Lot 4 Binningup Road, Binningup, Dust Monitoring and Management

Final Plan

Version 1

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Lot 4 Binningup Road, Binningup, Dust Monitoring and Management

Final Report

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Signature		

Deanna Tuxford

Executive Summary

The GM Giacci Family Trust (the applicant) is proposing to extract limestone from a 26 hectare (ha) area (herein referred to as the subject site) located on Lot 4 Binningup Road, Binningup (refer to Figure 1-1). The subject site is located in the municipality of the Shire of Harvey, approximately 1 km south-east of Binningup and approximately 1 km west of the Forrest Highway.

A Dust Management Plan (DMP) for the site has been prepared (Accendo Australia, 2020) outlining the nature of the operations and key dust sources, as well as the proposed dust management measures proposed to be implemented.

Given the relatively close proximity to Binningup community and current community concern expressed toward the quarry, amendments to the DMP are proposed to account for both proactive and reactive dust management responses.

In addition an ambient monitor is proposed to be installed and operated (on the boundary of the premises) to inform the implementation of dust controls and the response to potential dust events prior to impacts being experienced in the community of Binningup. As there is currently no air quality monitoring in this area, a dust monitor is planned to be installed prior to quarry operations commencing.

The purpose of this revised DMP is to document the dust control mechanisms that are proposed for Lot 4, and the plans to minimise the potential for impact from the operation of the quarry on the nearest receptors in the Binningup community, particularly from fugitive dust emissions from the limestone extraction operations.

The basis of the DMP is summarised in Table ES 1.

Table ES 1: Dust Management Plan Summary

Operational Dust Management Plan for Lot 4 Quarry Operations - Summary	
Aim	To manage dust at site to achieve acceptable performance criteria
Key sources	Wind erosion of exposed surfaces Wheel generated dust from transported limestone from pit to off-site on unsealed road surfaces Screening in the quarry Loading activities in the quarry • Dig and push limestone excavation • Lift and feed into mobile crusher • Loading limestone into trucks for off-site delivery Crushing in the quarry Scraper removing and moving topsoil in the quarry
Key management practice	Water truck used to apply water on surfaces (roads and cleared areas) where dust suppression is needed Vehicle movements at surface level will be restricted to designated roads

Operational Dust Management Plan for Lot 4 Quarry Operations - Summary	
	Vehicle speeds will be restricted to 30 km/hr on unsealed roads to minimise wheel generated dust Staging of cells and restricting the number of cells being actively worked. Surface stabilisation of topsoil stockpiles.
Relevant company procedures | documents	Company Dust Management Procedures • Dust Management – Site induction • Water truck – Scheduling and Maintenance • Water spray – Flow checks and Maintenance • Complaint response • Ambient monitor – Servicing and Maintenance
Key performance indicators or criteria	No unacceptable off-site impact as determined through event and complaint investigation
Monitoring	An ambient dust monitor running continuously to measure PM_{10} (data accessible in near "real-time") will be installed and operational during the first 12 months of operation of the quarry. The need for monitoring beyond this first year will be determined based on review of the monitoring results. The Binningup PM_{10} monitor will be installed on the western boundary of the premises and may be relocated as each stage/cell is worked. Data from the monitor will be used to inform operations for the purpose of: • Defining baseline concentrations of dust in the region before quarry activities commence. • Determining any potential changes or impacts resulting from the quarry operations. • Supporting proactive and reactive dust management to be incorporated into the operational procedures.
Trigger-Action-Response	**TRIGGER** *Level 1 – Low risk of offsite impact* • Visual trigger - Visible dust observed from activity, but not observed leaving the premises boundary • Meteorology trigger - Wind arc away from the Binningup PM_{10} monitor/residents • Monitored PM_{10} trigger - Rolling 1-hour average $PM_{10} < 90\ \mu g/m^3$ at Binningup PM_{10} monitor *Level 2 – Medium risk of off-site impact* • Visual trigger - Visible dust observed from activity • Meteorology trigger - Wind arc toward Binningup PM_{10} monitor/residents, and

Operational Dust Management Plan for Lot 4 Quarry Operations - Summary	
	○ Poor dispersion conditions - Wind speed <2 m/s OR ○ Wind erosion conditions - Wind speed >6 m/s • Monitored PM10 trigger - 2 consecutive 10-minute readings above 90 µg/m^3 at Binningup PM_{10} monitor *Level 3 – High risk of off-site impact* • Visual trigger - Visible dust observed from activity and across premises boundary • Meteorology trigger - Wind arc toward Binningup PM_{10} monitor/residents, and ○ Wind erosion conditions - Wind speed >8 m/s • Monitored PM10 trigger - 3 consecutive 10-minute readings above 90 µg/m^3 at Binningup PM_{10} monitor **RESPONSE ACTION** *Level 1 – Low risk of offsite impact* • Check forecast and current condition. • Check controls in place. ○ If not in place apply control *Level 2 – Medium risk of off-site impact* • Check forecast and current condition. • Check controls in place. ○ If not in place apply control • If a Poor dispersion event (i.e. calm)- ○ If wind is < 2 m/s prepare to stop dust generating activity until sources / work areas are wetted down • Wind erosion event- ○ If wind > 6 m/s prepare to stop dust generating works until sources / work areas are wetted down *Level 3 – High risk of off-site impact* • Check forecast and current condition. • Check controls in place. ○ If not in place apply control • If a Poor dispersion event (i.e. calm)- ○ If wind is < 2 m/s stop dust generating activity until sources / work areas are wetted down • Wind erosion event-

Operational Dust Management Plan for Lot 4 Quarry Operations - Summary	
	○ If wind > 8 m/s stop dust generating works until sources / work areas are wetted down or until wind speed drops
Reporting	To be confirmed by client • Annual environmental report (expected to be a requirement of the Part V Environmental Protection Act approval to operate a prescribed activity)
Corrective actions	To be confirmed by client • Appropriate actions will be issued and managed via the company's Trigger-Action-Response as outlined.

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1 Introduction

The GM Giacci Family Trust (the applicant) is proposing to extract limestone from a 26 hectare (ha) area located on Lot 4 Binningup Road, Binningup (refer to Figure 1-1). The site is located in the municipality of the Shire of Harvey, Western Australia, approximately 1 kilometre (km) south-east of Binningup and approximately 1 km west of the Forrest Highway. The site is positioned within 2 km of the coastline on land that has been previously cleared of native vegetation. It is zoned "Rural" under the Greater Bunbury Region Scheme and "General Farming" pursuant to the Shire of Harvey Local Planning Scheme No. 1 (Accendo Australia, 2020a).

The nearest sensitive receptors locations are the nearby residences at Binningup at least 680 metres (m) away, and the Rodgers Family residence 125 m away, shown in Figure 1-1. Other land uses in the immediate area (within a 2 km radius) includes residential (suburb of Binningup), sport and recreational venues (golf, lawn bowls, tennis), and agricultural activities.

1.1 Operational Dust Management Plan Objective

The purpose of the dust management plan (DMP) is to document the dust control mechanisms that will be in place for the life of the limestone extraction operations (approximately 5 years). The plan provides a standard set of working instructions and procedures to be adopted for dust suppression and response action on-site. It is assumed that all on-site personnel will be inducted to the plan, and will follow the procedures as outlined.

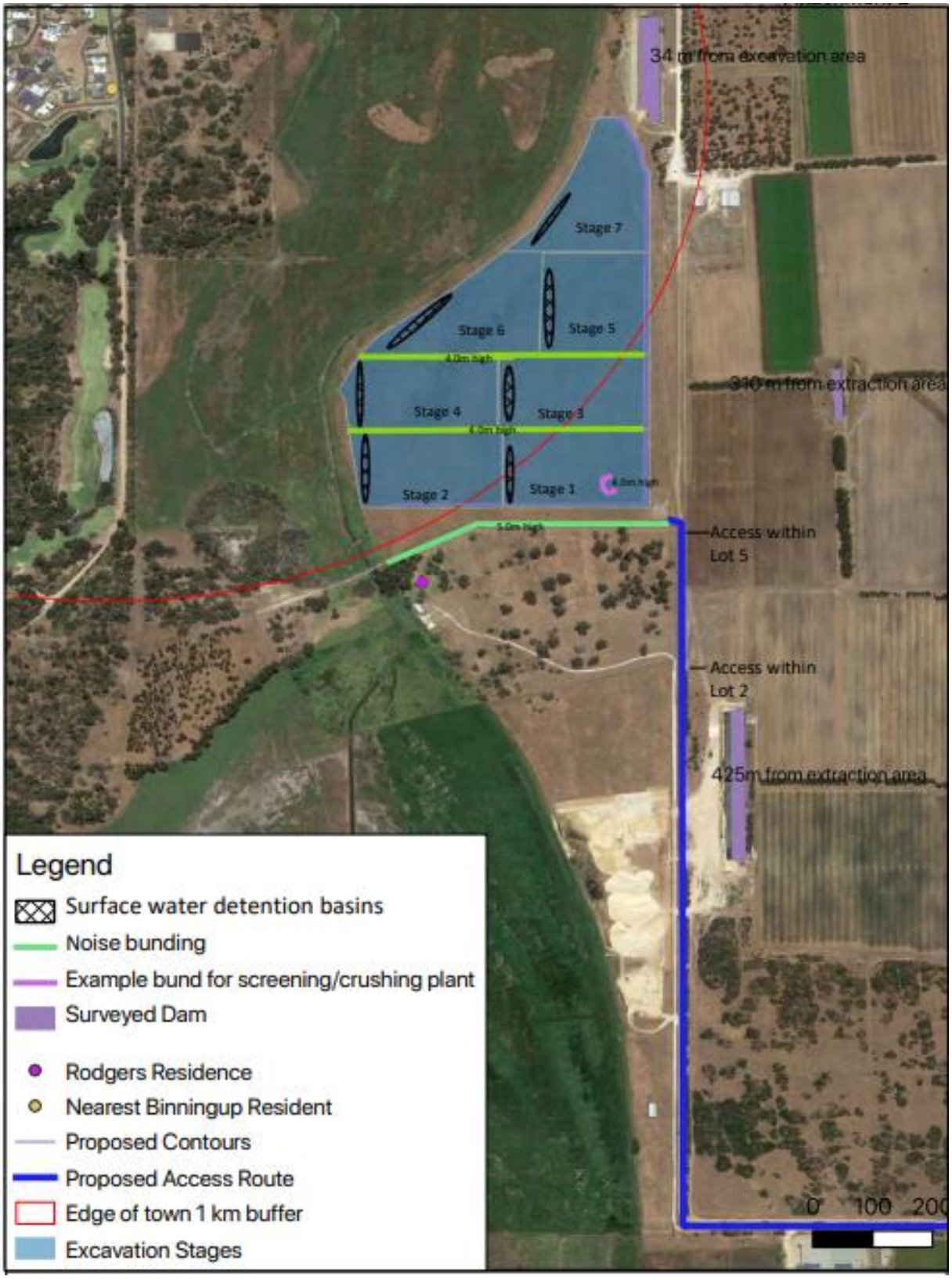

Figure 1-1: Project location and setting (Accendo Australia, 2020)

2 Operations Potential Dust Impacts

2.1 Background and Context

Dust is a generic term used to describe solid airborne particles generated and dispersed into the air. Airborne particles are classified by their aerodynamic size as Particulate Matter (PM), PM_{10}, $PM_{2.5}$ and Total Suspended Particles (TSP).

- PM_{10} – particles with an equivalent aerodynamic diameter of up to 10 microns (µm), and important for assessing potential impact on human health. These particles do not usually settle out of the atmosphere in the absence of another mechanism such as further reaction, nucleation or due to precipitation.
- $PM_{2.5}$ – particles with an equivalent aerodynamic diameter of up to 2.5 µm, and important for assessing potential impact on human health, and similar to PM_{10} are not likely to settle in close proximity to the source.
- TSP - All particles suspended in the atmosphere including fine, respirable particles (PM_{10} and $PM_{2.5}$) and larger particles that will settle out of the air and generally considered as having an aerodynamic diameter of up to 50 µm, and is important for assessing potential impact on amenity (dust nuisance). Particles in this size range are mainly generated by mechanical action, and will result from wind erosion of cleared surfaces when wind speeds are above around 8 m/s. These particles (at the higher size range) are also expected to be removed from the atmosphere (i.e. settle or deposit) within a few kilometres of a source.

There are a number of environmental factors that will contribute to the generation of dust at site, specifically the local climate features of wind speed, wind direction, rainfall and evaporation. In the absence of local monitoring data, the long term climate statistics for Bunbury (Bureau of Meteorology (BoM) Station number 009965) are considered to be generally representative of Binningup. The temperature and rainfall data for the period 1995 – 2020 are shown in Figure 2-1. The data indicates the possibility of rainfall occurring across all months in the year, with the highest mean rainfall occurring May to September. Winter temperatures are relatively cool, with mean summer temperatures generally above 25 degrees Celsius. While evaporation is not recorded at this station, the cycle of very few days in the summer months receiving rainfall and relatively high temperatures will lead to dry surface conditions and increases the tendency to be susceptible to wind erosion.

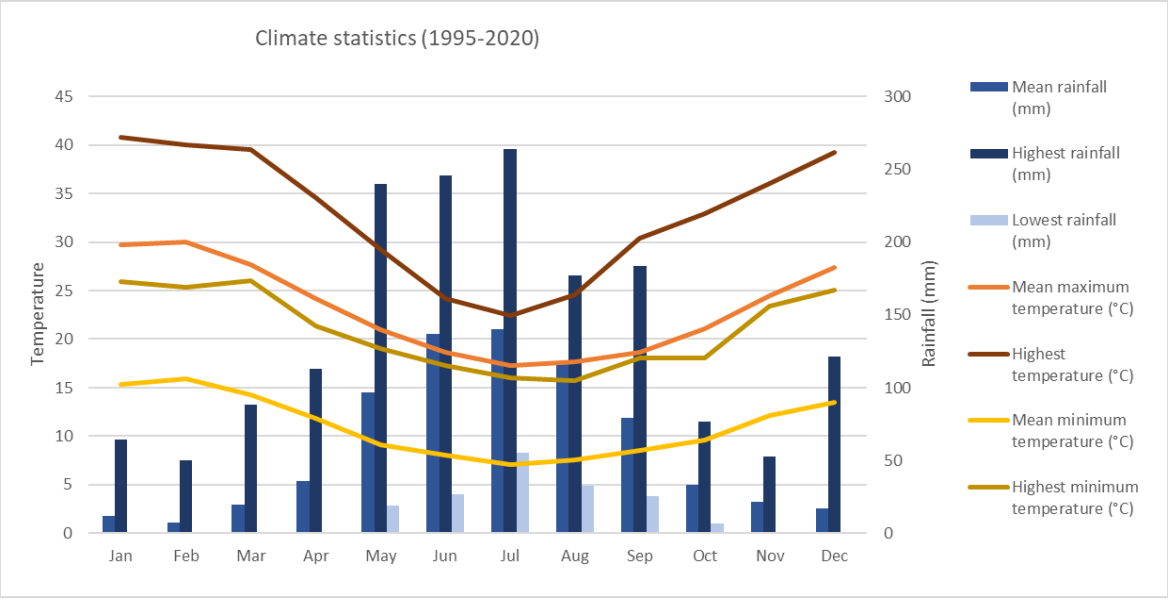

Figure 2-1: Long term climate statistics for Binningup (temperature and rainfall, as measured by BoM Bunbury)

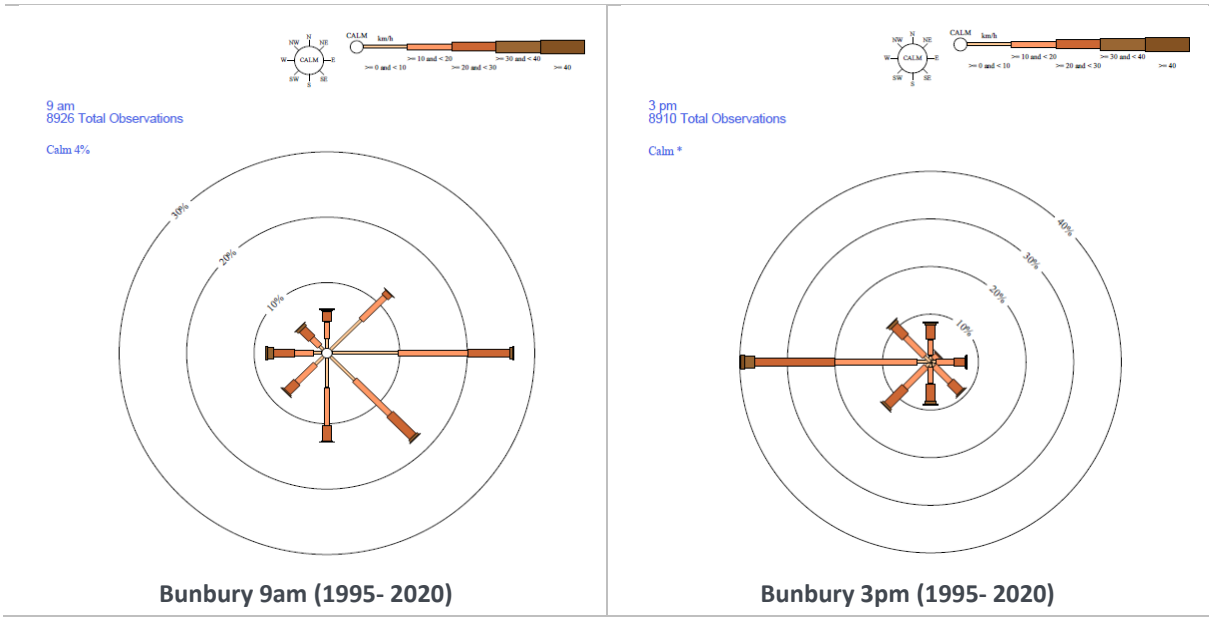

Figure 2-2: Long term climate statistics for Binningup (wind speed and direction, as measured by BoM Bunbury)

The long term annual average wind roses are shown in Figure 2-2. Seasonal differences are present in the wind speeds and wind directions at this BoM station, based on 9 am and 3 pm measurements (see Appendix A). The dominant feature in the morning wind rose is the wind from the east to south-east, and from the west in the afternoon. Wind speeds greater than 8 m/s (30 km/hr) are generally associated with dust lift-off from unsealed surfaces. The wind roses indicate wind speeds of this magnitude are frequently present.

There are also a number of factors that will influence the potential for impact on sensitive receptors, including the source-receptor pathway (i.e. the direction of the sensitive receptors compared to the location of the source and whether receptors are likely to be upwind or downwind of the prevailing wind direction) and the relative distance between the source and the receptor.

Guidelines for Western Australia (EPA, 2005) indicate a separation of distance of 500 m between screening activities and sensitive receptors and between 300-500 m for limestone extraction (no grinding and milling) and sensitive receptors, to reduce the potential for dust impacts. The guideline notes that “in most cases, land use conflicts resulting from industrial emissions are not expected where the generic separation distances are maintained.” Where the separation distance is less, then it is necessary to review and ensure that there are appropriate controls in place such that the potential dust sources are managed and controlled at source, as has been the approach taken for Lot 4.

2.2 Sources of dust

2.2.1 Non-project related (existing) particulate (dust) sources

Other land uses in the immediate area (within a 2 km radius) of Lot 4 that have the potential to contribute particulate material (dust) includes the residential area of Binningup (smoke from wood heaters, vehicles emissions), sport and recreational venues (golf, lawn bowls, tennis courts with unsealed access roads and areas),

and agricultural | horticultural activities which will have a seasonal component linked to the growing and cropping cycle. Being located on the coast, the area will also be influenced by marine aerosols (sea salt) especially during strong westerly winds. The area will also be seasonally influenced by particles derived from fires (both locally and regionally) as a consequence of prescribed or controlled burning activities as well as wildfires.

In summary, the existing dust sources in the local area that are not associated with the quarry include:

- dust entrainment due to vehicle movements along unsealed public roads
- episodic emissions from local vegetation/prescribed burning (e.g. grass and bushfires)
- marine aerosol (close proximity to coastline)
- high wind events
- seasonal emissions from residential wood burning fires
- local agricultural activities
- vehicle emissions from vehicle movements along public roads.

2.2.2 Project related particulate (dust) sources

The sources of dust in relation to the quarry activities were identified through the initial DMP (Accendo Australia, 2020) as being:

- Topsoil stripping by a scraper
- Earthworks during excavation/limestone extraction activities by front end loader
- Loading and transportation of material – topsoil, overburden and limestone
- Crushing and screening of limestone
- Stockpiling of material - topsoil, overburden and limestone
- Limestone loading and transport off-site
- Vehicle movement within the site and along unsealed road surfaces (transport route)
- Wind erosion of exposed surfaces

The excavation of the limestone itself is not expected to be a significant source of dust emissions given the typically moist nature of the material. Further, crushing and screening of the limestone does not generally produce significant dust as the limestone remains moist, and the activity will be undertaken within the pit. In-pit operations also tend to generate less dust than surrounding activities due to the reduced airflow within the pit. The removal and replacement of topsoil material has a high risk associated with dust generation due to the large volumes of material involved and the potential for lower levels of soil moisture. Each source has been considered in terms of annual emission estimation, both in the absence of control and with the proposed dust control, in Section 2.4.

2.3 Potential dust impact

Dust has the potential to impact the environment, health and welfare of the community, as well as the local amenity, causing a nuisance to surrounding land users. Therefore managing air quality for the protection of human health and amenity (including nuisance) requires consideration of dust in two contexts:

- Health impacts, as demonstrated by the concentration of dust measured as particles that could enter the human respiratory system, and due to their small size enter the lungs (i.e. PM_{10} and $PM_{2.5}$).
- Amenity, as demonstrated by dust that is visibly leaving the site or dust that has settled (deposited) on surfaces (i.e. deposited dust and TSP).

Ambient air quality standards and guidelines are the numerical values generally adopted as the measure of acceptable air quality. These are set out in Table 2-1 for information purposes.

Table 2-1: Summary of Adopted Assessment Criteria

Parameter	Air quality assessment criteria	Protection value	Reference
TSP	90 µg/m^3 (24-hour average)	Amenity	DWER (2019)
PM_{10}	50 µg/m^3 (24-hour average)	Heath	NEPM (NEPC, 2016)
	25 µg/m^3 (annual average)		
$PM_{2.5}$	25 µg/m^3 (24-hour average)		
	8 µg/m^3 (annual average)		
Deposition	4 g/m^2/month (annual average)	Amenity	EPAV (2007)

It should be noted that there are challenges in evaluating the potential impact on amenity, as amenity is a subjective value, and people generally have different tolerances to dust levels. Perception of dust can therefore lead to community complaints at levels lower than the adopted criteria. Unreasonable amenity impacts may occur due to regular dust events over several weeks leading to a gradual build-up of dust on surfaces, or may be a result of short period dust events of very high concentrations which cause rapid build-up of dust on surfaces.

These ambient air quality standards and guidelines are set to account for all contributing dust sources in the airshed. By definition, and intention, they are not suitable as dust management response trigger values.

The nearest community sensitive receptors to Lot 4, are summarised in Table 2-2, noting that there is one receptor within the separation distance guideline (at approximately 125 m). The next nearest receptor is approximately 680 m (ie. beyond the guideline distance and therefore not expected to be unreasonably impacted by dust from the quarry). This notional receptor location is the closest point of the Binningup township.

Table 2-2: Nearest sensitive receptors (Accendo Australia, 2020)

Resident No.	Receptor	Separation distance (m)	Note
1	Rodgers Family	125 m	Written agreement in place. Location is influenced by 139 ha horticultural land to the immediate east and existing limestone quarry 250 m south.
2	Binningup residents	680 m	This is the minimum separation distance to a resident and takes into account the seven Stages (cells)

A set of good practice design features have been incorporated into the design of the quarry which will effectively reduce the potential for dust impact. These design features include:

- Quarry design is for seven separate cells, with no more than two cells open or being worked at any point in time – this effectively reduces the potential area open and susceptible to wind erosion factors.
- The crushing and screening plant is a mobile unit in that it will be relocated to each working cell ensuring that there is minimal distance for material movement in pit. It will be positioned to maintain a 1 km

separation distance between the unit and the nearest Binningup residence irrespective of the cell being worked, where possible.

- Excavation and processing will be carried out on the pit floor which is lower than natural ground level, allowing for a degree of dust retention within the pit.
- Construction of a 4 m high bund around the crushing and screening plant to assist in retaining dust in the pit. The bund will be seeded with grass to minimise surface exposure to wind erosion.
- Water truck on-site when operating the quarry

Conventional dust management measures have been incorporated into the operational plan for the quarry. These measures, in conjunction with good operating practice, are expected to deliver emissions that do not present unreasonable increases above existing background dust levels at the sensitive receptors.

To account for community concern, a further layer of dust management control will be achieved at site through adopting a set of "Trigger" values that will guide the implementation of dust response actions in a tiered response. The tiered response is intended to ensure that the dust from the operations and site is identified and addressed appropriately and in a timely manner so as to minimise the potential for impact on the Binningup community. The Trigger-Action-Response is outlined in Section 3, and will be supported by ambient air quality monitoring at the boundary of the quarry operations.

2.4 Dust emissions estimation

The dust generating emission sources associated with the project, and the estimate of emission from these activities is summarised in Table 2-3. The detailed basis of estimation is provided in Appendix B.

Emission estimates indicate the potential for wind erosion from exposed areas of the quarry pit itself and other exposed areas and dust generated from the screening plant are the most significant source of dust emissions from the project, as shown in Figure 2-5. The influence of estimated operating hours is clearly seen in Figure 2-4, compared to the potential for wind blown dust over the year. A conservative approach has been applied to the emission estimates.

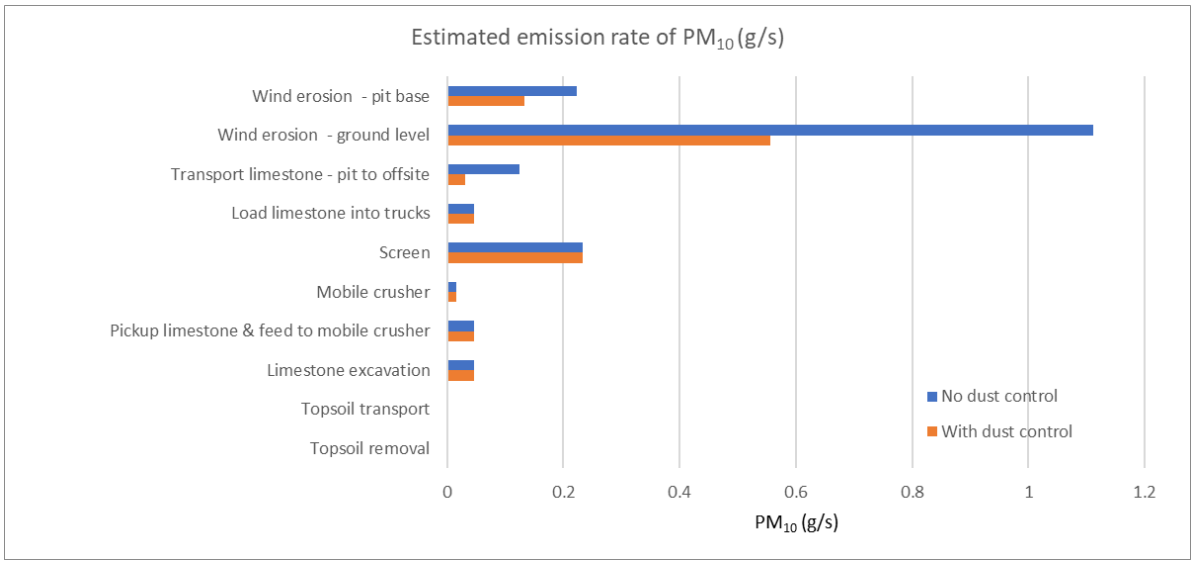

Figure 2-3: Estimated emission rate for dust source contribution by project activity (with and without dust control)

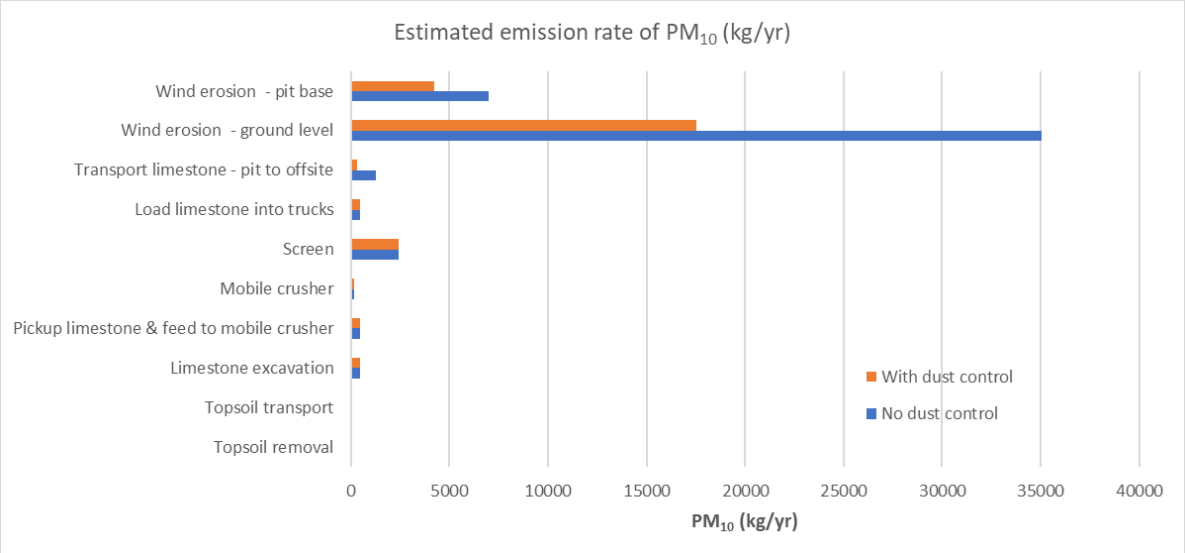

Figure 2-4: Estimated annual emission for dust source contribution by project activity (with and without dust control)

Table 2-3: Dust source emissions estimation – kilograms per year(kg/yr)

Source	Activity	Without dust control			With dust control			Control applied	Emission Reduction
		TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$		
Scraper (stripping topsoil)	Topsoil removal	94	24	4	47	12	2	Scraper on topsoil naturally/artificially moist	50%
Scraper (travel mode)	Topsoil transport	100	14	2	50	7	1	Watering	50%
Loader	Limestone excavation - dig and push limestone down excavation face	1,000	480	72	1,000	480	72	No control	0%
	Rubber tyred loader pick up limestone and feed to mobile crusher	1,000	480	72	1,000	480	72	No control	0%
Crusher	Mobile crusher	400	160	24	400	160	24	Bund (wind break)	0%
Screen	Screen	3,200	2,400	360	3,200	2,400	360	Bund (wind break)	0%
Loader	Load limestone into trucks	1,000	480	72	1,000	480	72	No control	0%
Wheel-generated dust	Transport limestone - pit to offsite	4,344	1,282	192	1,086	321	48	Level 2 watering (haul roads)	75%
Wind erosion of exposed area	Wind erosion of exposed area - ground level	100,114	35,040	5,256	50,057	17,520	2,628	Watering	50%
	Wind erosion of exposed area - pit base	20,023	7,008	1,051	12,014	4,205	631	Wind erosion - vegetation established but not sustaining	40%

Figure 2-5: Relative dust source contribution by project activity

2.5 Impact Analysis

The dust generating emission sources associated with the project, and the potential environmental, health and amenity impacts associated, are summarised in Table 2-4. The dust management controls incorporated into the design and operation of the Project are also indicated.

The primary mechanism for dust generation from the site is due to mechanical separation, wind erosion from exposed surfaces, and wheel action. The main control mechanism is the application of water, protection from prevailing wind and exposed surface stabilisation.

Table 2-4: Dust impact analysis

Dust source	Dust generating activity	Potential Impact	Dust control by design	Dust control through management
Topsoil stripping and other earthworks (other than limestone extraction)	Bulldozer or front end loader (FEL) used to remove the topsoil by pushing it into windrows. Overburden pushed to perimeter to form bunding around the active area.	Wheel/track-generated dust from bulldozer/FEL moving dry surface material. Dust may impact on nearby sensitive receptors in close proximity to the processing plant[1] • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors.	Staging will minimise the disturbance to the land providing a staged clearing excavation and rehabilitation program that will move across the site. Avoid stripping topsoil when it is saturated or when very dry. Avoid stripping topsoil when winds are > 8 m/s irrespective of wind direction. Establish a 4 m high bund around the crushing and screening plant. Bunds seeded with grass to assist with visual amenity and reduce potential dust emissions.	Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast (> 8 m/s) will lead to a review of site activities and works may be suspended if deemed appropriate. Topsoil stripping and bund construction shall not commence during the following conditions: • Winds in excess of 8 m/s • Northerly or north-easterly to south easterly winds. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episodes. Watering of surface area prior to commencing topsoil stripping and bund construction - by water truck.
Limestone extraction	Extraction by front end loader	Wheel/track-generated dust from bulldozer/FEL moving dry surface material. Dust may impact on nearby sensitive receptors in close proximity to the processing plant • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors.		Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast (> 8 m/s) will lead to a review of site activities and works may be suspended if deemed appropriate. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episodes. Watering of surface area prior to commencing excavation - by water truck. Water trucks are to be available at all times during quarry activities to water the site on observation of dust lift.
Loading and transportation of material	Loading limestone in pit by front end loader. Transporting on unsealed roads out of pit and offsite.	Wheel/track-generated dust from bulldozer/FEL moving dry surface material. Dust may impact on nearby sensitive receptors in close proximity to the processing plant • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors	Minimise drop distances when loading and handling limestone to reduce dust generation Limestone material expected to be naturally moist prior to and during loading Truck loads will be covered with tarpaulin or similar. Road surface design, preparation and construction Transport of dust-prone material will be via covered trucks or dampened prior to transport to prevent dust lift during transport.	Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast (> 8 m/s) will lead to a review of site activities and works may be suspended if deemed appropriate. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episode. Watering of surface area prior to commencing transport - by water truck. Water trucks are to be available at all times during quarry activities to water the site on observation of dust lift. Road surface maintenance.

[1] Mobile crushing and screening plant.

Dust source	Dust generating activity	Potential Impact	Dust control by design	Dust control through management
Crushing and Screening	One FEL operating - push ore delivered and load to crusher. Wind erosion. Operation of crushing and screening plant.	Wheel-generated dust from FELs moving ore in pit. Dust may impact on nearby sensitive receptors in close proximity to the processing plant • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors at Binningup.	Crushing and screening plant to be located in designated areas 1 km from Binningup residents at all times, where possible. Installing plant/equipment sheltered from prevailing winds (concealed at the lowest contours of the quarry/pit stage) - Excavation and processing will be conducted on the floor of the pit, 3 m below natural ground level behind the excavation face. Establish a 4 m high bund around the crushing and screening plant. Bunds seeded with grass to assist with visual amenity and reduce potential dust emissions. *Water sprays to be considered by the client.*	Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast from the east to southeast will lead to a review of site activities and works may be suspended if deemed appropriate. Watering of surface of work area with water truck. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episodes.
Stockpiling	Building stockpile, reclaiming from stockpile, wind action on stockpile.	Dust may impact on nearby sensitive receptors in close proximity to the processing plant • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors at Binningup.	Long term stockpiles seeded with grass to assist with visual amenity and reduce potential dust emissions. Temporary bunds, stockpiles and exposed areas will be watered and stabilised as required. Stabilisation techniques that will be considered depending on environmental conditions will include hydro-mulching. In pit crushing, screening and handling. Stockpiling limited to in pit. Stockpiles, where possible, will be limited to the anticipated cubic volume/vehicle movement for cartage on the following operating day.	Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast from the east to southeast will lead to a review of site activities and works may be suspended if deemed appropriate. Minimise material drop-height during stockpile building. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episodes.
Vehicle movement	Vehicle movements within the site, and exiting site	Dust may impact on nearby sensitive receptors in close proximity to the processing plant, entrance and exits points to site and unsealed road surfaces • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors at Binningup. Material may be tracked off site.	Speed limits onsite. Vehicle speeds will be restricted to no more than 30 km/hr on the site to minimise dust lift off. Site traffic will be restricted to designated internal access ways to prevent disturbance of vegetated or natural areas - designated roads. Loads leaving site are covered.	Daily forecast and works planning to consider wind speed and wind direction forecast • high wind speeds forecast from the east to southeast will lead to a review of site activities and works may be suspended if deemed appropriate. Water trucks are to water down unsealed roads during operation to reduce dust lift. Dust episode management procedure to be reviewed and if necessary, slow or temporarily stop site operations during high dust episodes.
Wind erosion of exposed surfaces	Stockpile surface and working face Un-stabilised surfaces Access roads (other than haul roads)	Wind erosion of open and unsealed areas. Wind speeds above 4 m/s will generally disturb the soil surface layer causing dust to disperse into the air. Dust may impact on nearby sensitive receptors in close proximity to the processing plant • Settling on sensitive vegetation • Settling on surfaces • Sensitive receptors at Binningup.	Onsite watercart with a capacity of 15,000 L. Water will be sourced from an onsite dam located directly to the north of the extraction area. Average 8 movements per day. Rehabilitation will be undertaken sequentially and as soon as reasonably possible to reduce the exposed areas. Where rehabilitation is delayed (i.e. staged completion occurs in summer), additional dust control measures will be considered.	Water trucks are to water down unsealed surfaces during operation to reduce dust lift. In dry conditions with predicted strong winds (> 8 m/s), watering will occur at the end of each working day to minimise dust generation outside of working hours.

Dust source	Dust generating activity	Potential Impact	Dust control by design	Dust control through management
			This includes the application of a paper-water mixture to exposed surfaces to create a temporary crust and prevent wind-borne dust lift-off. Temporary bunds, stockpiles and exposed areas will be watered and stabilised as required. Stabilisation techniques that will be considered depending on environmental conditions will include hydro-mulching. Areas of land cleared and the period of time they remain cleared are to be kept to a minimum. Protect topsoil stockpiles from erosion. Avoid long term stockpiling of topsoil by using it to rehabilitate worked out areas immediately. Stabilise temporarily disturbed land as soon as practicable (i.e. spreading of aggregate, hydro mulching or other material). Restrict access to cleared areas during and after clearing of vegetation to minimise unnecessary disturbance and generation of dust. Stabilise temporarily disturbed land as soon as practicable (i.e. spreading of aggregate, hydro mulching or other material).	

3 Dust Monitoring and Response Program

Ambient dust monitoring will be undertaken during the first 12-months of the quarry being operational. **The purpose of the ambient monitoring is to inform operations of an increasing trend in dust levels in the vicinity of sensitive receptors at Binningup[2].**

In summary, the monitoring program includes:

- Visual monitoring by site personnel
- Single ambient monitoring location on the boundary of the premises
  - Continuous real-time weather monitoring (wind speed and wind direction)
  - Continuous real-time PM10 monitoring (ES-642 Dust monitor (type – nephelometer))
- Wind speed and wind direction alert levels (to indicate when winds are blowing such that sensitive receptors would be downwind of Lot 4 excavation activities
- PM10 alert levels (to indicate when measured levels are approaching pre-determined management levels and therefore initiate (trigger) pre-determined management responses.

As there is currently no local ambient monitoring data in the immediate vicinity of Lot 4 or the township of Binningup, the intent will be to install the ambient monitor as soon as practicable, and prior to commencing quarry operations. This will improve the understanding of existing ambient air quality (PM_{10}), which is expected to be influenced by the close proximity to the coast (marine aerosols) and neighbouring agricultural / cropping activities, so as to confirm suitability of Trigger levels.

Monitoring will be in place for the first 12-month period of the quarry being in operation, following which the monitoring results will be reviewed to determined if ongoing monitoring is needed.

3.1 Local meteorology monitoring

Meteorological conditions have a direct influence on dust generation. Periods of little to no wind speed can prevent the dissipation and dispersion of dust in the vicinity of a source, and periods of high wind speed can increase the generation of dust due to the action of wind erosion on exposed surfaces.

Local meteorological conditions will be monitored to assist in planning operational activities and dust mitigation and management responses, and to assist in dust incident investigations. Wind direction and wind speed will be measured continuously, and taken into consideration in planning surface activities including dust suppression, specifically:

- Proactively – review daily weather forecast for predicted wind conditions in the direction of Binningup
  - When winds are forecast above 4 m/s and to be in the direction of Binningup, the day/shift activities will ensure all dust controls are operational
- Reactively – review monitored data (live 10-minute average data) as part of
  - Response when in receipt of wind speed trigger alert or high dust level alert

[2] Note that purpose of monitoring will influence the design of the monitoring program. It has been assumed that given the proximity of the Binningup community and the presence of other dust sources in the area, that a continuous monitor with wind speed and wind direction will facilitate the directional delineation of dust likely or not likely being attributable to the quarry. Installing the monitor prior to the commencement of quarry activities will also facilitate the relative baselining of existing PM_{10} levels in the area.

- Routine visual inspection
- In response to a notification, complaint or as part of a dust investigation.

3.2 Local particulate monitoring

An ambient dust monitor (nephelometer) measuring particles in the size of 10 microns in aerodynamic diameter (PM10) continuously on a 10-minute average basis, will be installed at a nominated location on the western edge of the premises boundary. The purpose of the monitor is to provide near "real-time" data to inform operational response to changing dust conditions associated with the operations. Wind speed and wind direction is also measured at this site. Monitoring will be in place for the first 12-month period of the quarry being in operation, following which the monitoring results will be reviewed to determined if ongoing monitoring is needed.

OPTION for client consideration - as the excavation will be staged over time, the single monitor will be most effective for the program when it is aligned between the active quarry cell/stage and the community of Binningup. To achieve this consideration may be given to relocate the monitor as the quarry excavation progresses from Stage 1 through to Stage 7. This option could be pursued in future if the single monitor approach is shown to be inadequate for actual dust levels, or if monitoring is determined to be necessary beyond the first 12-month period of quarry operation.

OPTION for client consideration - as the excavation will be staged over time, the single monitor could be supplemented with video monitoring, along the western boundary. This would be intended to capture evidence of dust departing the site boundary, and could be used to supplement (reduce) the frequency with which work stoppages may be required due to high wind speeds, and as part of the dust incident investigation or complaint resolution process. This option could be pursued in future if the single monitor approach is shown to be inadequate for actual dust levels, or if monitoring is determined to be necessary beyond the first 12-month period of quarry operation.

3.3 Visual observation of dust

The ambient monitoring will be supplemented with site personnel visual observation of dust. Visual diligence is an instantaneous checking mechanism and provides the benefit of any issues being observed can be acted on promptly, irrespective of the measured dust levels at the time. Observation of dust and the source supports the deployment or initiation of targeted action to address the dust directly and promptly. The practice of visual observation will continue for the duration of the quarry operation.

3.4 Trigger-Action-Response to Alerts

Initial "trigger-action-response" levels have been proposed to provide a tiered approach to operations management and mitigation of potential dust impact on the community of Binningup. A tiered approach is adopted, placing emphasis on dust management of the actual dust sources. The tiered approach is also applied with the intention of providing a balance between allowing adequate time to implement management changes, without acting prematurely or inadvertently, leading to unnecessary change in the operational daily plan.

Three metrics are proposed to be used initially, each with a three-tiered trigger based on low, medium and high risk of an off-site dust impact. The three metrics used are:

- Visual monitoring for dust lift-off – the principle is to manage dust from each activity being undertaken in the quarry. Dust seen to be leaving the work area or source (e.g. haul roads, pit, loading/stockpiling, open areas) will trigger a required action.

- Meteorological monitoring – includes the use of current and forecast weather conditions (wind speed, wind direction and rainfall) to plan and schedule works to avoid (where possible) windy conditions where the wind is blowing from the east to south-south-east sector directly towards Binningup community; and where this is not possible, implementing additional dust mitigation controls particularly increasing the water application on site.
- Ambient dust monitoring – operating a continuous dust monitor (nephelometer, PM10) on the western boundary of the operations to provide real-time data on dust levels, including automated alerts (SMS and email to critical site personnel) when reaching each Trigger level.

The initial trigger levels proposed are shown in Table 3-1, and the associated response actions proposed are set out in Table 3-1. These would guide the implementation of a series of actions intended to reduce the likelihood of an impact (i.e. elevated PM_{10}) occurring in the direction of the Binningup community.

As with any proposed trigger, a review process is necessary to ensure the ongoing suitability and effectiveness of the trigger framework. This will support the review and refinement of the values and conditions that are most applicable to achieving the dual desired outcome of minimising the likelihood of potential impact at the Binningup community, and minimising the initiation of unnecessary action (i.e. false alerts).

An initial review of the triggers will be carried out within the first three months of the quarry commencing operations. A further review will be undertaken after the first 12 months of the quarry being operational, and will done in conjunction with the ambient PM10 monitoring data review.

3.5 Complaints system

The community's concern with potential dust generation and impacts from the operations is acknowledged and has been considered in revising the DMP.

Good communication is essential to good working relationships with the community and will help to ensure the effective management of any impacts of a quarry. Central to this will be to have in place an effective complaints handling process.

A Complaints Register will be maintained. The following information will be recorded:

- the date and time of the complaint
- who the complaint was from
- the specific issue/s raised in the complaint
- investigations undertaken into site activities and cause of dust emission
- the actions taken to address the specific issue/s raised in the complaint.

Any complaint that is received in relation to current conditions, will be addressed in line with the Trigger-Action Response protocol set out in Table 3-1, and will be considered a Level 2 or Level 3 incident for investigation.

Any complaint received retrospectively will be investigated accordingly.

Table 3-1: Initial Trigger Values

Trigger Level	Trigger values and Trigger-Action-Response		
	Visual observations of dust	**Meteorology (winds)**	**Monitored[3] PM_{10}**
Level 1 Low Risk of Off-site Impact	Visible dust observed from activity	Wind arc away from Binningup (160 clockwise to 60 degrees)	Rolling 1-hour average <90µg/m^3 and wind arc away[4] from Binningup (160 clockwise to 60 degrees)[5]
Response	*Report and investigate as a potential "incident"* • *Check controls in place.* *If not in place apply control.*	*Poor dispersion conditions present or forecast.* *Report and investigate as a potential "incident"* • *Check controls in place.* *If not in place apply control.*	*Report and investigate as a potential "incident"* • *Check controls in place.* • *If not in place apply control.*
Level 2 Medium Risk of Off-site Impact	Visible dust observed from activity across site Visible dust observed leaving activity area(s)	Wind arc toward Binningup (60 to 160 degrees) Poor dispersion conditions • Wind speed < 2 m/s OR Wind erosion conditions • Wind speed > 6 m/s	2 consecutive 10 minute readings • > 90 µg/m^3 at boundary monitor and with a broad wind arc toward[6] Binningup
Response	*Report and investigate as an "incident"* • *Check controls in place.* • *If not in place apply control.* *Check forecast and current conditions for meteorology-* • *Check wind speed and wind direction* • *Rainfall* *Action in line with Meteorology response.*	*Increased potential for dust lift-off.* *Report and investigate as an "incident"* • *Check controls in place.* • *If not in place apply control.* *Poor dispersion event (i.e. winds are calm)-* • *If wind is < 2 m/s* ***prepare to stop*** *dust generating activities until sources / work areas are wetted down* *Wind erosion event-* *If wind > 6 m/s* ***prepare to stop dust generating activity*** *until sources / work areas are wetted down*	*Report and investigate as an "incident"* • *Check controls in place.* • *If not in place apply control.* *Check forecast and current conditions for meteorology-* • *Check wind speed and wind direction* • *Rainfall* *Action in line with Meteorology response.*
Level 3 High Risk of Off-site Impact	Visible dust observed leaving premises site boundary	Wind arc toward Binningup (60 to 160 degrees) Wind erosion conditions • Wind speed > 8 m/s	3 consecutive 10 minute readings • >90 µg/m^3 at Binningup monitor and with narrow wind arc toward Binningup monitor
Response	Report and investigate as an "incident". Locate source. Stop all activity until dust is suppressed at source. Do not resume normal works until wind speed reduces to 8 m/s.		

[3] Monitor is assumed to be positioned on the western boundary of the premises in alignment to Binningup. If the monitor is positioned closer to Binningup, then a lower PM trigger value will need to be specified.

[4] The wind arc "Away" from Binningup is considered to be wind blowing from the direction 160 degrees clockwise to north and to 60 degrees. Given the coastal location, it is expected that winds from the direction of the Indian Ocean will have the potential to trigger elevated levels of PM10 due to marine aerosol.

[5] Current dust emission limits applied in European countries and regions vary between 20 and 150 mg/m^3.day for ambient dust measured around quarries – no Australian reference.

[6] The wind arc "Toward" Binningup is considered to be wind blowing 60 degrees (clockwise) through to 160 degrees. A narrow arc may be determined once the monitor is in place, and will take into account the quarry cell being worked

4 Roles and Responsibilities

In order to be effective and efficient, dust management and mitigation needs to be an operations wide integrated activity. To this end the key roles, accountabilities and responsibilities are summarised in Table 4-1.

Table 4-1: Operational dust management plan – roles, responsibilities and accountabilities

Role	Responsibility
Asset Owner | Licensee	Ensure that operational dust management is integrated as part of business outcomes. Ensure personnel are aware of their obligations in relations to the implementation of the operational dust management plan. Ensure resources are available to achieve the commitments in the operational dust management plan. Implement the operational dust management plan.

Site Manager	Accountable for:
	
	• Implementation of controls to manage dust – suppression activities
	• Maintaining of equipment to ensure machinery does not cause unnecessary / excessive dust emissions
	• Ambient air quality monitoring
	  ○ Configure Trigger Alerts and review periodically for effectiveness
	  ○ Regularly review monitoring data
	  ○ Internal reporting of monitoring
	• Responding to Trigger Alert requiring action
	  ○ Investigate results indicating high dust levels
	  ○ Investigation response and resolution of dust event investigations and reporting, including
	  - Notification to Shire of Harvey
	  - Remedial action implemented within 2-hours of complaint verification
	  - Halting operations when remedial action does not resolve high dust levels
	• Audit operations success in implementing corrective actions responding to ambient monitoring alerts for dust management and dust mitigation

Site personnel - All	Ensure that operational dust management is integrated as part of daily work routine. Observations of visual dust are reported promptly. Implementation of action in response to trigger alerts are actioned promptly.

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6 Acronyms and Glossary

Acronym	Description
BoM	Bureau of Meteorology
BWh	Koppen-Geiger classification
C	Degrees Celsius (temperature)
CV	Conveyor
DWER	Department of Water and Environmental Regulation
EPAV	Environmental Protection Authority Victoria, Australia
ES-642	Nephelometer (dust monitor model)
ETA	Environmental Technologies& Analytics Pty Ltd
FEL	Front end loader
g/m^2/month	Grams per square metre per month
g/s	grams per second
h/yr	Hours per year
kg	kilogram
kg/t	kilogram per tonne
kg/yr	kilograms per year
kPa	kiloPascals
km	kilometre
m	metre
m/s	metres per second
mm	millimetre
Mt	Million tonnes
Mtpa	Million tonnes per annum

Acronym	Description
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NPI	National Pollutant Inventory
NSW	New South Wales
ODMP	Operations Dust Management Plan
PM	Particulate matter, small particles and liquid droplets that can remain suspended in air.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 10 µm or less.
PM_{10}	Particulate matter with an aerodynamic diameter of 2.5 µm or less.
ROM	Run of mine
t	Tonnes
t/h	Tonnes per hour
tpa	tonnes per annum
tph	tonnes per hour
TS	Transfer station
TSP	Total suspended particulates
µg/m^3	micro grams (one millionth of a gram) per cubic metre
µm	micrometre
USEPA	United States Environment Protection Agency

7 Appendices

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Appendix B - Emissions Estimation 24

Appendix A - Long term climate statistics – wind speed and direction

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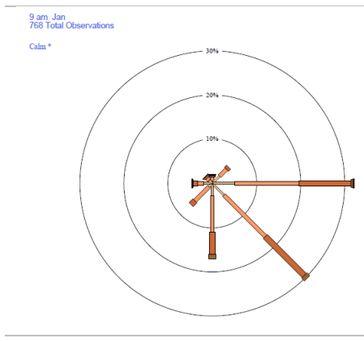	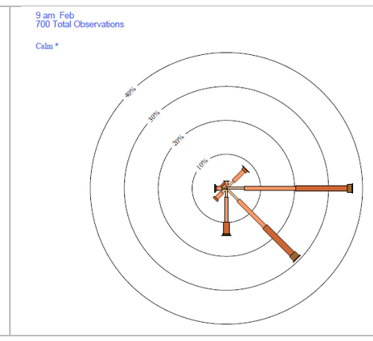	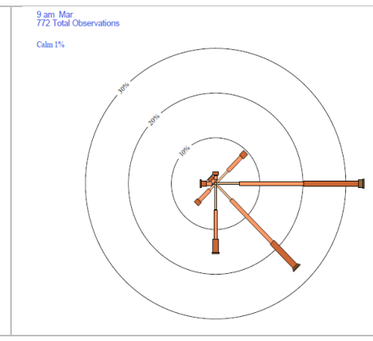	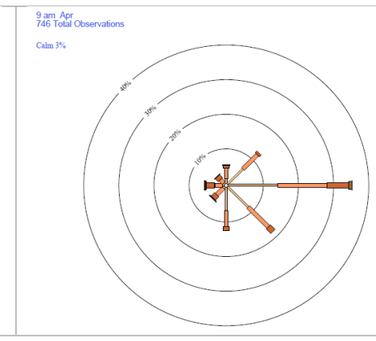	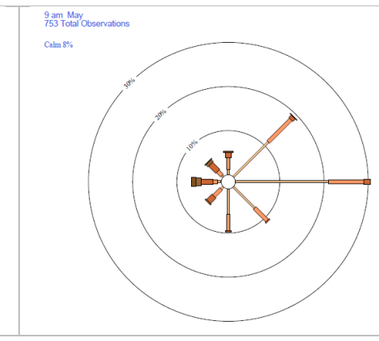	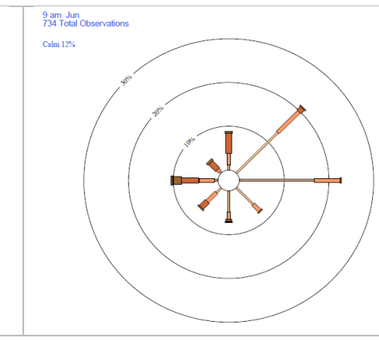
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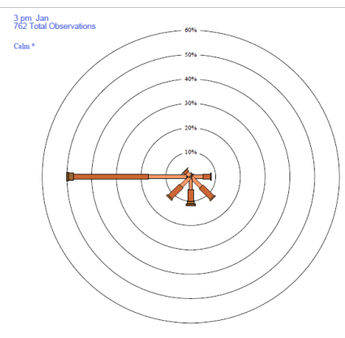	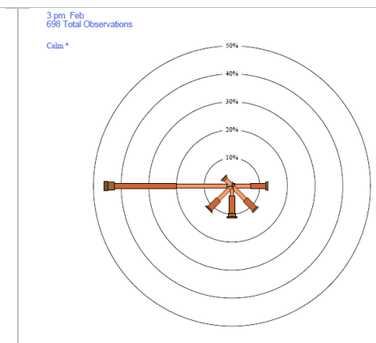	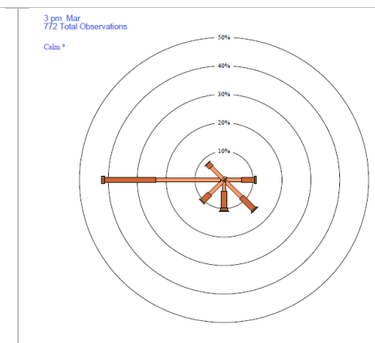	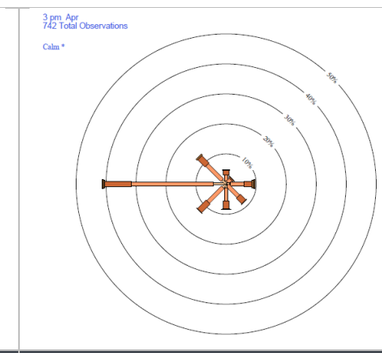	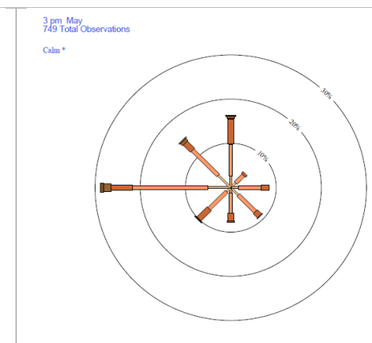	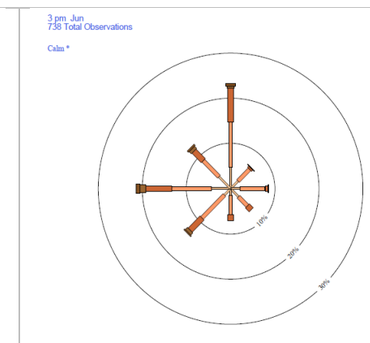
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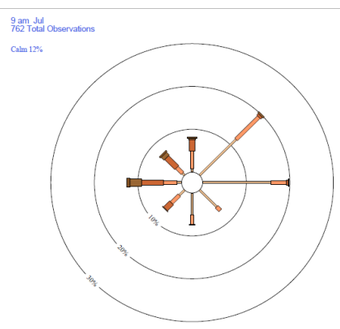	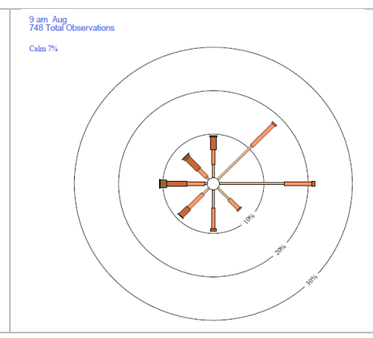	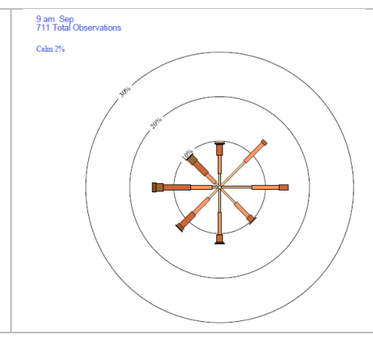	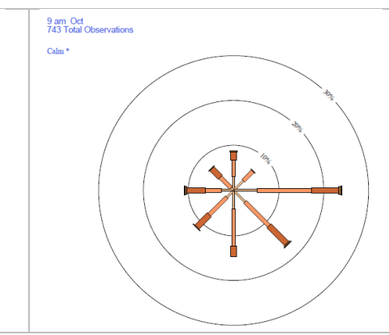	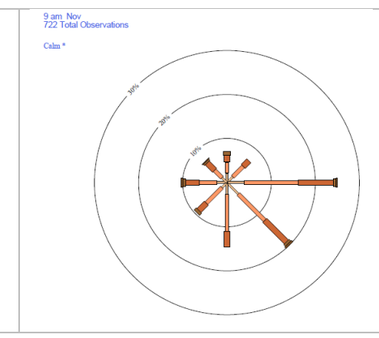	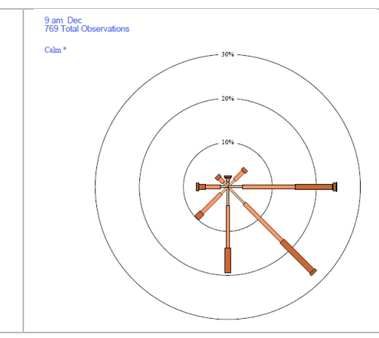
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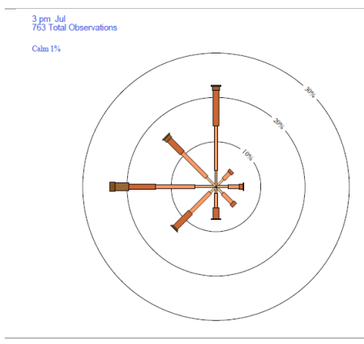	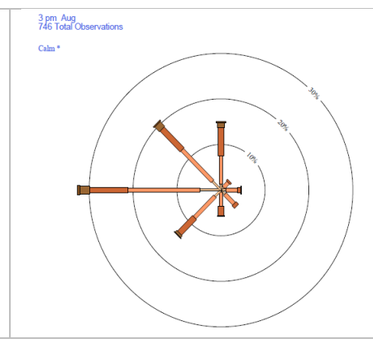	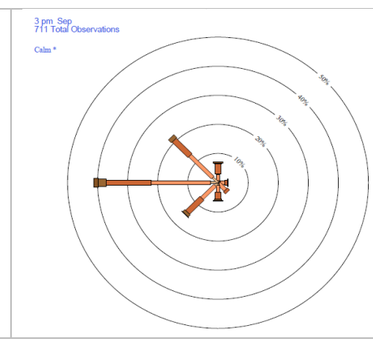	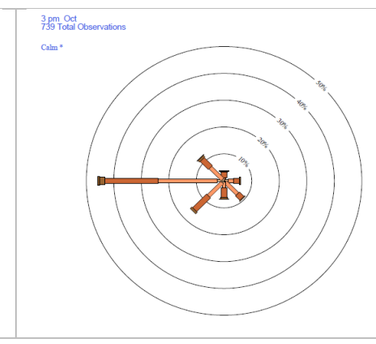	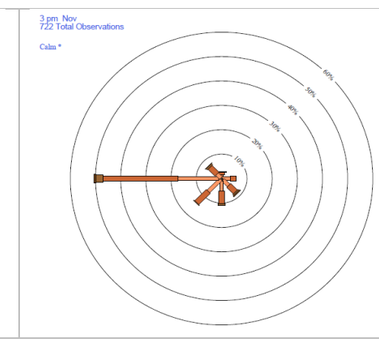	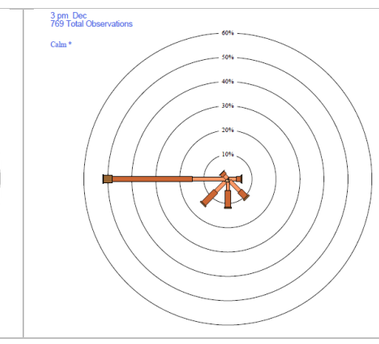

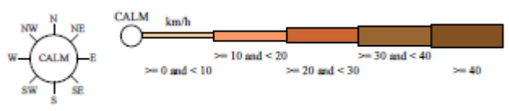

Appendix Figure 1: Climate statistic for Bunbury (BoM, 2020)

Appendix B - Emissions Estimation

			Emission Factors				Activity Rate		Op Hours	Uncontrolled emissions						Controlled emissions							
										Emission Rates (g/s)			Emission Rates (kg/yr)			Control		Emission Rates (g/s)			Emission Rates (kg/yr)		
Activity	Source	Source - Emission Factor	Units	TSP	PM10	PM2.5	Value	Units	hrs/yr	TSP	PM10	PM2.5	TSP	PM10	PM2.5	Description	Reductio	TSP	PM10	PM2.5	TSP	PM10	PM2.5
Topsoil removal	Scraper (stripping topsoil)	NPI for mining 1.1.13	kg/tonne	0.029	0.0073	0.0011	3,231	tpa	2,860	0.009	0.002	0.000	94	24	4	Scraper on tops	50%	0.005	0.001	0.000	47	12	2
Topsoil transport	Scraper (travel mode)	NPI for mining 1.1.12	kg/VKT	2.57	0.35	0.05	39	VKT/yr	2,860	0.010	0.001	0.000	100	14	2	Watering	50%	0.005	0.001	0.000	50	7	1
Limestone excavation - dig and push limest	Loader	NPI for mining 1.1.13	kg/tonne	0.025	0.012	0.0018	40,000	tpa	2,860	0.097	0.047	0.007	1,000	480	72	No control	0%	0.097	0.047	0.007	1,000	480	72
Rubber tyred loader pick up limestone and t	Loader	NPI for mining 1.1.13	kg/tonne	0.025	0.012	0.0018	40,000	tpa	2,860	0.097	0.047	0.007	1,000	480	72	No control	0%	0.097	0.047	0.007	1,000	480	72
Mobile crusher	Crusher	NPI for mining Table 3	kg/tonne	0.01	0.004	0.0006	40,000	tpa	2,860	0.039	0.016	0.002	400	160	24	No control	0%	0.039	0.016	0.002	400	160	24
Screen	Screen	NPI for mining Table 3	kg/tonne	0.08	0.06	0.0090	40,000	tpa	2,860	0.311	0.233	0.035	3,200	2,400	360	No control	0%	0.311	0.233	0.035	3,200	2,400	360
Load limestone into trucks	Loader	NPI for mining 1.1.13	kg/tonne	0.025	0.012	0.0018	40,000	tpa	2,860	0.097	0.047	0.007	1,000	480	72	No control	0%	0.097	0.047	0.007	1,000	480	72
Transport limestone - pit to offsite	Wheel-generated dust	NPI for mining 1.1.13	kg/VKT	3.91	1.15	0.17	1,111	VKT/yr	2,860	0.422	0.125	0.019	4,344	1,282	192	Level 2 watering	75%	0.105	0.031	0.005	1,086	321	48
Wind erosion of exposed area - ground leve	Wind erosion of exposed area	SKM (005) modfied Shao equation	kg/ha/hr	1.143	0.400	0.060	10	ha	8,760	3.175	1.111	0.167	100,114	35,040	5,256	Watering	50%	1.5873	0.5556	0.0833	50,057	17,520	2,628
Wind erosion of exposed area - pit base	Wind erosion of exposed area	SKM (005) modfied Shao equation	kg/ha/hr	1.143	0.400	0.060	2	ha	8,760	0.635	0.222	0.033	20,023	7,008	1,051	Wind erosion -	40%	0.3810	0.1333	0.0200	12,014	4,205	631