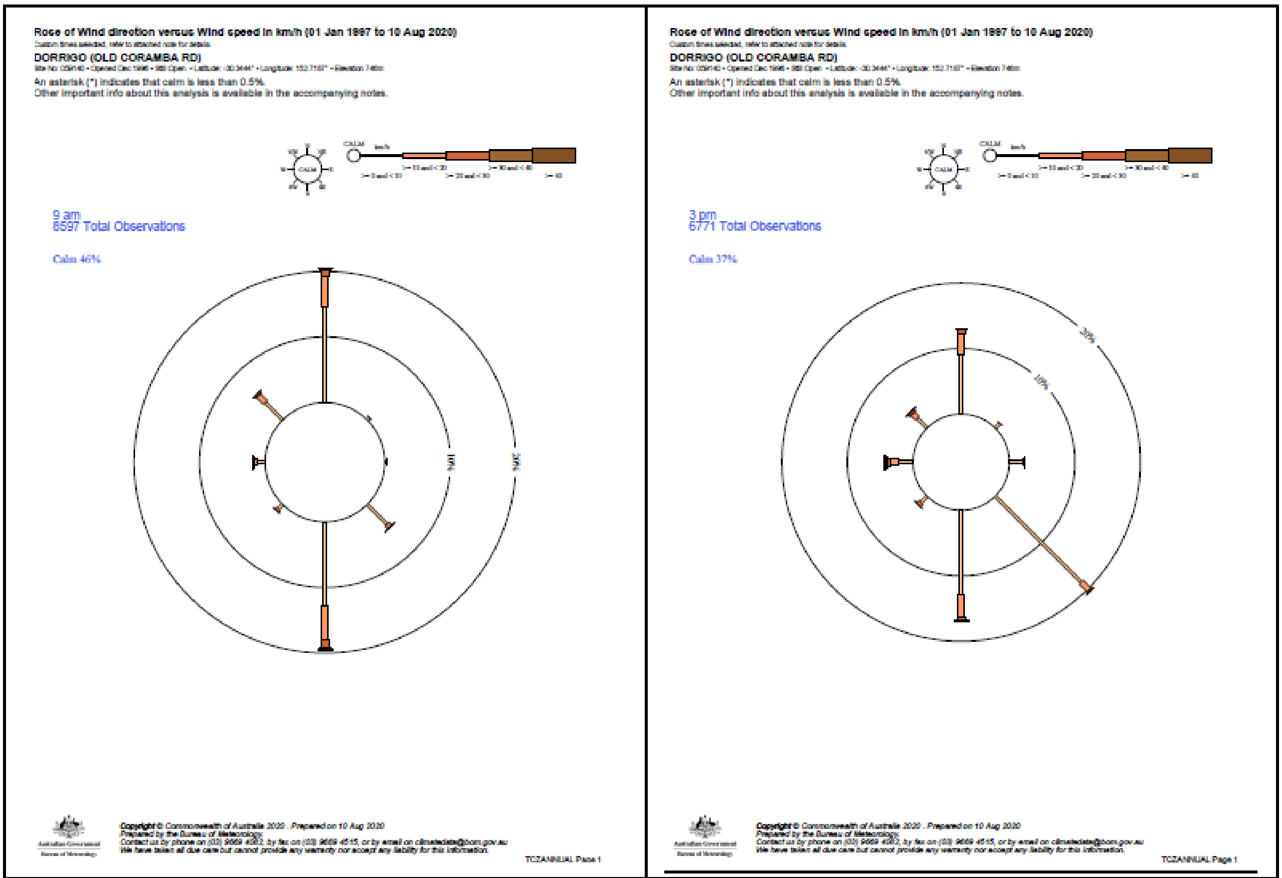
The long term mean temperature range is between 4.4°C and 24.6°C with the coldest month being July and the hottest months being December to February. On average, most of the annual rainfall is received between January and March. Rainfall is lowest between July and September, with a mean annual rainfall of 1867 mm. Rainfall reduces the dispersion of air emissions and therefore the potential impact on visual amenity and health.

Table 5-1: Long-term weather data for Dorrigo [BOM]

Month	Mean Temperature		Rainfall			9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)	Mean (mm)	Mean Rain Days	No. of Days ≥ 1 mm	Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	RH (%)	Wind Speed (km/h)
Jan	24.6	15.2	263.8	14.8	13.7	18.6	83	5.3	22.4	73	4.9
Feb	23.9	15.1	276.2	16.1	15.1	18.1	87	4.1	22.1	75	4.2
Mar	22.4	13.7	308.4	18.2	16	16.5	89	3.9	20.6	75	4.3
Apr	19.9	10.8	133.5	14.4	12.3	15.4	80	4.4	17.8	73	3.9
May	17.1	7.4	83.1	10.6	9.1	12.3	78	4.3	15.2	68	4.2
Jun	14.9	5.6	133.2	10.6	9	9.9	77	4.4	13.3	65	5.4
Jul	14.7	4.4	56.1	8.8	7.3	9.2	74	5.6	12.8	60	5.7
Aug	16.2	4.7	96.3	7.3	6.3	10.5	68	6.2	14.4	55	7
Sep	19.3	7.6	77.8	8.9	7.8	13.9	66	6.4	17.3	57	6.5
Oct	21.3	9.9	117.6	12	10.7	16.1	66	6	18.9	61	6.8
Nov	22.4	12.1	172.2	15.1	13.8	16.4	78	6	19.7	70	5.8
Dec	24	13.9	175.6	16.2	14.3	18.4	78	5.2	21.9	70	5.4
Annual	**20.1**	**10**	**1866.9**	**153**	**135.4**	**14.6**	**77**	**5.2**	**18**	**67**	**5.3**

A review of the number of rainfall days per year at Dorrigo shows that on average rainfall, is recorded on 153 days per year and the number of days where rainfall is ≥ 1 mm is 135 days per year.

The long term wind roses recorded daily at the Dorrigo station at 9am and 3pm are provided in Figure 5-1. Winds are shown to be primarily from the south and north at 9am and from the south and southeast directions at 3pm. Stronger winds (>40km/hr or >11.1m/s) are extremely rare.



Location: **Dorrigo BoM Station**	**Data Period:** 1997 to 2020	**Data Type:** Measured Data

Figure 5-1: Annual wind roses for Dorrigo Weather Station (1997 to 2020)

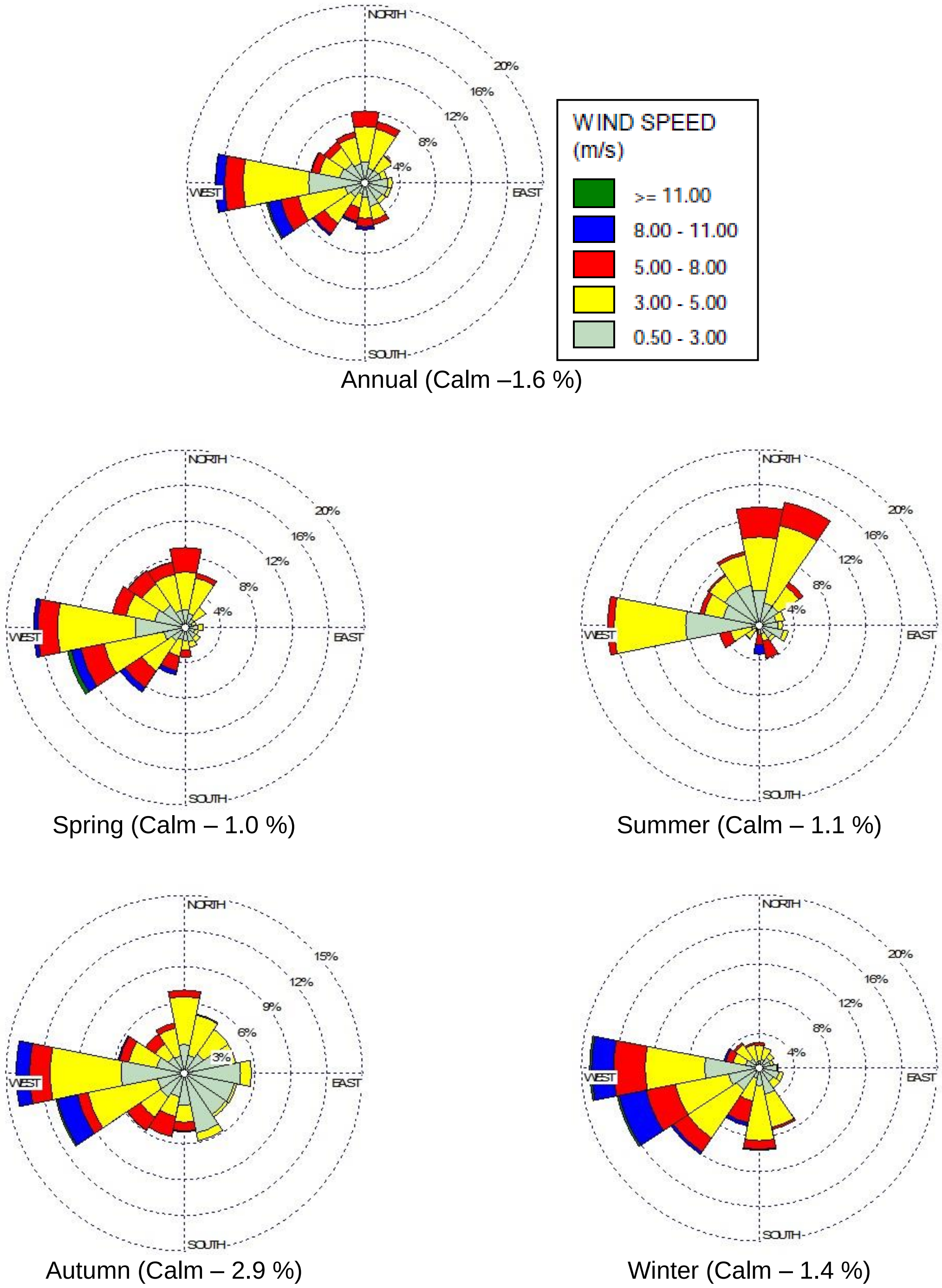
5.1.1 LOCAL METEOROLOGY

5.1.1.1 INTRODUCTION

A three dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used as a precursor to CALMET which produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables for each hour of the modelling period. The TAPM-CALMET derived dataset for 12 continuous months of hourly data from the year 2019 and approximately centred at the proposed Project has been used to provide further information on the local meteorological influences.

5.1.1.2 WIND SPEED AND DIRECTION

The wind roses from the TAPM-CALMET derived dataset for the year 2019 are presented in Figure 5-2 and Figure 5-3 for the Project site. Figure 5-2 shows that the dominant wind direction is westerly for all seasons. In addition, some northerly winds are recorded during summer. Overall, winds from the east are infrequent which is likely indicative of the influences on wind flow from the elevated terrain in this direction.



Annual (Calm –1.6 %)

Spring (Calm – 1.0 %)

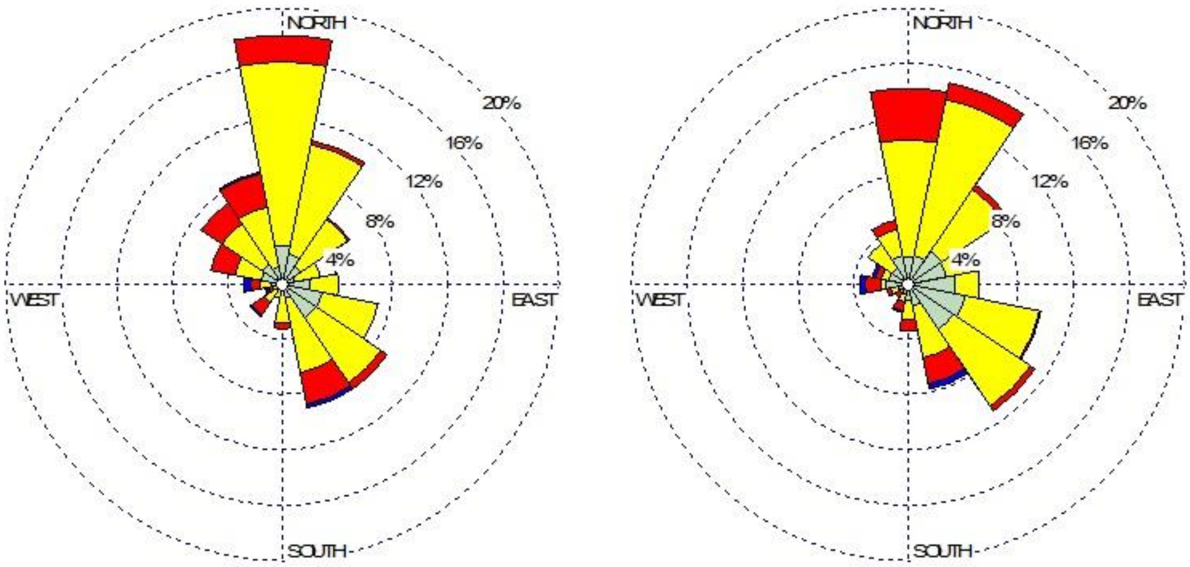
Summer (Calm – 1.1 %)

Autumn (Calm – 2.9 %)

Winter (Calm – 1.4 %)

Figure 5-2: Site-specific wind roses by season for the TAPM-CALMET derived dataset, 2019

Figure 5-3 shows the wind roses for the time of day during the year for 2019 for the modelled data at a site as close as possible to the Dorrigo BoM Station site. It can be seen that there the northerly winds are dominant at both times with some south easterly influences also apparent, in particular, in the afternoon. These wind patterns are consistent with those shown for the long term measured data at the Dorrigo BoM Station in Figure 5-3.



9am (Calm – 4.5 %) 3pm (Calm – 1.5 %)

Figure 5-3: Dorrigo site wind roses by time of day for the TAPM-CALMET derived dataset, 2019

In addition, as specified in the Approved Methods (2016), a comparison of the modelled data wind rose generated (as close as possible to Tamworth) for 2019 is provided with the most recent five years of measured data at the BoM Station[1]. As shown in Figure 5-4, the modelled data is consistent with the measured data for the past five years.

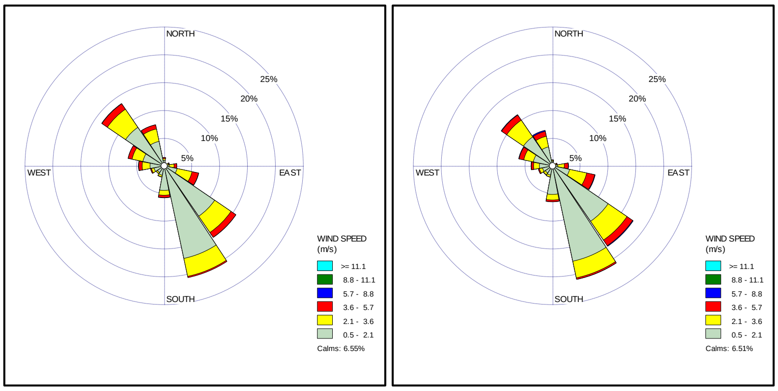


Figure 5-4: Wind roses comparison of modelled 2019 data (left) with 5 years Tamworth measured data (right)

5.1.1.3 ATMOSPHERIC STABILITY

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion of pollutants. The Pasquill-Turner assignment scheme identifies six Stability Classes (Stability Classes A to F) to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used in various air dispersion models. The frequency of occurrence for each stability class for 2019 is shown in Figure 5-5. The data identifies that Stability Class F is most common; this stability class is indicative of clear skies and light winds.

[1] Note, the BoM Station at Dorrigo has not recorded 5 years of consecutive hourly wind speed and direction data. Furthermore, the two closer NSW EPA Stations that do record hourly wind data have not been operational for 5 years.

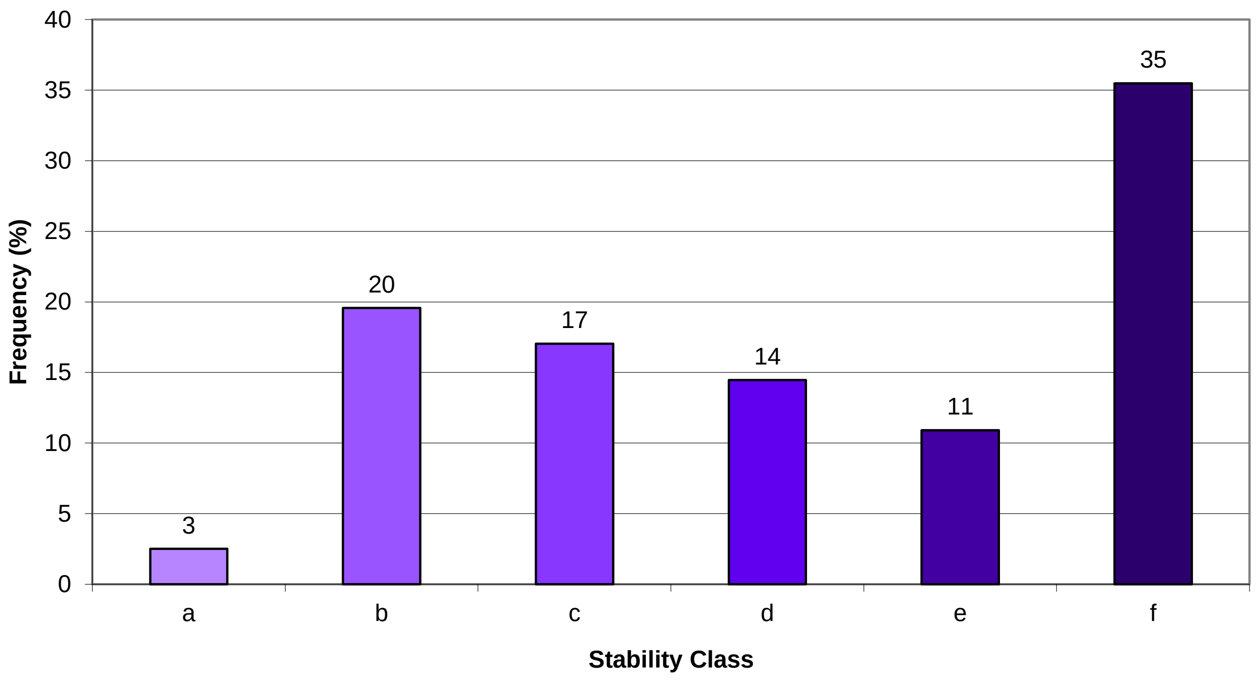


Figure 5-5: Stability class frequency for the TAPM-CALMET derived dataset, 2019

5.1.1.4 MIXING HEIGHT

Mixing height refers to the height above ground within which particulates or other pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions, the mixing height is often quite low and particulate dispersion is limited to within this layer.

Diurnal variations in mixing depths are illustrated in Figure 5-6. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of convective mixing layer.

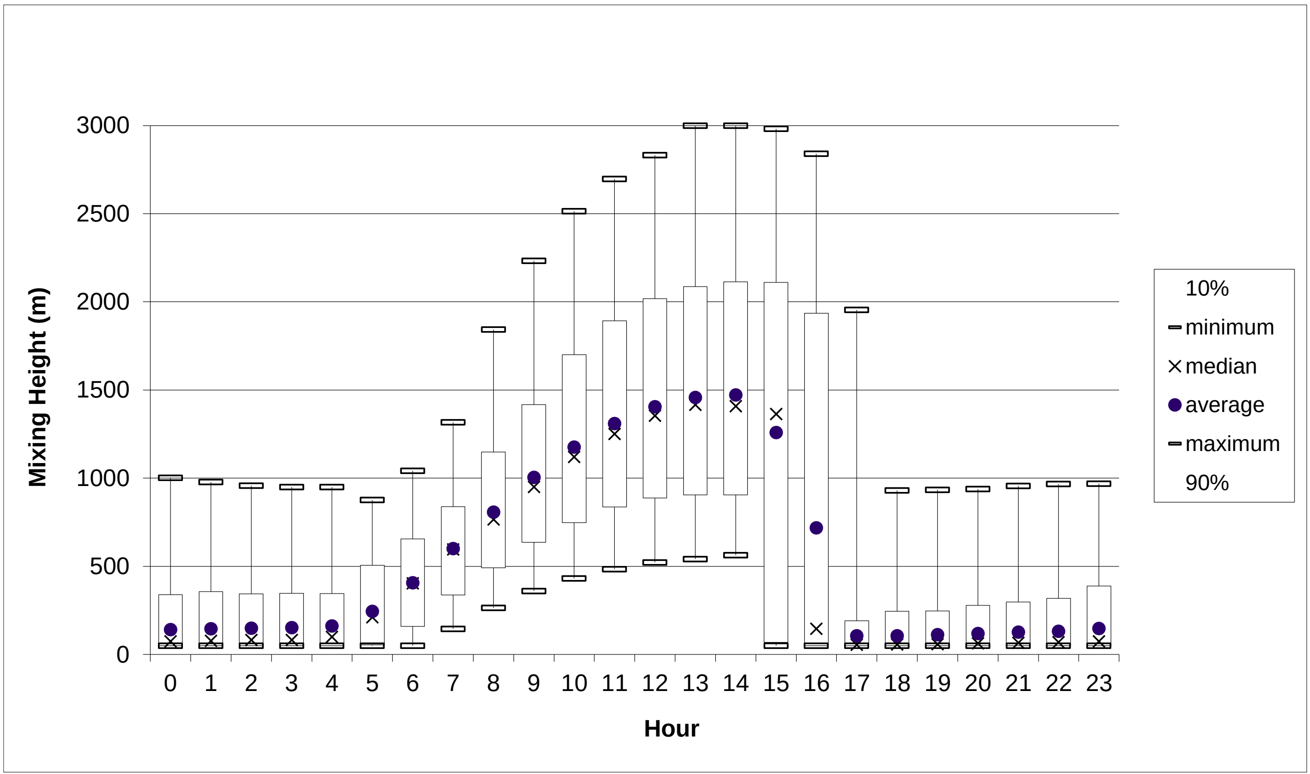


Figure 5-6: Mixing height for the TAPM-CALMET derived dataset, 2019

5.2 EXISTING AIR QUALITY

Faheys Pit is situated within a sparsely populated rural area. Background dust levels are therefore expected to be primarily impacted by agricultural activities. As discussed in Section 2.1, adjoining Faheys Pit, is a local council quarry pit, known as 'Ellis' Pit', on Lot 1 DP 1139996. Ellis Quarry, which has operated since 1953, is small, with a limited area, resource and limited production capacity. The approval granted (Nymboida Council DA41/95) is for a pit of up to 3ha, with a resource of up to 15,000 cubic metres and a maximum depth of 5 metres. Ellis Quarry has achieved permitted depth and limits of extraction and resource recovery and future contributions to background dust levels under these conditions would therefore be expected to be minimal.

An extensive network of NATA-accredited air quality monitoring stations which use Standards Australia methods, where available is operated by the NSW EPA. The closest monitoring site to the Project site is at Coffs Harbour, approximately 65 km to the east. However, this station has only been operational since November 2019 and is located in the city centre. The Narrabri is located at Narrabri Airport, Airport Rd, in Narrabri on the north-west slopes and is considered to provide a more representing background estimation of the remote rural concentration levels expected for the project site. Of the pollutants of interest, PM10 and PM2.5 are measured at the Narrabri site. As with all NSW air quality monitoring stations concentration levels of these pollutants were elevated by smoke from bushfires in summer. Where available, the maximum 24 hour average data collected at this site for 2019 is outlined in Table 5-2 for a Level 1 Assessment as specified in the Approved Methods (2016). Individual 24-hour average predicted PM_{10} concentration paired in time with the corresponding 24-hour concentration within the adopted 2019 monitoring dataset to obtain total impact at each receptor is provided for the Assessment. In addition, annual average concentration data are adopted for the background levels of pollutants requiring assessment for these periods (e.g. PM2.5 and PM10).

Where unavailable, a conservative assumption is adopted. For example, annual TSP background is derived as 2.5 x measured PM10 based on data collected around Australian mines (ACARP, 1999). No dust deposition data is available, however the results of dust deposition monitoring undertaken at similar locations in central Queensland have been utilised. The average dust deposition from monitoring at these locations is 33 mg/m^2/day. This is likely to be typical of annual average dust fallout in rural regions although higher levels may exist in the vicinity of local sources. Therefore, the average background deposition rate for the air quality impact assessment in relation to the Project has been assumed to be double the nominated monitoring result that is 2.0 g/m^2/month (67 mg/m^2/day). This methodology is consistent with the Approved Methods, which specifies criteria of 2 g/m^2/month without background and 4 g/m^2/month including background.

As shown in Table 5-2, the maximum measured 24 hour average PM_{10} and $PM_{2.5}$ are already above the relevant criteria of 50 µg/m^3.

Table 5-2: Assigned Background Concentrations

Parameter	Air Quality Criteria	Period	Maximum Measured	Adopted Background	Comments
TSP	90 µg/m^3	Annual	46.4 µg/m^3	46.4 µg/m^3	Conservative assumption
PM_{10}	50 µg/m^3	24 Hour	232.6 µg/m^3	Varies	NSW EPA Measurement
	25 µg/m^3	Annual	23.2 µg/m^3	23.2 µg/m^3	
$PM_{2.5}$	25 µg/m^3	24 Hour	87.7 µg/m^3	Varies	NSW EPA Measurement
	8 µg/m^3	Annual	7.8 µg/m^3	7.8 µg/m^3	
Dust Deposition	2 g/m^2/month	Month	-	-	-
	4 g/m^2/month	Month	2 g/m^2/month	2 g/m^2/month	Conservative assumption

6 METHODOLOGY

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM10, PM2.5, and deposited dust for the proposed Project was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the Project (outlined in Section 6.1).
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model (Section 6.2).
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria described in Section 4.3 as part of the impact assessment (Section 7). Air quality controls are applied to reduce emission rates where applicable.

6.1 ESTIMATED EMISSIONS

6.1.1 POLLUTION CAUSING ACTIVITIES

The air quality assessment takes into account dust generating activities from quarry activities and disturbed surfaces within the site boundaries. The main emissions to air are dust and particulate matter generated by the onsite activities which primarily occur as a result of the following activities:

- site clearance of areas including vegetation clearance, topsoil removal and storage, and earthworks
- excavation
- loading/unloading of haul trucks
- bulldozer and grader operations
- wind erosion from disturbed areas and stockpiles
- transfer points
- conveyors
- crushing and screening
- vehicle movements
- blasting and drilling

In addition, air pollutants from diesel combustion may release other air pollutants such as particulate matter, (PM10 and PM2.5), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and trace quantities of volatile organic compounds. These substances are not considered to be emitted in sufficient quantities to affect air quality at sensitive receptors beyond the Project boundary; and have not been modelled in the air quality assessment.

6.1.2 EMISSION ESTIMATION

Emission factors can be used to estimate emissions of TSP and PM_{10} to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source. Common measures of activity include distance travelled, quantity of material handled, or the duration of the activity.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{i\,(kg/yr)} = \left[A_{(t/h)} \times OP_{(h/yr)} \right] \times EF_{i\,l(kg/t)} \times \left[1 - \frac{CE_i}{100} \right]$$

Where:

$E_{i\,(kg/yr)}$ = Emission rate of pollutant

$A_{(t/h)}$ = Activity rate

$OP_{(h/yr)}$ = operating hours

$EF_{i\,l(kg/t)}$ = uncontrolled emission factor of pollutant

CE_i = overall control efficiency for pollutant

The equations and activity rates are presented in ***Appendix A***.

6.1.3 EMISSIONS SCENARIOS MODELLED

The operational scenario representing maximum activities has been modelled for this assessment.

6.1.4 EMISSION CONTROLS

Emissions controls for dust abatement were included in the emissions estimation, summarised in Table A-1.

It should also be noted that some of the planned dust control measures are not easily quantifiable but will still serve to reduce dust emissions. The dispersion modelling study has taken a conservative approach and have not incorporated the effectiveness of these controls in the development of the emissions inventory.

- Routine visual monitoring and hazard minimisation.
- Planned activities will not occur during adverse weather conditions.
- Stockpile limits to 6m in height.
- Drill Rig fitted with engineered dust extraction / suppression as appropriate.
- Progressively establish vegetation on any topsoil/overburden stockpiles and rehabilitated landforms and in buffers.
- Material drop-height will be minimised during stockpile building.

6.1.5 EMISSIONS BY SOURCE

As discussed in Section 6.1, the emission estimation for individual activities accounting for control factors (outlined in ***Appendix A***) has been derived from NPI Emission Estimation Technique manuals and US EPA AP42 documentation. The annual calculated emissions for TSP, PM_{10} and $PM_{2.5}$ are summarised in Table 6-1 for each source type. Further details including the activity data applied in the emissions estimations are provided in ***Appendix A***. It should be noted that all sources are classed as fugitive and there are no point sources associated with this project.

Table 6-1: Calculated Annual Emissions by Source (kg/year)

Fugitive Source	TSP	PM10	PM2.5
Wind erosion (Pit & Stockpiles)	2,000	1,000	100
Wheel generated dust (Hauling internal and external)	22,600	6,700	400
Pit activities (Pit)	44,400	18,200	4,700
Blasting/drilling (Pit)	9,300	4,800	300
Processing	500	300	20
Total	**78,800**	**31,000**	**5,520**

6.2 AIR DISPERSION MODELLING

6.2.1 TAPM

A 3-dimensional dispersion wind field model, CALPUFF, has been used to simulate the impacts from the Project. CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed and distributed by Earth Tech, Inc. The model has been approved for use in the '*Guideline on Air Quality Models*' (Barclay and Scire, 2011) as a preferred model for assessing applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

TAPM was configured as follows:-

- Centre coordinates – 30° 18.5 S, 152° 30.5 E;
- Dates modelled – 30th December 2018 to 31st December 2019 (2 start up days);
- Four nested grid domains of 30 km, 10 km, 3 km and 1 km;
- 30 x 30 grid points for all modelling domains;
- 25 vertical levels from 10 m to an altitude of 8000 m above sea level;

- Data assimilation using measured meteorological data from the NSW EPA Air Quality Monitoring Station at Armidale; and
- The default TAPM databases for terrain, land use and meteorology were used in the model;

6.2.2 CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system.

The CALMET simulation was run as No-Obs simulation with the gridded TAPM three-dimensional wind field data from the innermost grid. CALMET then adjusts the prognostic data for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation.

6.2.3 CALPUFF

CALPUFF is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Due to the limited change in topography as discussed in Section 2.6, the radius of influence of terrain features was set at 5 km while the minimum radius of influence was set as 0.1 km. The terrain data incorporated into the model had a resolution of 1 arc-second (approximately 30 m) in accordance with the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'*.

6.2.4 OTHER MODELLING INPUT PARAMETERS

6.2.4.1 PARTICLE SIZE DISTRIBUTION

CALPUFF requires particle distribution data (geometric mass mean diameter, standard deviation) to compute the dispersion of particulates (Table 6-2).

Table 6-2: Particle size distribution data

Particle size	Mean particle diameter (µm)	Geometric standard deviation (µm)
TSP	15	2
PM10	4.88	1
PM2.5	0.89	1

6.2.4.2 MODELLING HOURS

Modelling was undertaken incorporating maximum hourly emission rates for operational hours limited to 7.00am to 6.00pm Monday to Friday (ie. 11 hours operation per day) and 7.00am to 1.00pm on Saturdays (ie. 6 hours operation) or 3172 hours annually.

In addition, modelling of other sources such as blasting was restricted to 9.00am to 3.00pm Monday to Friday and wind erosion for the entire 365 days of the year.

7 ASSESSMENT OF IMPACTS

This section presents the results of the air quality impact assessment for predicted ground level concentrations of TSP, PM10 and PM2.5 and dust deposition for the proposed operation of the Project.

The results of the dispersion modelling include individual sensitive receptor and contour plots that are indicative of ground-level concentrations and deposition. This impact assessment requires the predictions to be presented as follows:

- The incremental impact of each pollutant as per the criterion units and time periods;
- The cumulative impact (incremental plus background) for the 100th percentile (i.e. maximum value) in units as per the criterion and time periods.

7.1 TSP

The predicted annual average TSP is presented in Table 7-1.

The model predictions for TSP are well below the criteria of 90 µg/m^3. TSP emissions from the proposed Project are not predicted to adversely impact upon the sensitive receptors. A contour plot is presented in ***Appendix B***.

Table 7-1: Predicted Annual Average TSP Concentrations (µg/m^3)

ID	Predicted Annual Average TSP Concentrations (µg/m^3)	
	Incremental	**Cumulative**
SR1	5.58	51.98
SR2	0.37	46.77
SR3	0.09	46.49
SR4	0.05	46.45
SR5	0.03	46.43
Criteria	**90**	

7.2 PM10

The maximum predicted 24 hour (including maximum measured background of 232.6 µg/m^3) and annual average (including measured annual background of 23.2 µg/m^3) PM10 are presented in *Table 7-2*. The table shows the model predictions for annual average PM10 are below the criteria of 25 µg/m^3 at all sensitive receptors except the sawmill residence (SR1).

The model predictions for cumulative 24 hour average PM10 are above the criteria of 50 µg/m^3. As noted in Section 5.2, the measured 24 hour background PM10 of 232.6 µg/m^3 is already above the criteria of 50 µg/m^3. Further investigation of the contemporaneous measured background and predicted data is therefore undertaken.

Table *7-3* provides the maximum cumulative concentrations at each receptor including contemporaneous background concentrations and associated number of exceedances of the criteria for the modelled year. Timeseries plots of the model predictions for 24 hour PM10 showing the contemporaneous impact and background have also been provided in ***Appendix D*** to allow verification of the results reported. As shown in *Table 7-3*, 33 exceedances of the 24 hour average PM10 criteria (50 µg/m^3) are predicted at four of the sensitive receptors modelled (SR2 to SR5) and 36 exceedances at SR1 – the sawmill residence. The 33 exceedances at SR 2 to SR5 correspond to the dates of the elevated measured background which also exceed the criteria. The greatest contribution of the quarry emissions to the cumulative PM10 is 11.99 µg/m^3 at these receptors and does not contribute to any additional exceedances of the relevant criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required for the four sensitive receptors.

However, as outlined above, model predictions exceed the 24 hour and annual average criteria at the sawmill residence. It is understood that an agreement exists between the Proponent and the residence (***Appendix C***) such that impact assessment is not required for this location.

The 24 hour and annual average PM_{10} emissions from the proposed Project are therefore not predicted to adversely impact upon the sensitive receptors. Contour plots are provided in ***Appendix B***.

Table 7-2: Predicted 24 Hour and Annual Average PM10 Concentrations (µg/m³)

ID	Predicted 24 Hour Average PM10 Concentrations (µg/m³)		Predicted Annual Average PM10 Concentrations (µg/m³)	
	Incremental	Cumulative	Incremental	Cumulative
SR1	35.89	268.49	3.28	26.48
SR2	11.99	244.59	0.58	23.78
SR3	4.37	236.97	0.16	23.36
SR4	1.25	233.85	0.05	23.25
SR5	0.54	233.14	0.03	23.23
Criteria	**50**		**25**	

Table 7-3: Predicted Cumulative 24 Hour Average PM10 Concentrations and Number of Exceedances

ID	Predicted Cumulative 24 Hour Average PM10 Concentrations (µg/m³)	Number of Exceedances[a]
SR1	233.7	36
SR2	232.7	33
SR3	232.6	33
SR4	232.6	33
SR5	232.6	33
Criteria	**50**	

a Note - number of exceedances of criteria by measured background data is 33

7.3 PM2.5

The maximum predicted 24 hour (including maximum measured background of 87.7 µg/m³) and annual average (including measured annual background of 7.8 µg/m³) PM2.5 are presented in Table 7-4.

The model predictions for annual average PM2.5 are below the criteria of 8 µg/m³ for sensitive receptors SR2 to SR5 and are slightly above at SR1 (i.e. 8.48 µg/m³ compared with a criteria of 8 µg/m³).

As shown in Table 7-4, the cumulative model predictions for 24 hour average PM2.5 are above the 25 µg/m³ criteria. The measured 24 hour background PM2.5 of 87.7 µg/m³ is already above the criteria of 25 µg/m³. Further investigation of the contemporaneous measured background and predicted data is therefore undertaken. Table 7-5 provides the maximum cumulative concentrations at each receptor including contemporaneous background concentrations and associated number of exceedances of the criteria for the modelled year. Timeseries plots of the model predictions for 24 hour PM10 showing the contemporaneous impact and background have also been provided in ***Appendix D*** to allow verification of the results reported. As shown in Table 7-5, 22 exceedances of the 24 hour average PM2.5 criteria (25 µg/m³) are predicted at SR2 to SR5. These exceedances correspond to the dates of the elevated measured background which also exceed the criteria. The greatest contribution of the quarry emissions to the cumulative PM2.5 is a maximum of 3 µg/m³ at these four receptors compared with the background and does not contribute to any additional exceedances of the relevant criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required for the four sensitive receptors.

However, as outlined above, model predictions exceed the 24 hour and annual average criteria at the sawmill residence. It is understood that an agreement exists between the Proponent and the residence (***Appendix C***) such that impact assessment is not required for this location.

The 24 hour and annual average PM2.5 emissions from the proposed Project are not predicted to adversely impact upon the sensitive receptors. Contour plots are provided in ***Appendix B***.

Table 7-4: Predicted 24 Hour and Annual Average PM2.5 Concentrations

ID	Predicted 24 Hour Average PM2.5 Concentrations (µg/m³)		Predicted Annual Average PM2.5 Concentrations (µg/m³)	
	Incremental	Cumulative	Incremental	Cumulative
SR1	7.81	95.51	0.68	8.48
SR2	3.00	90.70	0.12	7.92
SR3	1.09	88.79	0.03	7.83

ID	Predicted 24 Hour Average PM2.5 Concentrations (µg/m³)		Predicted Annual Average PM2.5 Concentrations (µg/m³)	
	Incremental	Cumulative	Incremental	Cumulative
SR4	0.29	87.99	0.01	7.81
SR5	0.14	87.84	0.01	7.81
Criteria	**25**		**8**	

Table 7-5: Predicted Cumulative 24 Hour Average PM10 Concentrations and Number of Exceedances

ID	Predicted Cumulative 24 Hour Average PM10 Concentrations (µg/m³)	Number of Exceedances[a]
SR1	87.8	23
SR2	87.7	22
SR3	87.7	22
SR4	87.7	22
SR5	87.7	22
Criteria	**50**	

a Note - number of exceedances of criteria by measured background data is 22

7.4 DUST DEPOSITION

The maximum predicted monthly average dust deposition are presented in Table 7-6.

The model predictions for incremental and cumulative monthly average dust deposition are well below the criteria of 2 g/m^2/month and 4 g/m^2/month. Dust deposition from the proposed Project is not predicted to adversely impact upon the sensitive receptors. Contour plots are provided in ***Appendix B***.

Table 7-6: Predicted Monthly Average Dust Deposition

ID	Predicted Monthly Average Dust Deposition (g/m²/month)	
	Incremental	Cumulative
SR1	0.72	2.72
SR2	0.17	2.17
SR3	0.02	2.02
SR4	0.01	2.01
SR5	0.01	2.01
Criteria	**2**	**4**

8 CONCLUSION

An Air Quality Impact Assessment has been carried out in support a development consent for the continuation and expansion of a small quarry at Tyringham on the Dorrigo Plateau known as 'Faheys Pit'. The Proponent proposes to increase the capacity of Faheys Pit to extract and to process up to 150,000 tonnes per annum of quarry material within an enlarged quarry footprint totalling 4.1ha and a total resource of about 1.8 million tonnes.

As summarised in Table 8-1 and Table 8-2, the results of the modelling have shown that the TSP, PM10, PM2.5 and dust deposition predictions comply with the relevant criteria and averaging periods at all sensitive receptors modelled for the Project in isolation.

TSP, dust deposition and annual average PM10 and PM2.5 predictions are also less than criteria for the Project including background at SR2 to SR5. Whilst the 24 hour average PM10 and PM2.5 predictions are above, The exceedances are driven by the elevated background adopted for the assessment, which are already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and that best management practices will be implemented to minimise emissions as far as is practical. In the absence of the elevated background therefore, we would anticipate no exceedances of the criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

However, model predictions exceed the 24 hour and annual average PM10 and PM2.5 criteria at SR1 - the sawmill residence. It is understood that an agreement exists between the Proponent and the residence such that impact assessment is not required for this location.

It is therefore concluded that air quality should not be a constraint to proposed quarry increase in extraction.

Table 8-1: Summary of Results – Project in Isolation

ID	Predicted Concentrations (µg/m³)					Dust deposition (g/m2/month)	Compliant
	PM10		PM2.5		TSP		
	24 h	Annual	24 h	Annual	Annual	Month	
SR1	35.89	3.28	7.81	0.68	5.58	0.72	✓
SR2	11.99	0.58	3.00	0.12	0.37	0.17	✓
SR3	4.37	0.16	1.09	0.03	0.09	0.02	✓
SR4	1.25	0.05	0.29	0.01	0.05	0.01	✓
SR5	0.54	0.03	0.14	0.01	0.03	0.01	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**2**	

Table 8-2: Summary of Results – Cumulative

ID	Predicted Concentrations (µg/m³)					Dust deposition (g/m2/month)	Compliant
	PM10		PM2.5		TSP		
	24 h	Annual	24 h	Annual	Annual	Month	
SR1	268.49	26.48	95.51	8.48	51.98	2.72	✗
SR2	244.59	23.78	90.70	7.92	46.77	2.17	✓
SR3	236.97	23.36	88.79	7.83	46.49	2.02	✓
SR4	233.85	23.25	87.99	7.81	46.45	2.01	✓
SR5	233.14	23.23	87.84	7.81	46.43	2.01	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**4**	

Appendix A EMISSIONS ESTIMATION

A.1 Emission Estimation Equations

The major air emission from extraction activities is fugitive dust. Emission factors can be used to estimate emissions of TSP, PM_{10} and $PM_{2.5}$ to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source. Common measures of activity include distance travelled, quantity of material handled, or the duration of the activity.

The National Pollutant Inventory Emission Estimation Technique Manual for Mining (January 2012) provide the equations and emission factors to determine the emissions of TSP and PM_{10} from mining and quarrying activities. These emission factors incorporate emission factors published by the USEPA in their AP-42 documentation.

Excavation on Overburden

The default emission rates in the NPI EET for Mining have been used for this emission factor.

Bulldozer on Material other than Coal

Emission rates have been calculated using the equation in the NPI EET for Mining as follows:

$$EF\ TSP = 2.6\ x\ \frac{s^{1.2}}{M^{1.3}}\ \text{kg/h}$$
$$EF\ PM10 = 0.34\ x\ \frac{s^{1.5}}{M^{1.4}}\ \text{kg/h}$$

Where:

$s_{(\%)}$ = silt content.

$M_{(\%)}$ = moisture content

The fraction of $PM_{2.5}$ in TSP is 10.5%

Miscellaneous Handling and Transfers

Emission rate for dust from stockpile has been calculated using the following emission rates from AP42 11.19.2:

TSP = 0.005 kg/t

PM_{10} = 0.002 kg/t

$PM_{2.5}$ = 15% of PM_{10} is $PM_{2.5}$

Crushing and Screening

The default emission rates in the NPI EET for Mining and AP42 11.19.2 have been used.

Drilling

The default emission rates in the NPI EET for Mining and have been used for these emission factors. 10% PM_{10} is $PM_{2.5}$. 100 holes per day is the estimated rate.

Blasting

The TSP emission rate for blasting has been calculated using the following equation:

$$Emissions_{\text{TSP}} = 0.00022\ x\ Area\ blasted\ (m^2)^{1.5}\ \text{kg /blast}$$

PM_{10} is TSP multiplied by 0.47 and 10% of PM_{10} is $PM_{2.5}$. Area blasted is 900 m^2 with 1 blast per weekday of operation.

Haul Roads

The default emission rates in the NPI EET for Mining and have been used for these emission factors, where:

TSP = 4.23 kg/VKT

PM_{10} = 1.25 kg/VKT

$PM_{2.5}$ = 17% of TSP is $PM_{2.5}$

Wind Erosion

The emission rate for dust from stockpile has been calculated using the following equation for TSP:

$$Emissions = 1.9\ x \left(\frac{s_{(\%)}}{1.5}\right) x\ 365\ x \left(\frac{365-p}{235}\right) x \left(\frac{f_{(\%)}}{15}\right) \text{ kg /ha /yr}$$

Where:

$s_{(\%)}$ = silt content.

P = number of days per year when rainfall is greater than 0.25 mm. A review of the long term BoM meteorological data collected at the Dorrigo has determined there are 135 days where rainfall is greater than 1 mm.

$f_{(\%)}$ = percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile. The frequency of wind speed >5.4 m/s has been measured at Armidale to be 4.0%.

The fraction of PM_{10} in TSP is 50% and $PM_{2.5}$ is 15% of PM_{10}

A.2 Activity Overview

Table A-1 summarises the emissions inventory and key parameters applied in the emissions estimation for TSP. Table A-2 summarises the PM10 and PM2.5 emission factors and Table A-3 provides further details of the parameters applied.

Table A-1: Emissions Inventory - TSP

Source type	Emissions (kg/y)	Emission factor	Units	Intensity	Units	Variable	Units	Variable	Units	Variable	Units	Control
Pit Activities												
Excavator on Overburden	32,850	0.025	kg/t	3,300	t/day							Water sprays, 50%
Dozer on overburden	11,043	$2.6\ x\ \frac{s^{1.2}}{M^{1.3}}$	kg/h	1	Bulldozer.h/h	7.9	% silt content	6.9	% moisture			Water sprays, 50%
Blasting/drilling:												
Drilling	8,672	$0.00022\ x\ Area\ blasted\ (m^2)^{1.5}$	kg/blast	1	Blast/weekday	900	m^2					Water sprays, 70%
Blasting	591	0.59	kg/hole	100	Holes/day	100	holes/day					No control
Wind erosion:												
stockpiles/pits/haul roads	1,954	$1.9\ x\ \left(\frac{s_{(\%)}}{1.5}\right)\ x\ 365\ x\ \left(\frac{365-p}{235}\right)\ x\ \left(\frac{f_{(\%)}}{15}\right)$	kg/ha/y	4.1	ha	7.9	% silt content	135	days rain > 0.25mm/y	4	% wspd> 5.4m/s	Water sprays, 50%
Processing & Handling:												
Primary Crushing	92	0.01	kg/t	3,300	t/day							Water sprays, 50%
Screening	368	0.08	kg/t	3,300	t/day							Water sprays, 50%
Misc Handling	6,023	0.005	kg/t	3,300	t/day							No control
Wheel generated dust:												
Unpaved roads	22,637	4.23	kg/VKT	1,920	t/day	4.36	VKT/hr	0.4	km each way			Watering Level 2 + speed limit < 40 km/h (86%)

Table A-2: Source Emission Factors applied

Source type	Default TSP Emission factor	Derived TSP Emission factor	PM10/TSP ratio	PM2.5/TSP ratio	Units	Controls applied
Pit Activities						
Excavator on Overburden	0.025	-	0.47	0.105	kg/t	Water sprays, 50%
Dozer on overburden	-	2.52	0.20	0.105	kg/t	Water sprays, 50%
Blasting/drilling:						
Drilling	0.59	-	0.52	0.052	kg/hole	Water sprays, 70%
Blasting	-	5.94	0.47	0.047	kg/blast	No control
Wind erosion:						
stockpiles/pits/haul roads	-	0.11	0.5	0.075	kg/ha/h	Water sprays, 50%
Processing & Handling:						
Primary Crushing	0.01	-	0.40	0.083	kg/t	Water sprays, 50%
Screening	0.08	-	0.75	0.023	kg/t	Water sprays, 50%
Misc handling	0.0005	-	0.35	0.02	kg/t	Water sprays, 50%
Wheel generated dust:						
Unpaved roads	4.23	-	0.22	0.02	kg/VKT	Watering Level 2 + speed limit < 40 km/h (86%)

Table A-3: Parameters applied in emissions estimation

Parameter ID	Value	Units	Description	Data source
U	2.1	m/s	mean wind speed	NSW EPA meteorological data
W	37	t	Truck capacity	client supplied
p	135	days	rainfall > 0.25mm	BoM meteorological data
f	4	%	% time winds > 5.4m/s	BoM meteorological data
Holes	100	Holes/day	Holes drilled per day	Client supplied
A	900	m^2/blast	Area blasted	Default
B	1	Blast/day	Blasts per day	Client supplied
s	7.9	%	Silt content	Default
M	6.9	%	Moisture	Default
t	3,300	t/day	Maximum overburden moved	Client supplied
a	41,000	m^2	Area of land subject to wind erosion	Client supplied

Operating Hours

Extraction and processing of material has been modelled as 7 am to 6 pm on weekdays and 7 am to 1 pm on Saturdays.

Extraction Rates

The project proposes an annual average future extraction rate of 0.15 Mtpa.

Haul Roads

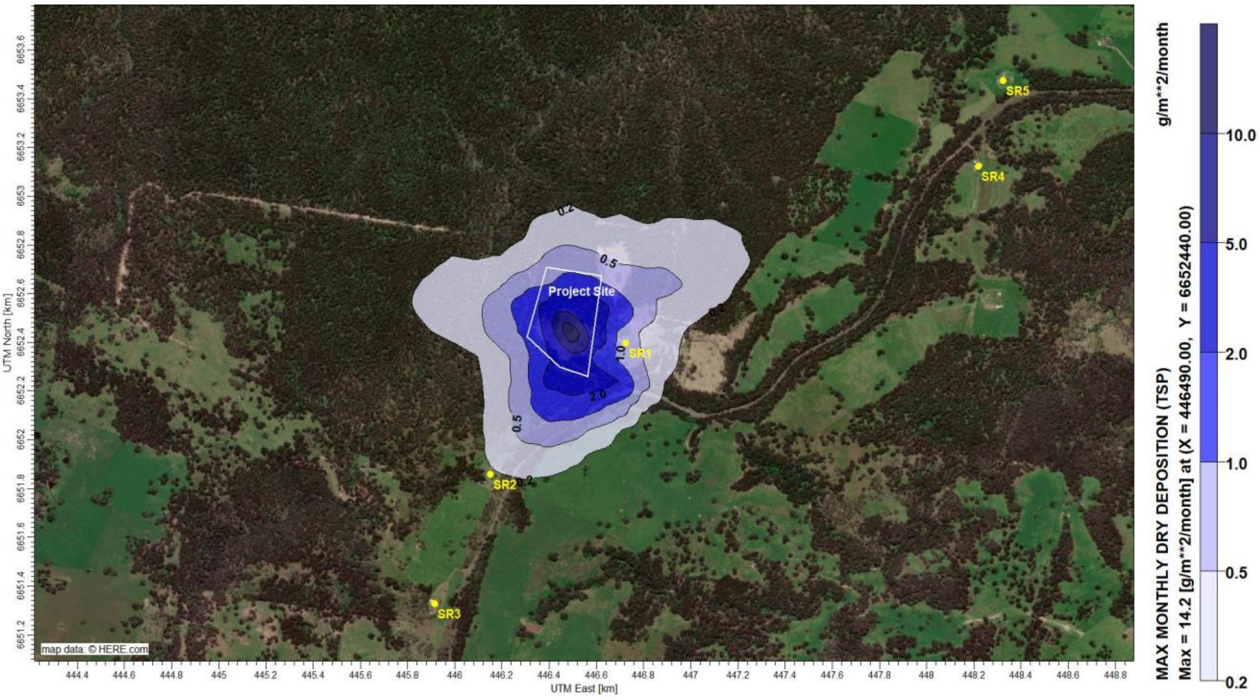
Haul road locations provided and incorporated into the model are summarised below.

Total Haul Road Length	Modelled Parameter (km)	VKT
Haul Road	0.4	4.4 VKT/h

Appendix B Contour Plots

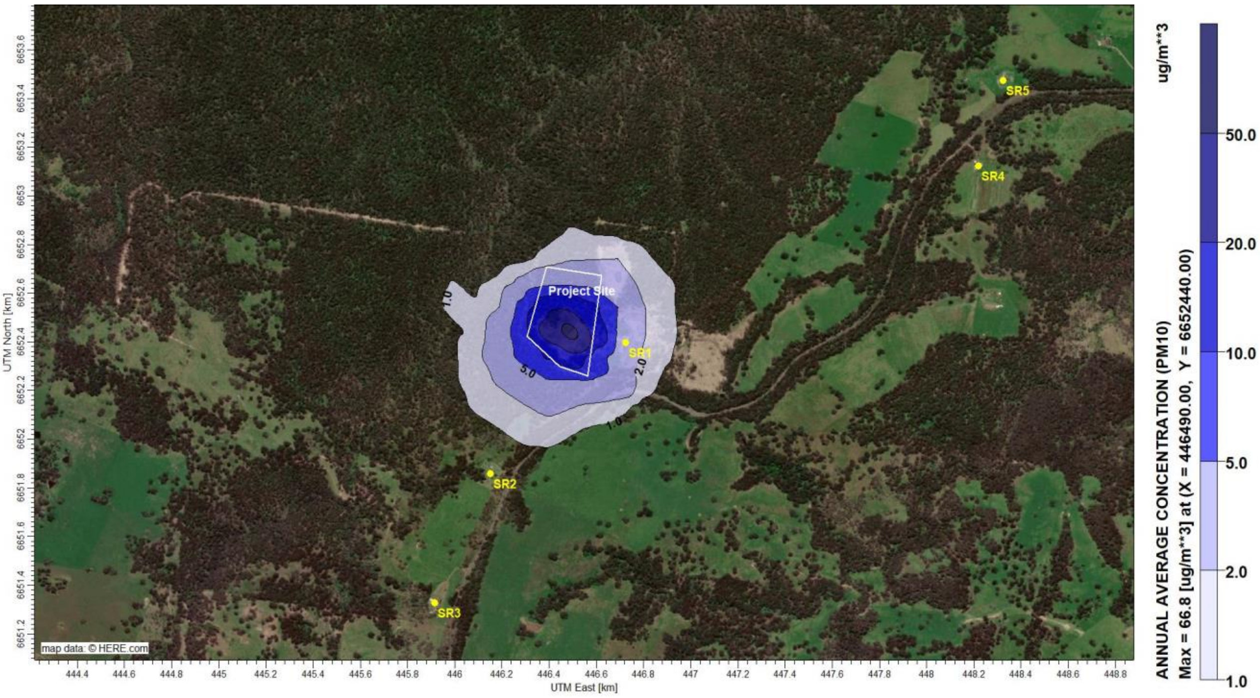
The contour plots are created from the predicted ground-level concentrations at the network of gridded receptors within the modelling domain at frequent intervals. These gridded values are converted into contours using triangulation interpolation in the CALPOST post-processing software within the CALPUFF View software (Version 7.2 - June 2014).

Contour plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of concern. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and discrete model predictions.



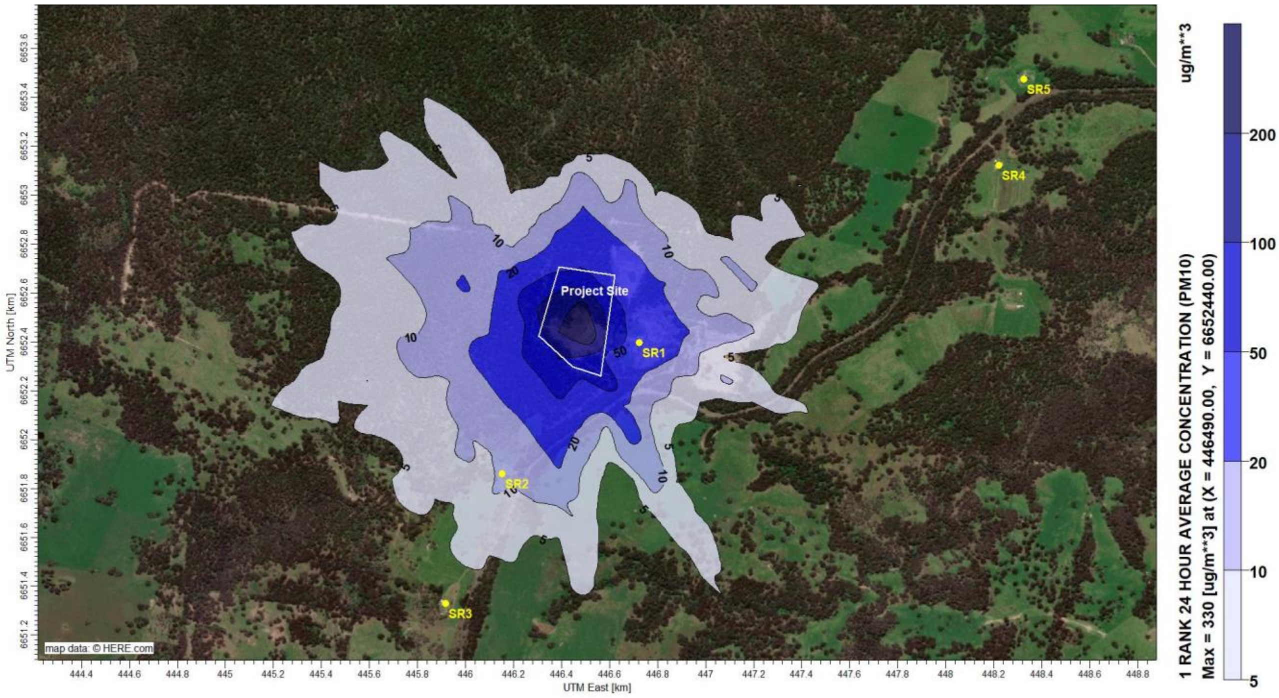
Pollutant:	Averaging Period:	Percentile:	Criteria:
Dust Deposition	Month	100^{th}	2 g/m^2/month

Comment:
Incremental



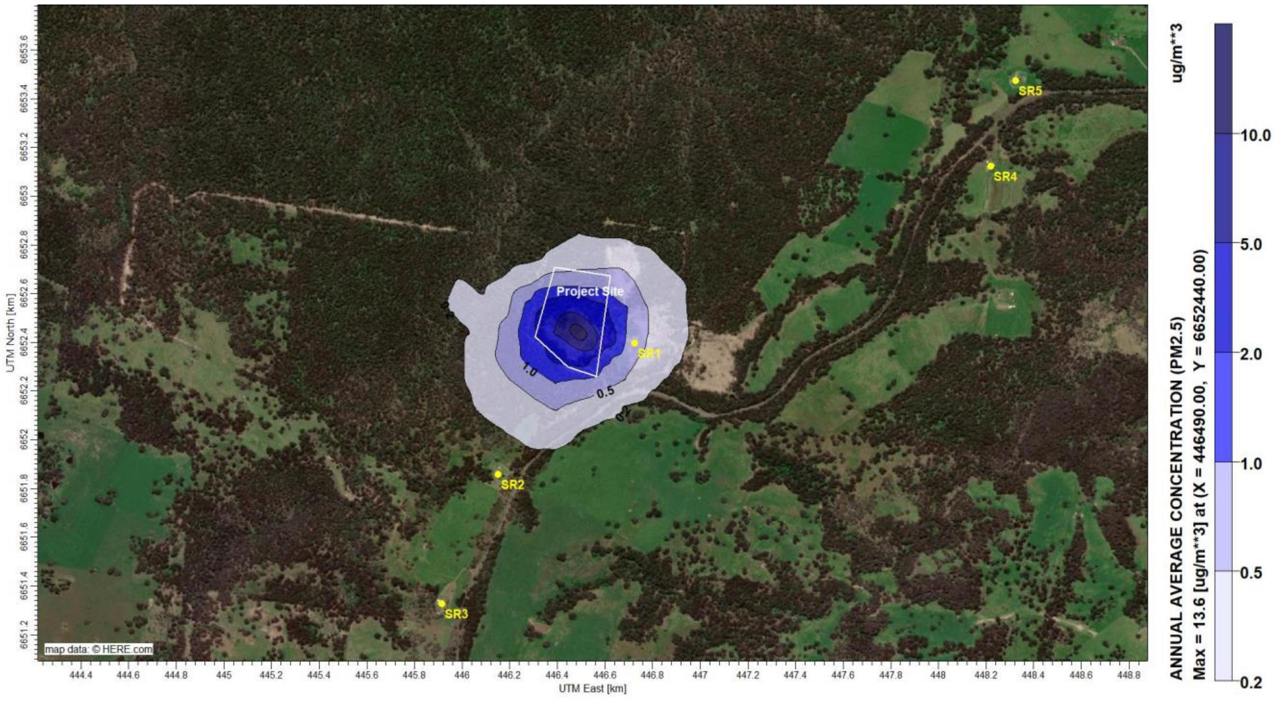
Pollutant: PM_{10}	Averaging Period: Annual	Percentile: 100th	Criteria: 25 µg/m^3

Comment:
Incremental



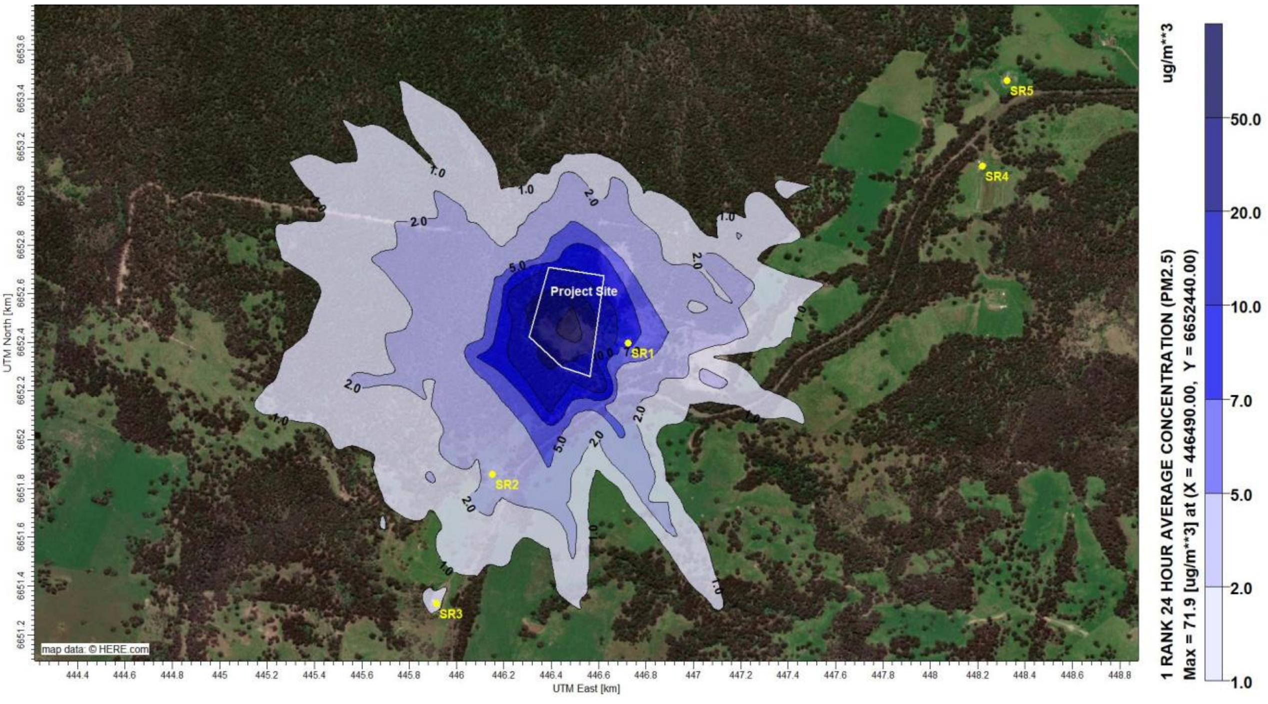
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 Hour	100^{th}	50 µg/m^3

Comment:
Incremental



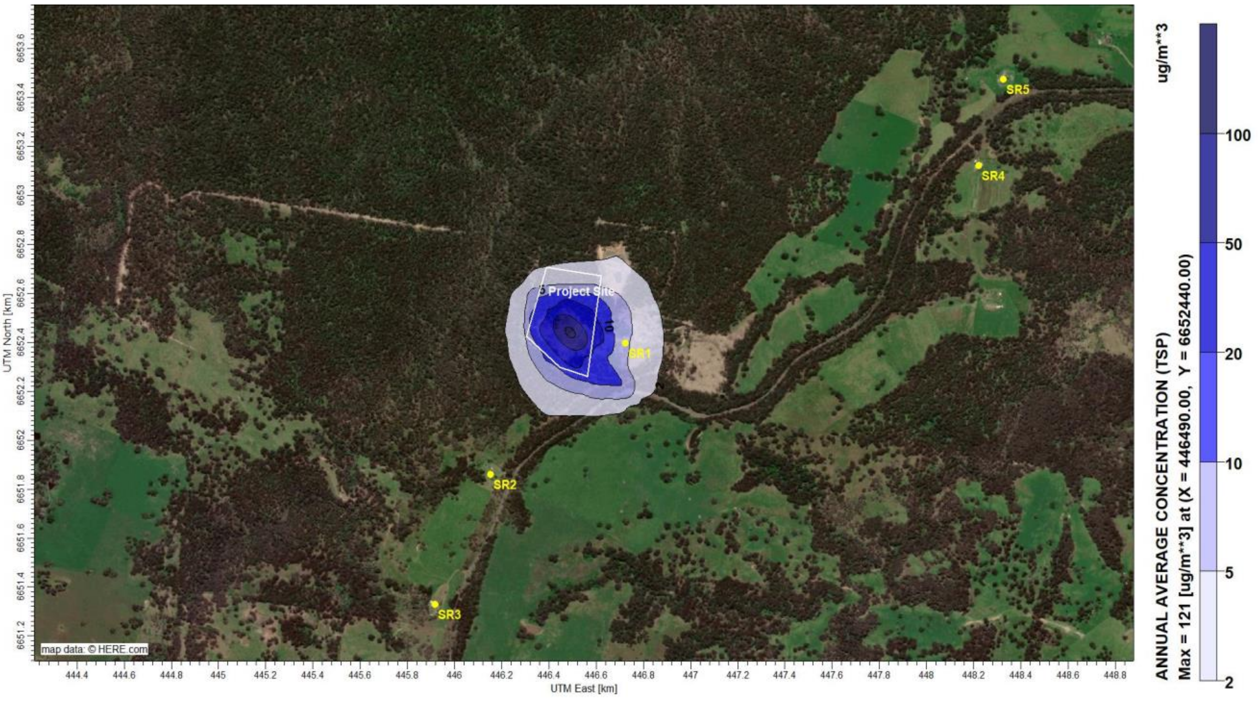
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	Annual	100th	8 µg/m^3

Comment:
Incremental



Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	24 Hour	100th	25 µg/m^3

Comment:
Incremental



Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	Annual	100th	90 µg/m^3

Comment:
Incremental

Appendix C Agreement between Proponent and Residence at SR1

Agreement between

Nicholas Baff & Sheridans Hard Rock Quarry Pty Ltd

in relation to

Residence at No. 9630 Armidale Road, Tyringham NSW 2453

1. Sheridans Hard Rock Quarry Pty Ltd ABN 58 151 721 989 (**SHRQ**) wishes to further develop and expand Faheys Pit at No.9720 Armidale Road, Tyringham NSW 2453 (**"the Quarry Project"**). SHRQ is in the process of obtaining development approval to develop and expand Faheys Pit.

2. The proposed hours of operation of the Quarry Project are to be limited to 7.00am to 6.00pm Monday to Friday and 7.00am to 1.00pm on Saturdays. Hours of blasting are to be restricted to 9.00am to 3.00pm Monday to Friday.(**"the Agreed Hours"**)

3. Nicholas Baff owns the property situated at No. 9630 Armidale Road, Tyringham NSW 2453 being Lot 2 in Deposited Plan 1139996 ("**the Property**") which property is adjacent to the Faheys Pit quarry site. The Property is currently occupied by an existing sawmill ("Baffs Sawmilling") and associated residence.

4. Environmental impact assessments have been undertaken in respect of the Quarry Project and its impact on the Property. A copy of the air quality impact assessment by Vipac, Engineers and Scientists, accompanying the exhibited EIS dated September 2023, has been made available to Nicholas Baff.

5. Following a review of the above assessment, Nicholas Baff now has a good understanding of the predicted air quality impacts arising from the operation of the proposed Quarry Project, and has accepted dust pollution impacts above the impact assessment criteria and/or the maximum impact that he, as a receptor, may be subject to.

6. This agreement applies for the life of the Quarry Project as proposed in the EIS dated September 2023.

Executed as an Agreement:

Sheridans Hard Rock Quarry Pty Ltd agrees to the terms of this Agreement:

EXECUTED by **SHERIDANS HARD ROCK QUARRY** ABN 58 151 721 989 in accordance with Section 127 of the Corporations Act 2001:

....	GRAHAM SHERIDAN
Signature of Director/Secretary	Name of Director

Nickolas Baff agrees to the terms of this Agreement:

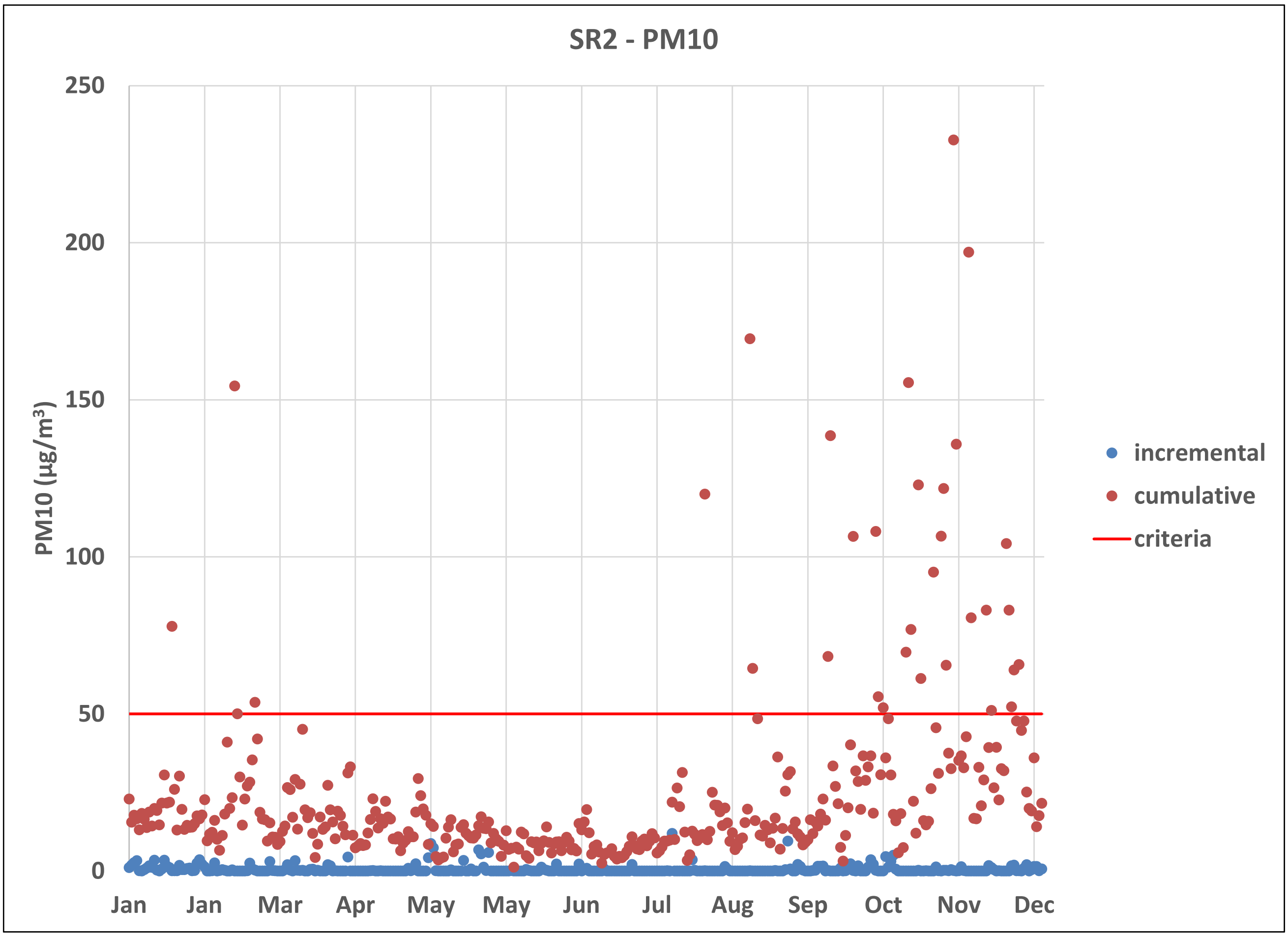
EXECUTED by NICHOLAS BAFF

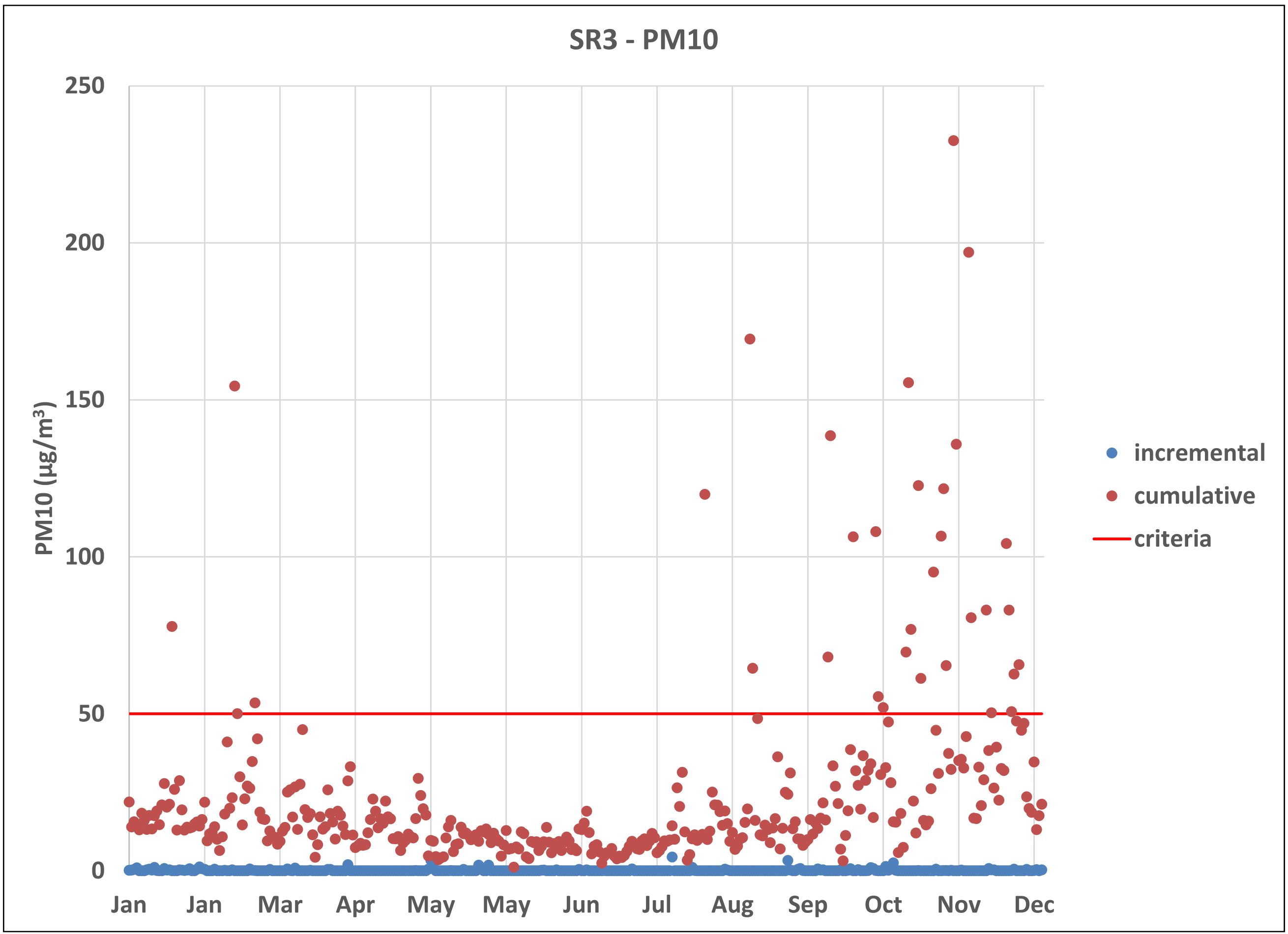
In accordance with Section 127 of the Corporations Act 2001:

N.L.Baff	Nicholas Baff
Signature of Nicholas Baff	Name

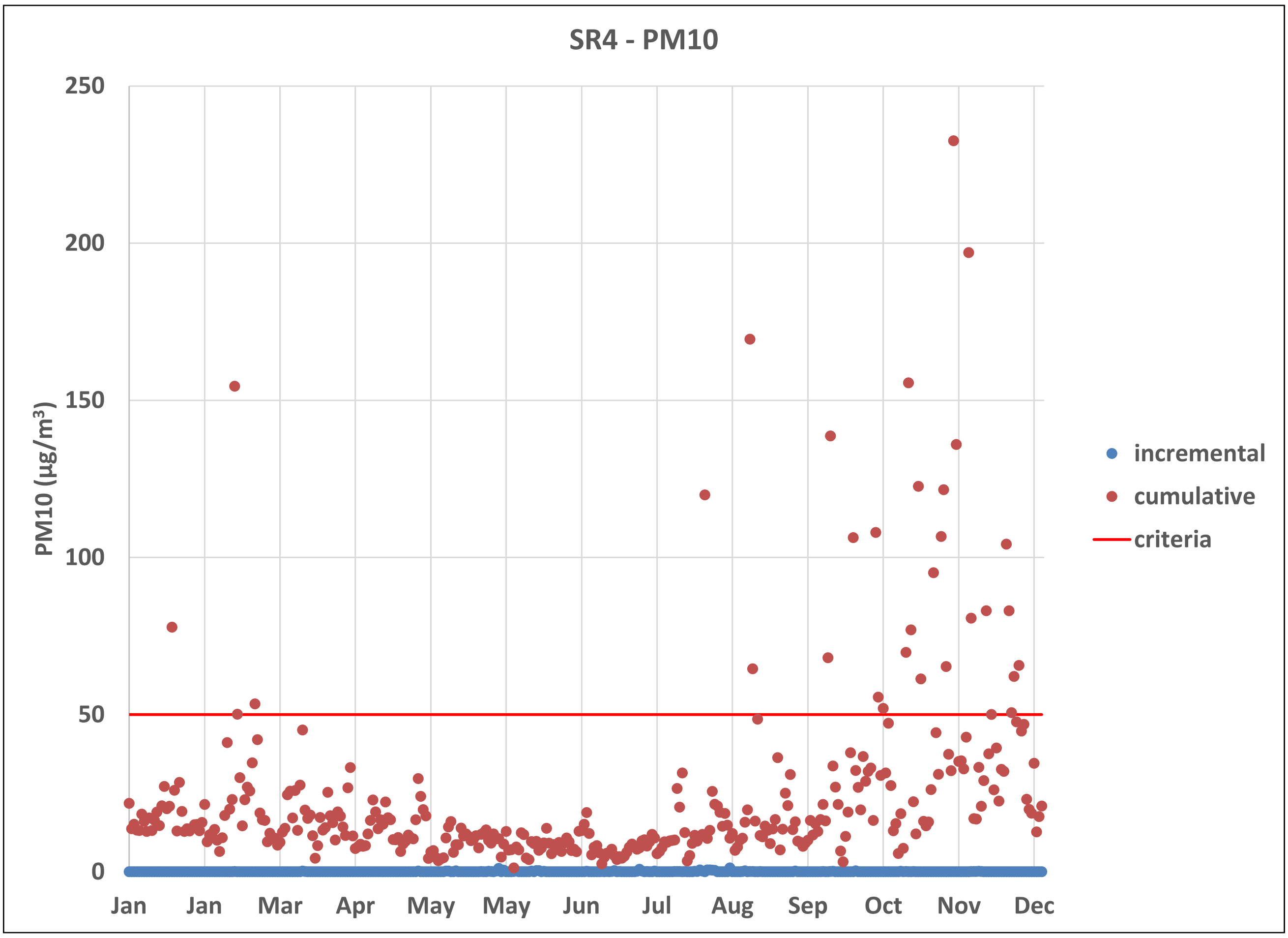
DATED 29 July 2022

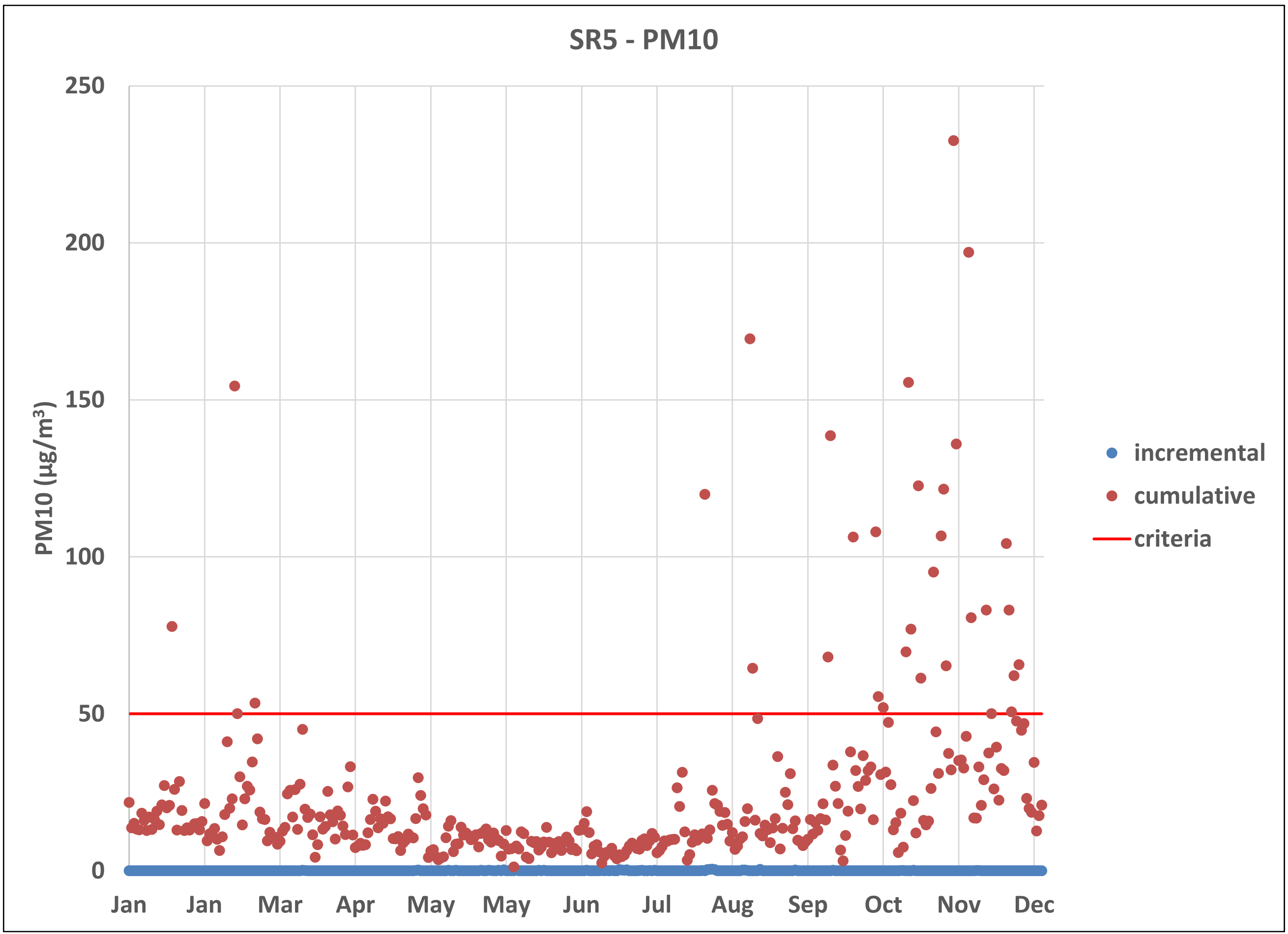
Appendix D Timeseries Plots of Incremental and Cumulative Predicted PM10 and PM2.5

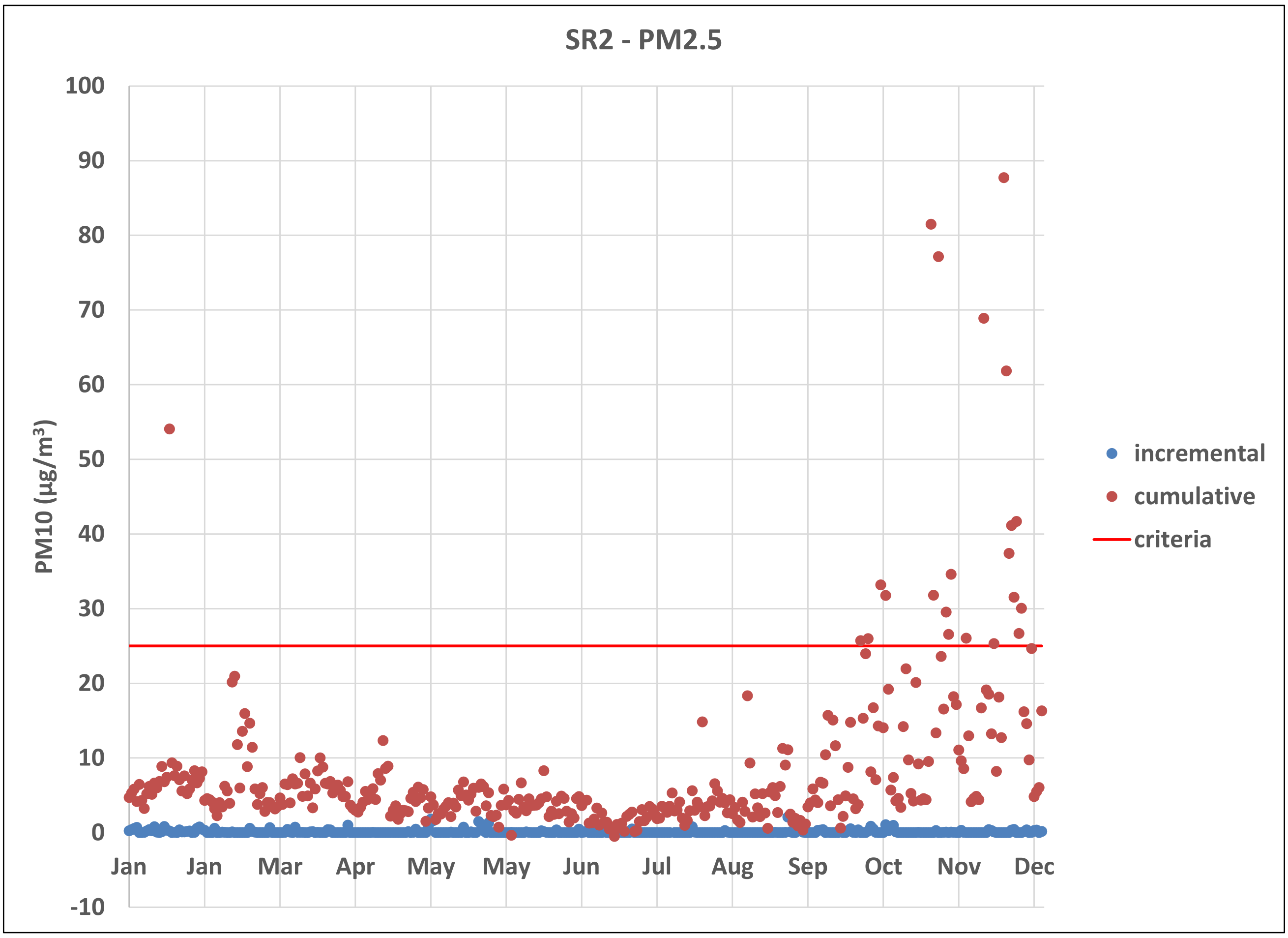


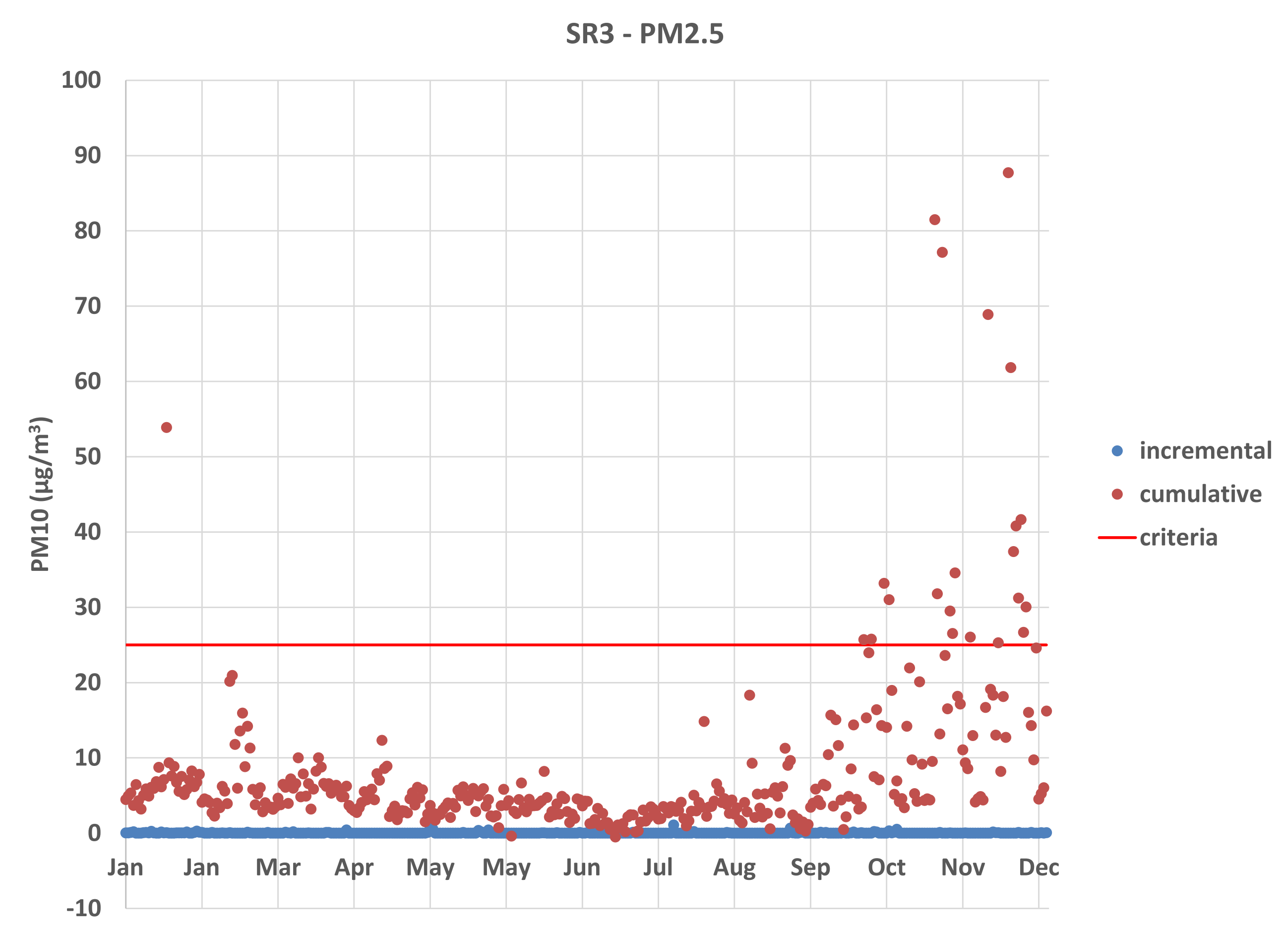


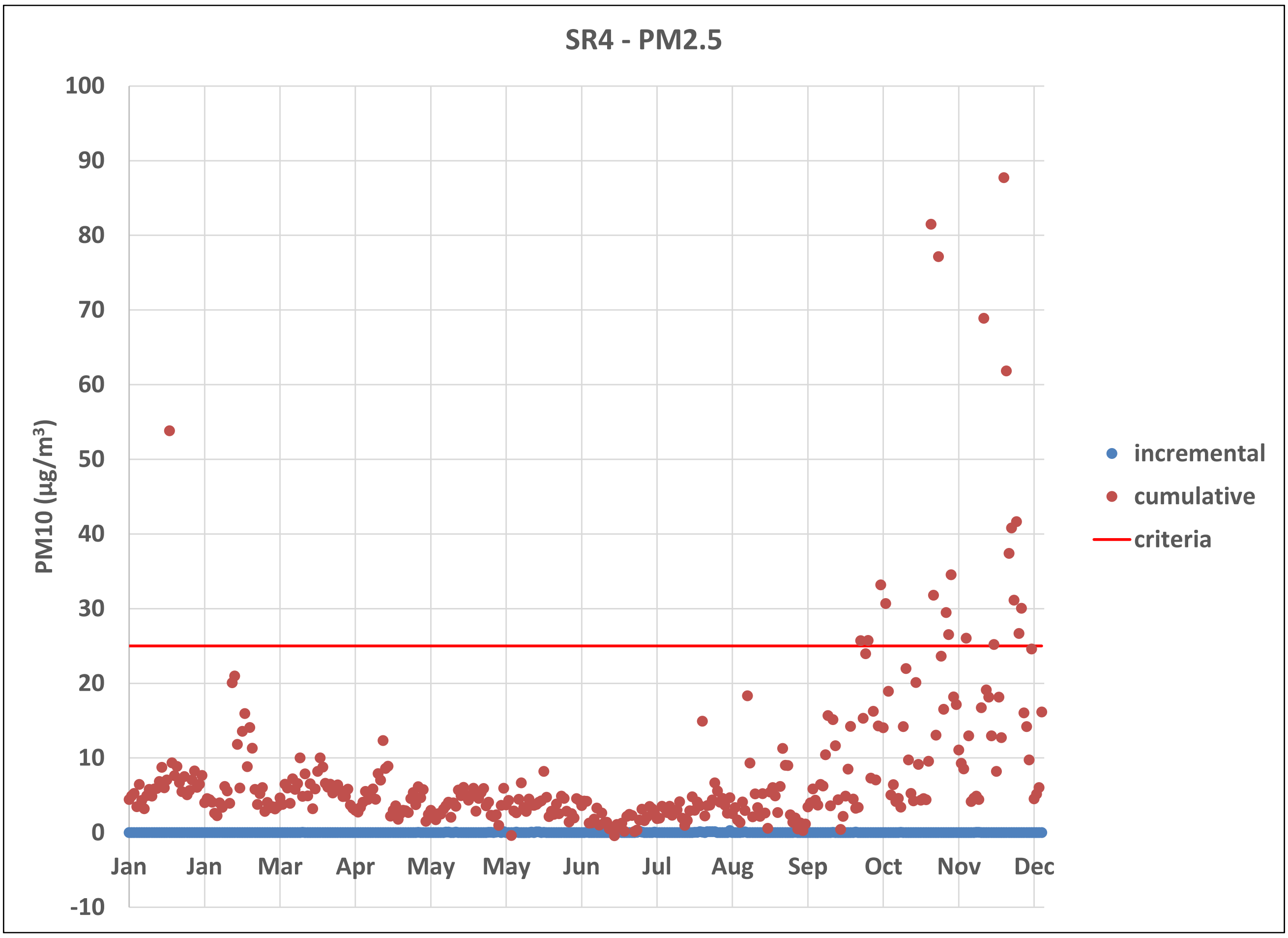
SR3 - PM10
250
200
150
100
50
0
PM10 (µg/m³)
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria

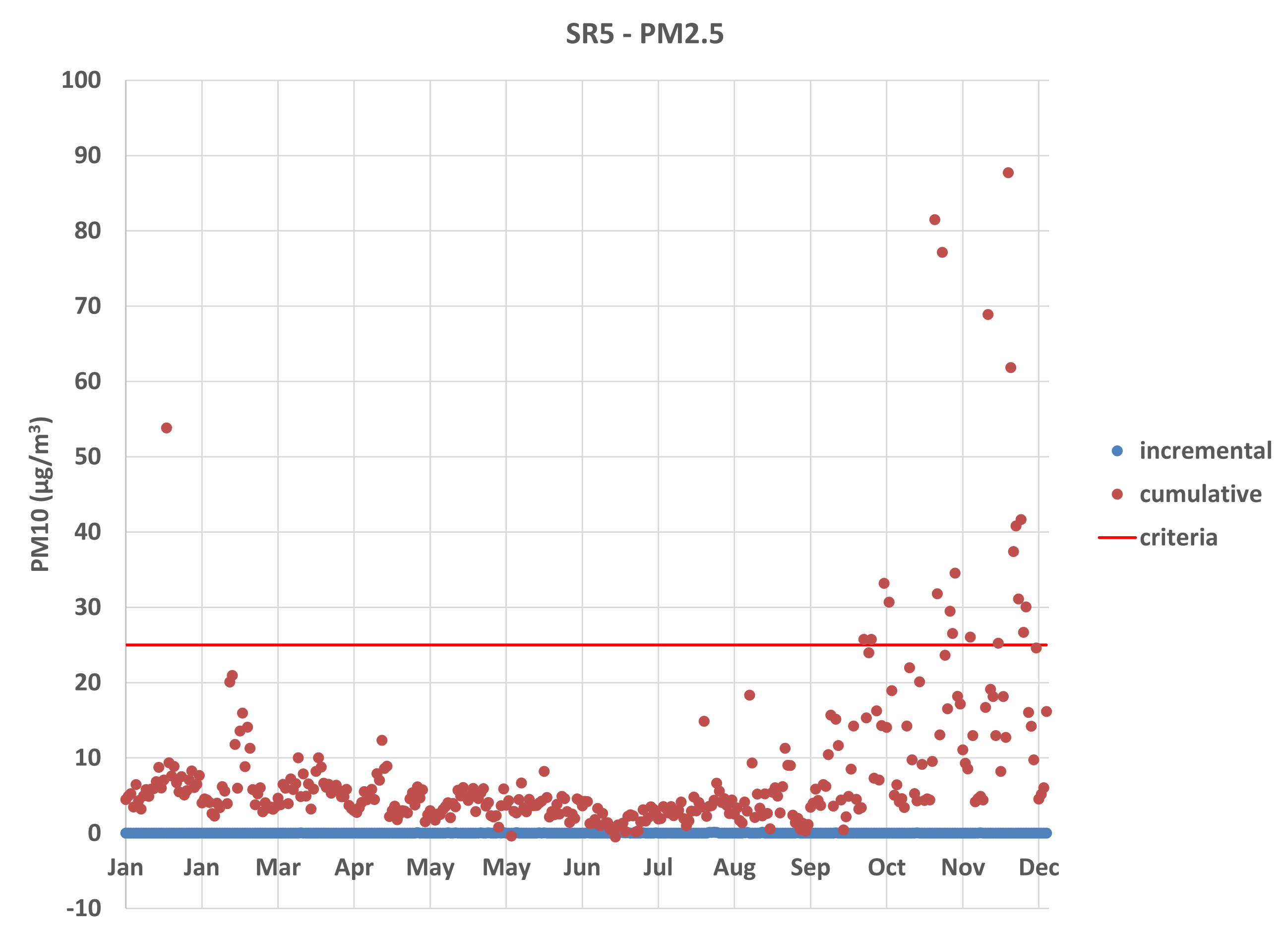

SR4 - PM10
PM10 (µg/m³)
250
200
150
100
50
0
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria


SR5 - PM10
250
200
150
100
50
0
PM10 (µg/m³)
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria


SR2 - PM2.5
PM10 (µg/m³)
100
90
80
70
60
50
40
30
20
10
0
-10
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria


SR3 - PM2.5
PM10 (µg/m³)
100
90
80
70
60
50
40
30
20
10
0
-10
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria


SR4 - PM2.5
PM10 (µg/m³)
100
90
80
70
60
50
40
30
20
10
0
-10
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria


SR5 - PM2.5
PM10 (µg/m³)
100
90
80
70
60
50
40
30
20
10
0
-10
Jan
Jan
Mar
Apr
May
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
incremental
cumulative
criteria