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ATLAS PROJECT
DUST MANAGEMENT PLAN

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ATLAS PROJECT
DUST MANAGEMENT PLAN

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1. INTRODUCTION

1.1 Project Description

Image Resources NL (Image) are planning to develop the Atlas Project; a mineral sand mine located approximately 170 km north of Perth and 18 km east of Cervantes in the Wheatbelt region of Western Australia (Figure 1). The project is intended to include an open-cut mine pit, processing plant, solar drying ponds, topsoil, overburden stockpiles and supporting infrastructure. The proposed project has an expected lifetime of three years and the pit will be mined and progressively rehabilitated in stages. The current design has an extent of approximately 3 km in length, 100 m to 600 m wide and up to a depth of 16 m (though could be extended to be 20m deeper).

1.2 Purpose of the Dust Management Plan

This Dust Management Plan (DMP) has been developed by Ramboll Australia Pty Ltd (Ramboll) on behalf of Preston Consulting for Image Resources to support the application of the construction and operation of the Atlas Project.

The Atlas Project dust assessment identified that the construction and ongoing mine operations have the potential to generate significant dust levels, which could impact on-site operations and nearby sensitive receptors.

This DMP aims to provide management procedures to mitigate potential emissions and exceedances of dust associated with the proposed Atlas Project.

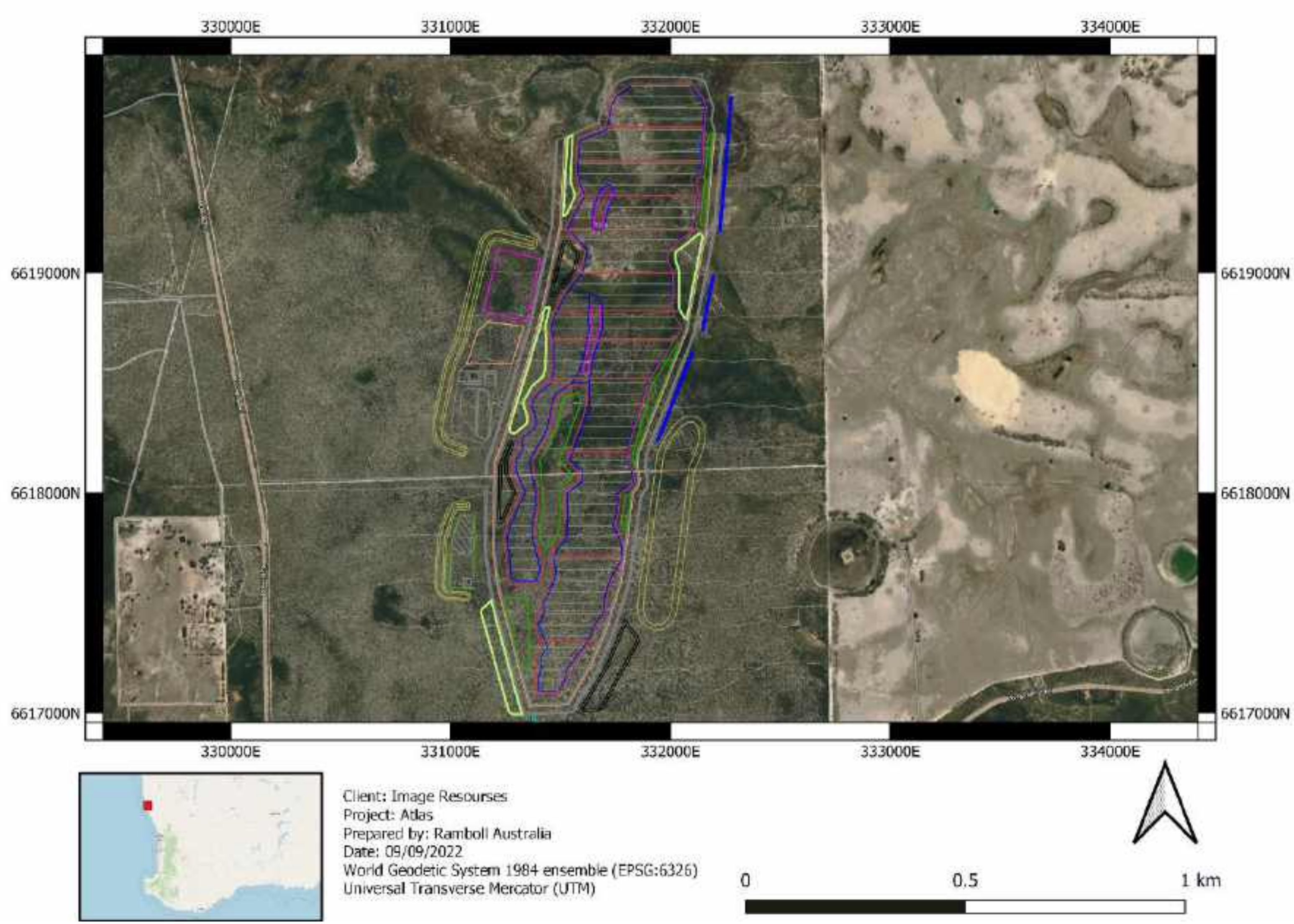

Figure 1: Atlas Project Location

2. POTENTIAL IMPACTS

2.1 Dust Composition

Particulate matter (PM) is generally defined as particles that can remain suspended in the air by turbulence for an appreciable length of time. PM can consist of a range of matter including crustal material, pollens, sea salts and smoke from combustion products. PM is commonly defined by the size of the particles including the following:

- Total suspended particulates (TSP), which is all particulate matter with an equivalent aerodynamic particle diameter below 50 µm diameter;
- PM_{10} is particulate matter below 10 µm in equivalent aerodynamic diameter; and
- $PM_{2.5}$ is particulate matter below 2.5 µm in equivalent aerodynamic diameter.

TSP contains PM_{10} and $PM_{2.5}$ fractions and is normally associated with amenity and nuisance impacts. PM_{10} and $PM_{2.5}$ are generally associated with the potential for health impacts as particles this size and below may enter the lungs.

Dust produced from mining and processing of some mineral sand species may pose potential risks due to composition. For example, monazite contains thorium that could be inhaled from airborne mineral sands dust.

The Atlas operation is mining a previous beach sand deposit and dust composition will reflect the source of this material. Atlas is not expected to contain high concentrations of any element of concern. The denser minerals concentrated to produce the HMC product at Atlas include a small concentration of monazite (~1%) which is a rare earth phosphate containing 5-7% radioactive Thorium.

2.2 Potential Impacts of Dust

The dust has the potential to pose impacts on health, the environment, the visibility of the area and the local amenity. Dust can settle in the surrounding land area causing nuisance. TSP is considered the nuisance dust as it has a larger particle size causing it to settle out of the air. Dust can also impact visual amenity through suspension in the air influencing visibility. The dispersion of dust via climatic conditions can cause environmental and health impacts.

The deposition of dust can cause impacts on the environment as dust can influence photosynthesis, transpiration and respiration of the surrounding flora (Farmer, 1993). Particulate deposition may influence the nutrients in the soil impacting the flora, however, the significance of the impacts depends on the dust's chemical composition, concentration and time of exposure. (EPA, 2016).

The World Health Organization (WHO) and the United States Environmental Protection Agency (USEPA) have identified increased respiratory symptoms to be a potential human health impact of dust exposure. The term “thoracic particles” is used for particles between $PM_{2.5}$ and PM_{10} as these can be inhaled into the upper part of the airways and lungs. Whereas PM equal to or smaller than 2.5 µm ($PM_{2.5}$) is called “respirable dust” as it can be inhaled more deeply into the human lungs (DEC, 2011).

Whilst these finer particles (< PM_{10}) may cause significant health risks as identified above, the larger particle fraction (TSP) may cause nuisance impacts. Nuisance dust causes amenity impacts without necessarily causing material harm. This dust often settles on surfaces causing soiling and commonly impacts neighboring land users.

Dust can cause other amenity impacts through deposition, which refers to any dust that falls out of suspension in the atmosphere. During deposition, dust generally accumulates on fabrics (such as washing), and house roofs, and is potentially transported from roofs into water tanks during wet weather (DECCW, 2010).

2.3 Health Impacts from Particulate Matter (PM_{10} & $PM_{2.5}$)

Research results show that exposure to particulates is associated with adverse health effects. The studies associate the exposure to particulates with the rising number of hospital admissions and the increased risk of death due to lung and heart-related diseases. Although there has been an extensive amount of epidemiological research conducted, there is currently no evidence of a threshold below which exposure to particulate matter does not result in any adverse health impacts. The health impacts of particulates can occur after both short and long-term exposure to particulate matter (NSW Government, 2020). Short-term and long-term exposure is thought to have different mechanisms of effect. Short-term exposure appears to exacerbate pre-existing diseases while long-term exposure most likely causes disease and increases the rate of progression (NSW Government, 2020).

Short-term exposure (hours to days) can lead to (NSW Government, 2020):

- irritated eyes, nose, and throat;
- worsening asthma and lung diseases such as chronic bronchitis (also called a chronic obstructive pulmonary disease or COPD);
- heart attacks and arrhythmias (irregular heartbeat) in people with heart disease; and
- increases in hospital admissions and premature death due to diseases of the respiratory and cardiovascular systems.

Long-term exposure (many years) can lead to (NSW Government, 2020):

- reduced lung function;
- development of cardiovascular and respiratory diseases;
- increased rate of disease progression; and
- reduction in life expectancy.

2.4 Dust Criteria

The National Environment Protection Measure (NEPM) for Ambient Air Quality" by the National Environment Protection Council (NEPC, 2021) and DWER Air Emissions Guideline contains the standards for pollutant particulate matter. Table 1 contains the relevant criteria for particulate matter at sensitive receptor locations. Note that a variation to the NEPM $PM_{2.5}$ standards has been proposed for implementation in 2025.

Table 1: Relevant Air Quality Standards

Pollutant	Averaging Period	Unit[1]	Ambient Air Concentration Standard	Proposed Variation in 2025	Source
Particles as PM_{10}	24-Hour	µg/m³	50	-	NEPC, 2021
	Annual	µg/m³	25	-	NEPC, 2021
Particles as $PM_{2.5}$	24-Hour	µg/m³	25	20	NEPC, 2021
	Annual	µg/m³	8	7	NEPC, 2021
TSP	24-Hour	µg/m³	90	NA	DWER, 2019

Note:

1. Reference to 0 °C and 1 atm

3. SITE AND OPERATIONS OVERVIEW

The combined ore tonnage inventory of the Atlas project is 5.45 million tonnes (Mt). Mining activities will commence with the topsoil and overburden removal. Dozers, excavators and trucks will be used for the removal and transportation of waste and ore mining. Operations are planned to begin at the southern end and south-west parts of the Atlas project footprint as shown in Figure 2 and proceed northwards. The Atlas Project plan is to rehabilitate the mine pit in stages as mining progresses.

The extracted ore will be stored in a ROM pad, located to the west of the proposed mining footprint, and later the ore will be fed into the Feed Processing Plant (FPP) using front-end loaders. The slurried ore from the FPP is transported to the Wet Concentrator Plant (WCP) to obtain the heavy minerals concentrate (HMC) and sand tails and clay fines as waste. Sand tails will be returned to the pit void after cycloning to dewater the material and clay fines will be pumped to solar drying ponds before being placed back into the pit void. The HMC will be transported offsite via Munbinea/Bibby roads to Brand Highway.

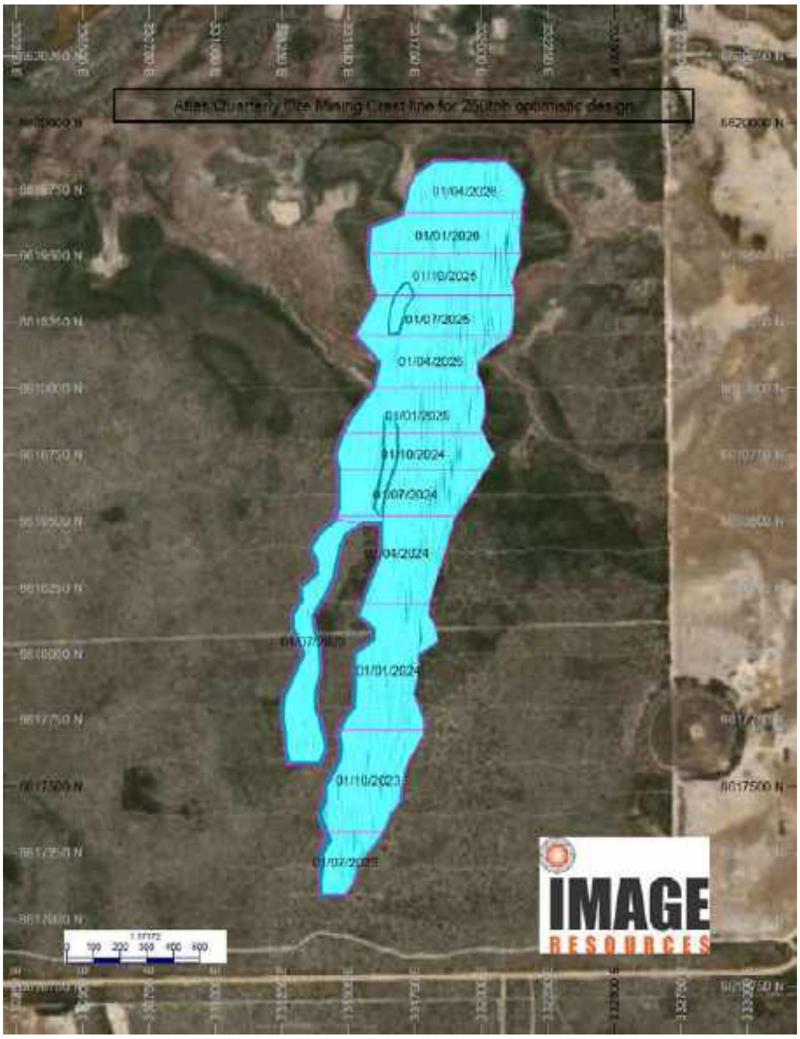

Figure 2: Atlas Project Proposed Mining Schedule

3.1 Sensitive Receptors

The nearest sensitive receptors identified in the surrounding of the mine are included in Table 2 and Figure 2. The closest receptors are Receptors 1 and 2. Receptor 1 (R1) is located east of Atlas, whereas Receptors 2 and 3 (R2 & R3) are located west. Receptor 5 (R5) is located the farthest and north of the mine site project.

Table 2: Atlas Receptor Locations

Receptor	Receptor Location		Proximity to Operations (Km)
	mE	mN	
Receptor 1	332,993	6,617,776	0.92
Receptor 2	329,967	6,617,750	0.97
Receptor 3	329,968	6,617,461	1.2
Receptor 4	329,607	6,616,131	2
Receptor 5	330,324	6,623,079	3.5

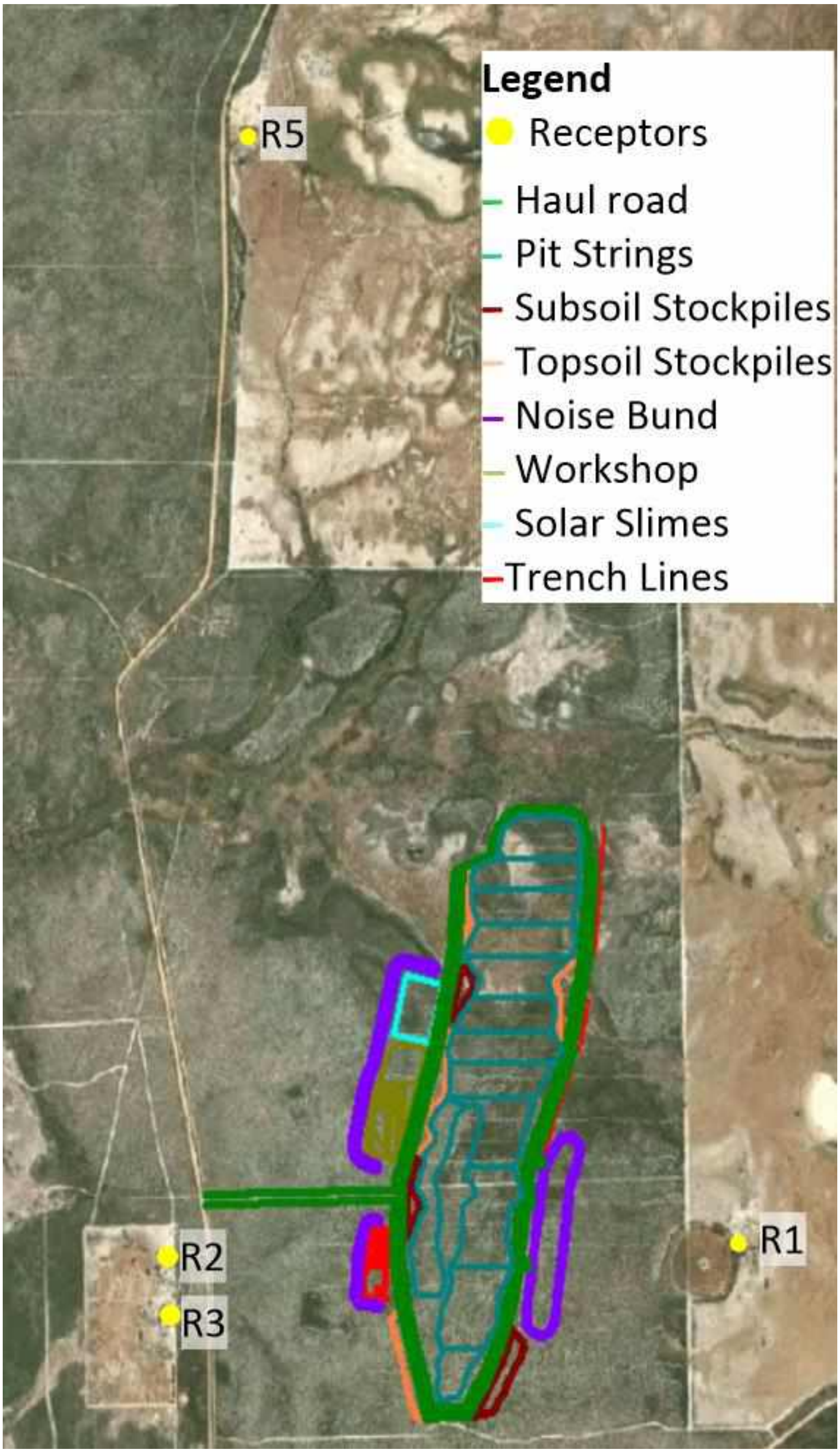

Figure 3: Atlas Project Proposed Mine Site Layout

3.2 Local Climate and Dust Conditions

Meteorological conditions strongly influence dust levels. Most significantly, wind speed, wind direction, temperature and rainfall can affect the generation and dispersion of particulates. The climate of the region is classed as Mediterranean, with hot, dry summers and mild winters.

For the regional climate information, data is taken from the nearest Bureau of Meteorology (BoM) monitoring station to the site, Gingin Aero, with a complete dataset available for analysis. The annual average rainfall is 738 millimetres (BoM, 2023). Rainfall events increase the moisture on the topmost soil layer suppressing dust emissions. Most of the rainfall within the region occurs between May to September (BoM, 2023), hence during these months the risk of high dust levels decreases. The remaining period October to April is usually dry with warm to hot conditions (BoM, 2023), increasing dust levels.

Wind direction determines where plumes travel and how they interact with terrain. Wind direction is important in determining whether emission sources are upwind from a receptor location and if so, higher concentrations are to be expected. Whereas wind speed is a key indicator of atmospheric dispersion. Low wind speeds correspond with less atmospheric mixing, generally resulting in higher observed concentrations. However, higher wind speeds can generate wind-blown dust emissions from exposed surface areas and can also contribute to elevated ambient particulate concentrations.

The wind rose for the 10-year period from 2010 to 2019 is presented in Figure 4, illustrating a dominant easterly through south-easterly component as well as a high frequency of winds from the south-west. Stronger winds (>6 m/s) are more commonly associated with winds from an easterly direction, while the highest proportion of light winds (<2m/s) are from a south-westerly direction. The average wind speed for the period is 3.4 m/s.

The seasonal wind roses (Figure 5) show relatively lower wind speeds occur during autumn and winter than in spring and summer. Winds occur predominantly from the southwest and the east during the summer, from the southwest in spring, from the east in autumn and from the north during winter.

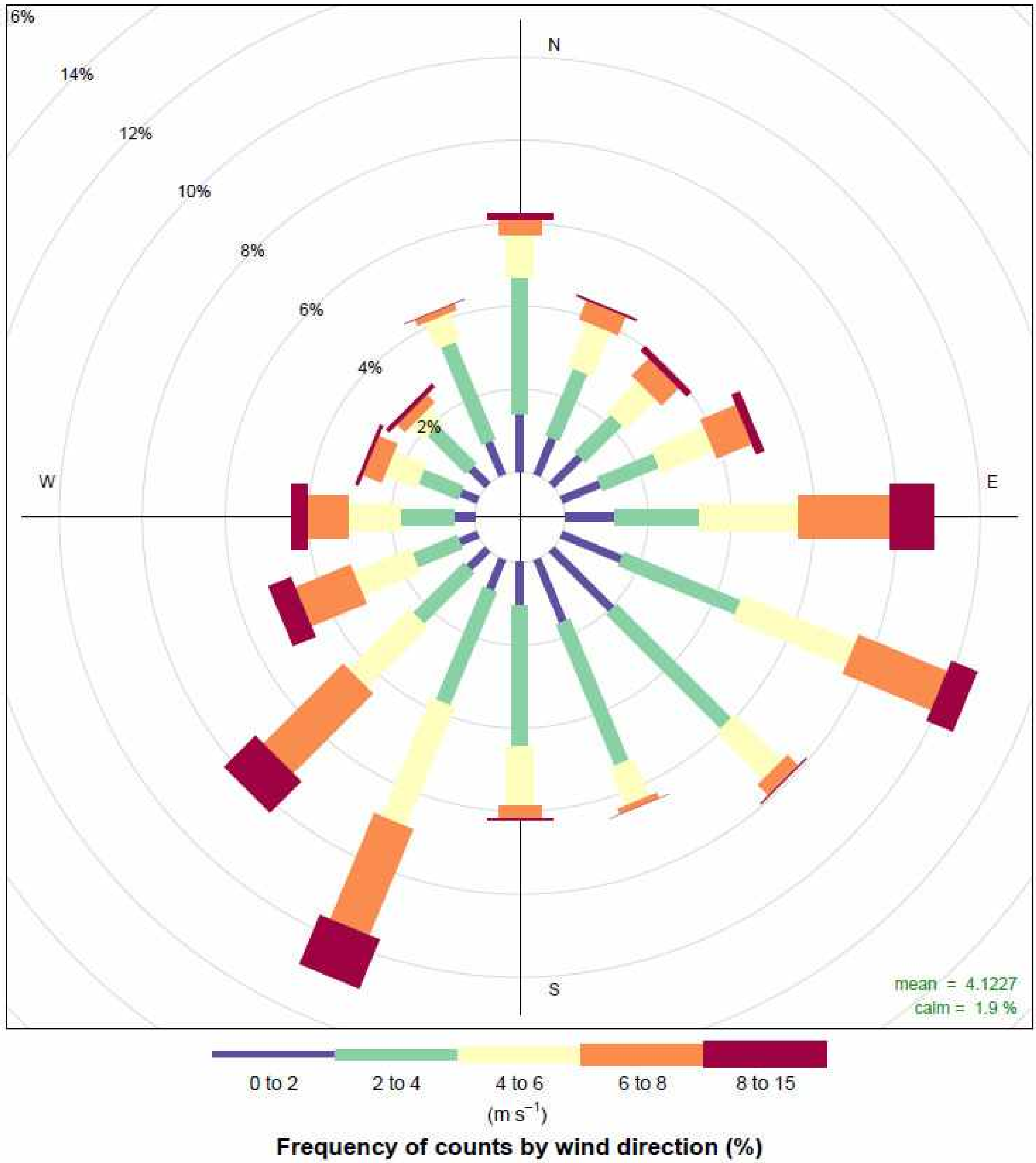

Figure 4: Long Term Wind Rose (2015-2020)

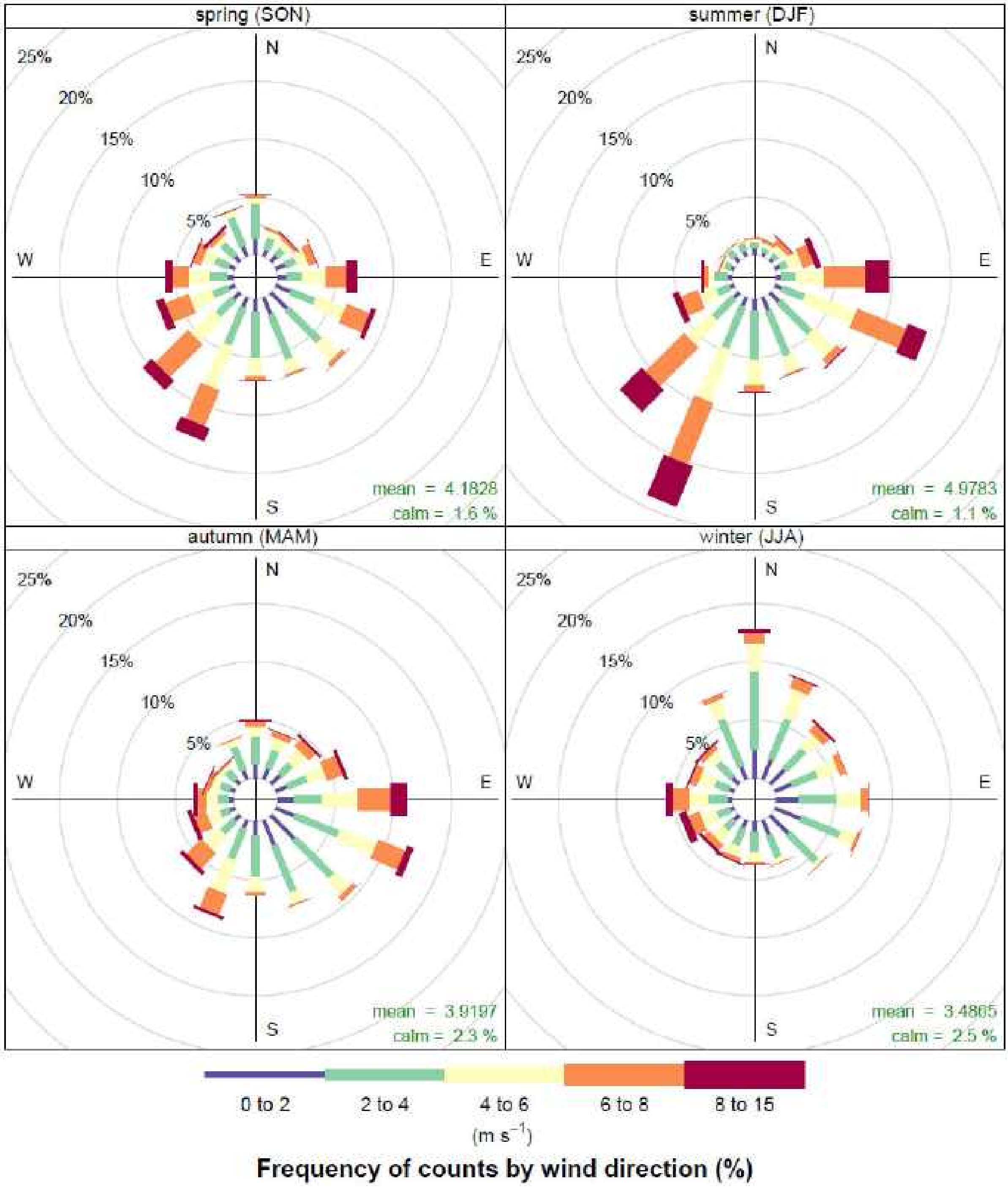

Figure 5: Long-Term Seasonal Wind Roses (2015-2020)

3.2.1 Summary of Wind Conditions

Overall, the region's local climate analysis indicates that the worst conditions for dust levels are expected to occur during the summer months. The summer season of the region is hot and dry, with high wind speeds and with a high frequency of winds occurring from an easterly direction. Receptors 1 and 2 will be located to the west of the mining site. Hence, potential impacts from dust will be elevated at these locations during the summer months.

4. MANAGEMENT PLAN

4.1 Operational Dust Analysis

Dust modelling conducted for the Atlas Project indicated that the five sensitive receptors could be impacted by dust emissions from the Atlas Project if dust sources are not properly managed (Ramboll, 2022). As part of the assessment the following operations of the Atlas Project were identified as potential dust sources:

- Stripping of topsoil;
- Dozing activities;
- Front-end load (FEL) operations;
- Excavation and removal of overburden and ore;
- Pits backfill process;
- Topsoil, overburden and ore transfers;
- Overburden, topsoil, ore and HMC stockpiles;
- Wind erosion of exposed areas;
- Recovering clay fines from solar cells;
- Truck loading and unloading; and
- Haulage of HMC, ore and overburden.

4.2 Aspect and Impact Analysis

The impact of each of the dust-generating activities was rated using information contained in Table 3 and the results of the dust modelling. The final risk rating of the dust-generating activities is contained in Table 4. It is important to consider that although some activities' risk rating is low that does not mean controls are not to be implemented, as multiple activities could be happening simultaneously and cumulative emissions can lead to elevated PM levels.

Table 3: Risk Ratings

	Score	Rating	Description
Consequence	Minimal Impact	1	Environmental impact reversible in 1 month
	Minor Impact	2	Short-term localised impact reversible in 1 year.
	Moderate Impact	3	Medium-term implications, not reversible in 1 year.
	Major Impact	4	Long-term impacts. Irreversible
Probability	Unlikely	1	No evidence of occurring - extreme situations only
	Occasional	2	May occur e.g., annually. It may be due to staff or equipment failure
	Likely	3	Intermittent in normal conditions e.g., monthly or weekly
	Certain	4	Constantly in normal conditions
Risk Rating	Low	≤4	Probability rating + Consequence rating
	Medium	5	
	High	≥6	

Table 4: Dust Impact Analysis of the Atlas Project

Item	Aspect	Impact Description	Probability	Consequence	Risk Rating
1	Clearing of vegetation exposing topsoil	A large area of vegetation is proposed to be cleared for the Atlas Project. Wind erosion of exposed areas can lift dust and increment particulate concentration at the closest receptors (i.e., R2, R2, R3, R4). Wind erosion of stockpiles will occur when wind speeds exceed a certain threshold, generally above 6 m/s. Dust emissions from wind erosion are also dependent on the erodibility of the material which in turn is dependent on the size distribution of the material and whether a crust has developed. Wind erosion is generally negligible below the wind speed threshold. Dust modelling results indicated that, if not managed properly, the probability of 24-hour average PM_{10} dust exceedances due to wind erosion is likely (Ramboll, 2022).	Likely (3)	Moderate Impact (3)	High (6)
2	Removal of topsoil	The stripping of topsoil can increase the concentration of dust at receptors R1, R2, R3 and R4 at different parts of the project. Dust modelling indicated stripping of topsoil as low-risk activity in isolation (Ramboll, 2022). However, the combination of other activity sources can cause short-term high levels of particulates.	Occasional (2)	Minor Impact (2)	Low (4)
3	Excavation of ore/overburden	The excavation process increases dust emissions through the winnowing of particles from the falling material. Dust modelling indicated that excavation poses a medium-risk activity in isolation regarding increasing PM levels (Ramboll, 2022). Therefore, this activity needs to be properly managed in isolation and when it is occurring along with other generating dust activities as it may short-term PM levels.	Likely (3)	Minor Impact (2)	Medium (5)
4	Stockpiling and open areas	Increased hours where dozers are used in the stockpile areas increases the amount of dust generated. In conjunction, like the exposed areas, wind erosion of the stockpiles will occur when wind speeds exceed a certain threshold and will be dependent on the erodibility of the material which in turn is dependent on the size distribution of the material. Dust modelling results indicated that, if not managed properly, the probability of 24-hour average PM_{10} dust exceedances due to wind erosion and dozing is likely (Ramboll, 2022).	Likely (3)	Moderate Impact (3)	High (6)
5	Loading/Unloading material	Handling of materials such as loading and unloading (dumping) of trucks at the stockpiles and the ROM is a source of dust. Dust modelling results indicated that the contribution of loading and/or unloading to the 24-hour averages of particulates is occasional (Ramboll, 2022).	Occasional (2)	Minor Impact (2)	Low (4)
6	Transport of materials	The transport of excavated materials will be conducted using the internal haul road. Wheel-generated dust (WGD) is expected during haulage of overburden and haulage of ore to the ROM and stockpiles. Dust modelling results indicated that, if not managed properly, the probability of 24-hour average PM_{10} dust exceedances due to WGD is likely (Ramboll, 2022).	Likely (3)	Moderate Impact (3)	High (6)

4.3 Summary of Dust Management Requirements

By implementing a series of integrated dust management methods, the potential impacts of dust generated from the project can be minimised. A summary of potential risks and dust management controls committed to by Image resources is outlined in Table 5. The updated risk indicates that the rating decreases as the probability of high concentration events decrease with the implemented controls. Medium risk activities are planned to be further managed with monitoring. The monitoring methodology is described in Section 5.

Table 5: Summary of Dust Management Measures

Item	Aspect	Control Description	Probability	Consequence	Updated Risk Rating
1	Clearing of vegetation exposing topsoil	A large area of vegetation is proposed to be cleared. Vegetation or ground cover in the area will be retained where appropriate or revegetated. Implementation of compaction, grading and watering of the area while pre-works operations occur where appropriate to control lift-off. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds.	Occasional (2)	Moderate Impact (3)	Medium (5)
2	Removal of topsoil	Water cart should make regular passes along the excavation area. Implementation of compaction, grading and watering of the area while pre-works and excavation occur can prevent dust uplift. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds.	Unlikely (1)	Minor Impact (2)	Low (3)
3	Excavation of ore/overburden	Water cart should make regular passes along the excavation area. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds	Occasional (2)	Minor Impact (2)	Low (2)
4	Stockpiling and open areas	Where possible vegetation in nearby areas should be retained or revegetated. Earth bunds will also be incorporated to minimise impact from wind. Stockpiles and open areas will be covered, chemically stabilised and or watered, to prevent uplift from wind erosion as required. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds.	Occasional (2)	Moderate Impact (3)	Medium (5)
5	Loading/Unloading material	All unloading of material including truck dumping and stockpile maintenance will be subject to regular watering where visible dust is generated. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds.	Unlikely (1)	Minor Impact (2)	Low (3)
6	Transport of materials	All haul roads should be well maintained, and a chemical suppressant applied periodically if required. Dust generated for haulage on roads outside the tenement will be controlled by driving to conditions and by ensuring the road is well maintained. Boundary monitoring using realtime air quality monitors with appropriate alarm thresholds.	Occasional (2)	Moderate Impact (3)	Medium (5)

5. DUST MONITORING PROGRAM

5.1 Boundary Monitoring

Monitoring is an effective dust management control method and can provide feedback for adaptive management of the Atlas Project to achieve the aforementioned goals. Dust management can include alarm trigger levels which can provide an early warning to prevent exceedances of the selected health guidelines. This can be effective in minimising the impact of dust generation on nearby amenities. Composition analysis can help to determine whether particulates generated from the operations contain potentially hazardous compounds which can help inform management actions.

Real-time and deposition Air Quality Monitors (AQMs) that can monitor PM_{10} and $PM_{2.5}$ will be located to the east and west of the Atlas Project site and as close as possible to the receptors. Initial locations for the monitors are shown in Figure 6. Please note that the location of the AQMs and monitor models could be subject to change as the project progresses and contingent on monitor availability.

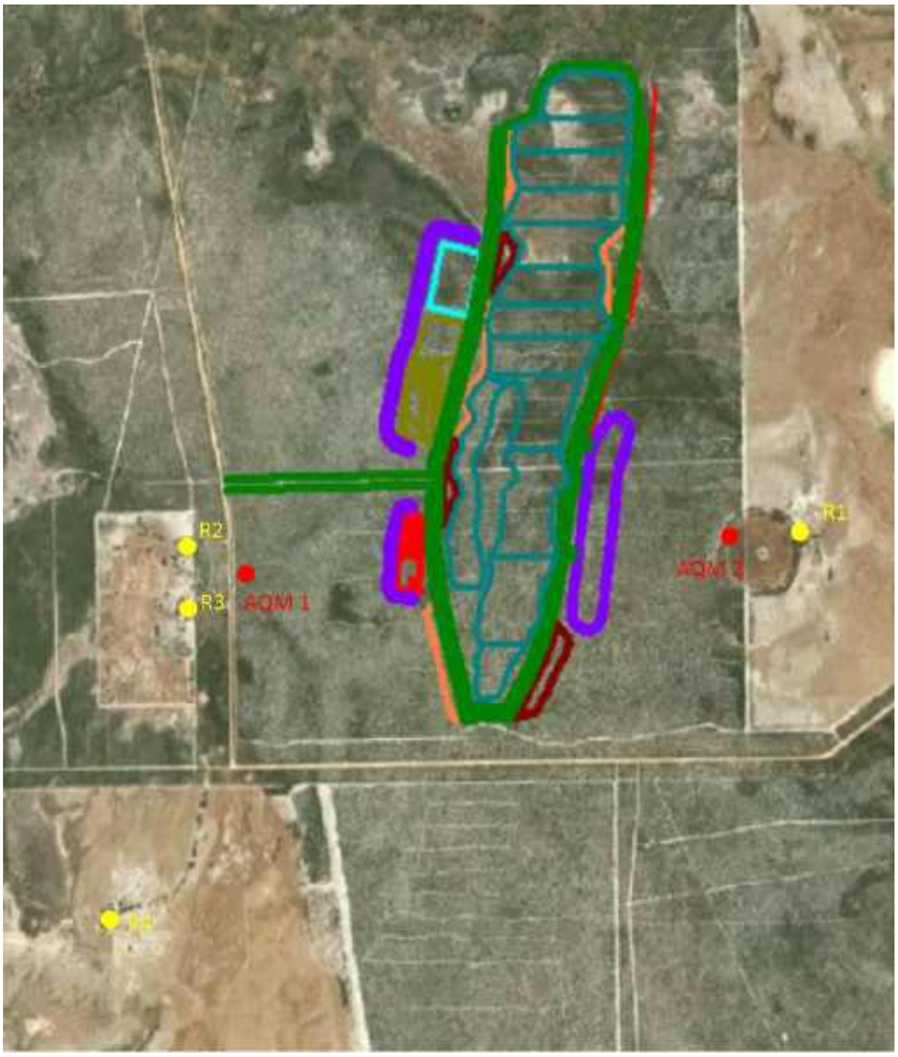

Figure 6: AQMs Initial Suggested Locations

5.2 Real-Time Particulate Monitoring

Image Resources will undertake air quality monitoring in the region. Real-time particulate monitors will record concentrations of PM_{10} and $PM_{2.5}$ and data can be accessed remotely when in range or be downloaded manually. Customisable alerts will be set to trigger when a level threshold is exceeded.

The proposed monitors are laser particle counters not listed in the *List of Designated Reference and Equivalent Methods* of the USEPA (USEPA, 2021), and it is non-compliant with the Australian Standards. However, if properly maintained and calibrated through the use of a reference monitor such as a high-volume air sampler, the monitor provides a reasonable approximation of PM levels that can be used to manage dust levels.

In addition, a high volume air sampler will be used to undertake regular sampling for TSP (quarterly) and potential heavy metals of concern.

5.2.1 Alarms Strategy

The real time monitors will be configured for alarms that will be triggered if the concentration at the monitor is anticipated to exceed values that may result in exceedances of the 24-hour average criteria, in which case, potential sources of dust will be investigated. If the elevated dust concentrations are found to be a result of the operations, appropriate controls will be implemented including stopping the work, controlling emissions sources, or reducing the intensity of the operation. Equation 1 was used to calculate the trigger alarm thresholds for 1-hour and 6-hour rolling averages contained in Table 6 (Turner, 1970).

Equation 1:

$$Cl = Cs\,({}^{t}/_{tl})^{0.2}$$

Where:

- Cl is the concentration for the new averaging period;
- Cs is the concentrations for the average period;
- t is the averaging time of Cs; and
- tl is the averaging time of interest.

Table 6: Monitor Trigger Alarms

Pollutant	Alarm	Criteria ($\mu g/m^3$)[1]	t	tl	Threshold ($\mu g/m^3$)[1]
PM_{10}	1-hour	50	1440	60	94
	6-hour – rolling	50	1440	360	66
$PM_{2.5}$	1-hour	25	1440	60	47
	6-hour – rolling	25	1440	360	33

Note:

1. Reference temperature 0 °C

5.3 Dust Composition Monitoring

Dust particles produced during the handling of mineral sands, can potentially contain hazardous contaminants which have the potential to be inhaled or ingested. A high volume sampler will be utilised at the site, and filters analysed to determine the composition of particulates generated by the operations. The high volume air sampler will also assist in calibrating the real time particle counter monitor through co-location studies, it will also be used to test for concentrations of heavy metals which will be assessed in line with the relevant health guidelines. Area and personal dust samples will also be analysed for radiation in accordance with the approved Atlas Radiation Management Plan (Image Resources, 2022).

5.4 Adaptive Management

5.4.1 Threshold Validation and Review

It is predicted that the establishment of the alarm trigger thresholds at the monitor in conjunction with appropriate reactive management methods will result in ambient dust concentrations at nearby sensitive receptor locations remaining below relevant health standards. However, it is important to note that the trigger levels contained in Table 6 should be reviewed every month for the first three months after their implementation and every year afterwards. The reviews aim to evaluate the threshold efficacy to reduce the risk of elevated dust concentrations and the likelihood of an exceedance of the guideline, whilst minimising impacts to operations.

5.4.2 Elevated Dust Events Management

If concentrations in exceedance of the derived trigger levels are recorded at the monitor, an investigation should be undertaken to assess if the elevated concentrations are associated with Atlas operations. If it is determined that the source is related to Atlas operations, appropriate controls should be immediately implemented, or operations potentially ceased.

Any exceedances of the ambient air quality criteria for particulates and heavy metals should be investigated. Table 7 contains the Atlas operations Arc of Influence for each of the AQMs. 10-minute wind direction and wind speeds will be obtained in the event of an exceedance. The obtained data will be analysed to determine the likelihood of the exceedance being related to Atlas operations.

Table 7: Atlas AQMs Arcs of Influence

Monitor ID	Atlas Arc of Influence (°)
AQMS 1	0-122
AQMS 2	227-350

If operations at the Atlas Project are identified as a significant contributor, further investigation of the operations conducted on the day of the exceedance should be undertaken. The results of the investigation should be used to review the efficacy of implemented controls and mitigations and updated control measures implemented if current controls are not proved to be adequate.

5.4.3 Complaints Management

Information regarding any complaints of nuisance dust events from sensitive receptors or employees and contractors should be documented and passed on to the site manager for review and action as soon as possible. A record of complaints should be kept within a project register (Refer to Dust Incident database in Appendix 1 – Complaints Management for an example register). Any verified complaints should be used to trigger a review into the applicability of the dust trigger levels and the effectiveness of controls at the operations.

5.4.4 Continual Review

The DMP, including the trigger values, should be subject to ongoing review for adaptive management to achieve continuous improvement in this area of operation. It is recommended that the DMP including the boundary trigger levels be initially reviewed every month for the first three months to determine the suitability of the trigger levels in line with the outcome of composition analysis. An additional review should be undertaken at six months and then on an annual basis until rehabilitation has reached a stage that it is deemed unnecessarily to continue by a suitably qualified person.

6. LIMITATIONS

Ramboll prepared this report in accordance with the scope of work as outlined in our proposal to Image dated 11th of January 2022 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Ramboll's professional judgement based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

6.1 User Reliance

This report has been prepared for Image and may not be relied upon by any other person or entity without Ramboll's express written permission

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8. APPENDIX 1

COMPLAINTS MANAGEMENT

Table 8: Register for Management of Complaints

Incident Date	Reported By (Name & Contact Details)	Duration of Incident	Description of Incident	Location of Incident	Management Controls Employed	Date Completed
	Name: Contact Number:					
	Name: Contact Number:					
	Name: Contact Number:					
	Name: Contact Number:					
	Name: Contact Number:					
	Name: Contact Number:					