Iron Road CEIP – Air Quality Management, Mine

COMMUNITY MEETINGS, CENTRAL EYRE PENINSULA, 10-11 MARCH 2015

Matt Pickett & Greg Simes

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Presentation

- Team: Qualifications & experience
- Part 1. Introduction
- Part 2. Scientific studies: Dust modelling
- Part 3. Scientific studies: Dust monitoring
- Part 4. Active Dust Management Program

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Qualifications & experience – Matt Pickett

- PhD Atmospheric Physics (Victoria University & CSIRO)
  BSc(Hons) Physics (Victoria University)
- 2002–present: Jacobs & SKM (Adelaide, Melbourne, Newcastle)
  - Senior Atmospheric Scientist / Air Quality Consultant, specialist in dust impact assessment
- 2001–2002 University of Newcastle NSW
  - Research Scientist on Australian Coal Association Research Project studying mine dust emissions in Hunter Valley NSW
- 1999–2000 Army Engineering Agency, Vic
  - Project engineer, optical equipment (thermal IR, range finder)
- 1994 – 1999 CSIRO Division of Atmospheric Research, Vic.
  - PhD student, atmospheric remote sensing; LIDAR, passive infrared, microwave

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Qualifications & experience – Greg Simes

- Bachelor of Science (Hons) in Chemistry (Flinders University)
- 1996 – 2003 (South Australia)
  - Enviroscan, Heathgate Resources (Beverly mine), Australian Water Quality Centre (AWQC), SGS Environmental / Australian Environmental Laboratories
- 2003 – 2014 (Middle East)
  - Stack Emission Testing and Ambient Air Quality.
  - Operation and Maintenance Contacts (Bahrain Gov / Dubai Aluminium (Dubal) / Abu Dhabi Government)
  - Environmental Equipment Distribution and Tech Support
- 2014 – Present (South Australia)
  - Jacobs Group. Environmental Scientist (Air Quality)

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Air Quality outcomes sought by community

- *No impacts from mine generated dust on neighbouring farming systems and community e.g: human health, stock health, native vegetation, rain water quality etc.*
- *No increase in radiation levels from the mining activity*

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Notes

Iron Road has been working with the CEIP Community Consultative Committee on the outcomes they would like to see from the project. Specifically related to air quality, the group developed two outcomes related to dust impacts on farms and community and radiation levels.

Iron Road will continue to work with the CCC on addressing these outcomes as the project progresses.

Part 1. Introduction: what is air quality?

- **Ambient air quality**
  - Air quality 'off-site'. Outdoors environment
  - National and state standards and guidelines are used to assist with protection of human health and amenity in the ambient air environment
  - Excludes Occupational Health & Safety (OHS) exposure standards
- **Why investigate ambient air quality?**
  - To describe the existing ('baseline' or 'background') air quality environment on central Eyre Peninsula
  - Predict and assess the expected emissions and dispersion of air pollutants from the CEIP mining and infrastructure proposals
  - Planning for future management of construction and operations

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Notes

In order to properly assess any dust impacts the mine may have on the community peripheral to the site, we must first have a quantitative understanding of what the current environment and conditions are like. This is known as the "baseline".

We also need to predict what the dust impacts of the operation are likely to be based on models that incorporate environmental and weather conditions and the types of equipment and processes that are proposed to be used (e.g. Crushers and screens, blasting, vehicle movements, etc.). This needs to be considered for both the construction phase and long-term operation.

Overlaying the modelled impacts over the existing baseline conditions helps determine what mitigation measures and monitoring practices need to be implemented to ensure impacts are minimised, measurable and within regulatory standards.

Air pollution in South Australia

- **Environmental Protection Authority (EPA) summary**
  - Road vehicles add to air pollution by contributing most of the carbon monoxide, oxides of nitrogen and benzene in the local atmosphere.
  - Major industries can have a significant effect on air quality including visual and health-related pollution.
  - Wood heaters emit smoke containing fine particles – in winter, wood heaters can add more small (inhalable) particles to our local atmosphere than cars.
  - Bushfires contribute significantly to air pollution throughout South Australia. Smoke from bushfires contains small particles and other harmful chemicals. Bushfire smoke can be transported over South Australia from areas as far away as NSW and Victoria.
  - During the summer, dry weather conditions can transport dust from the northern parts of SA to the southern parts of the state. This dust can form a haze over affected areas.

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Notes

EPA oversees that air quality standards are being met.

They view air quality from the perspective of the potential health impacts of the air we breathe and the potential contamination effects of dust settling on surfaces such as soils and dwellings.

Air pollution on Eyre Peninsula

- **Air pollution on central Eyre Peninsula**
  - Away from industrial centres and towns on the coast, mainly dust and small particles
  - Significant sources of airborne particles that cause visible plumes and hazes include:
    - wind-blown dust from soils on and outside Eyre Peninsula (e.g. willy willys)
    - smoke particles e.g. grass fire smoke; wood heaters
    - wheel-generated dust from vehicles on unpaved roads and paddocks e.g. grain trucks; combine harvesters; tractors and other farming equipment
    - dust emissions from activities on unpaved areas e.g. near wheat silos
    - sea salt aerosols including small water droplets

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Notes

Air pollution isn't just generated by heavy industry. Everyday activities such as driving on dirt roads, fires, wind off the sea and farming activities all generate forms of particulates (dust, smoke/ash, salt, seeds etc.).

What is dust?

- In the atmosphere we usually call airborne dust 'particulates' or 'Particulate Matter' (PM)
- Dust deposition
  - Dust fall-out from particles of any size in suspension in the atmosphere
  - Units usually gram/m^2/month (typical fallout 2.0 g/m^2/month)
- Total Suspended Particulates (TSP)
  - Units usually microgram per cubic metre (μg/m^3)
  - Collection of airborne particles up to size approx. 30-50 microns
  - Note: 20 microns is a typical diameter for a fine woollen fibre
- PM_{10} and $PM_{2.5}$
  - Units usually microgram per cubic metre (μg/m^3)
  - Collection of airborne particles up to size approx. 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$)

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Notes

Dust varies in size and it is important to know what concentrations of dust will be generated at each size so mitigation measures and monitoring can be designed appropriately.

What is dust?

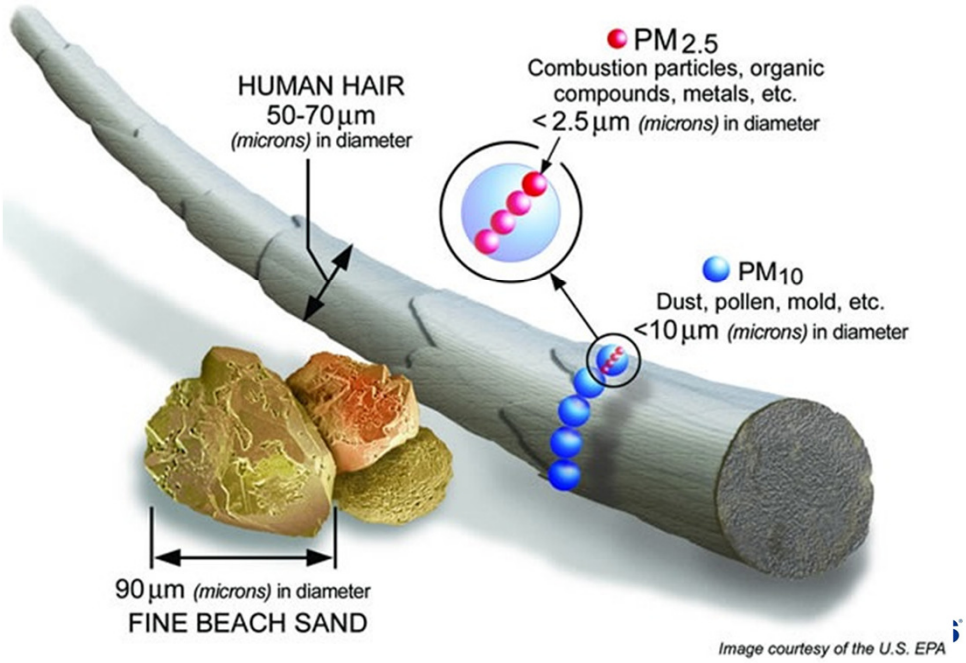
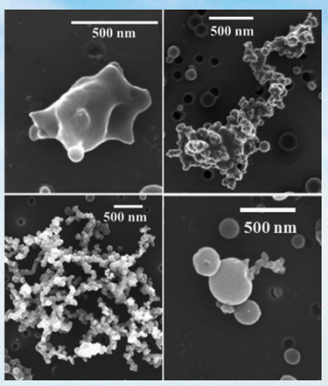
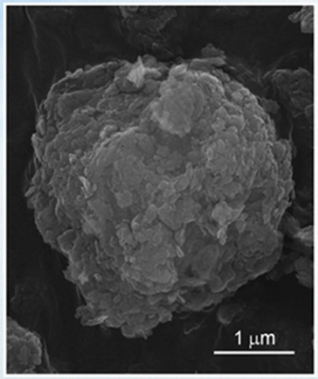


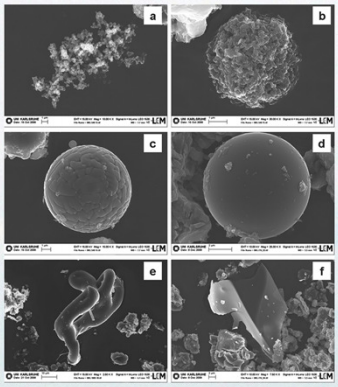
Image courtesy of the U.S. EPA

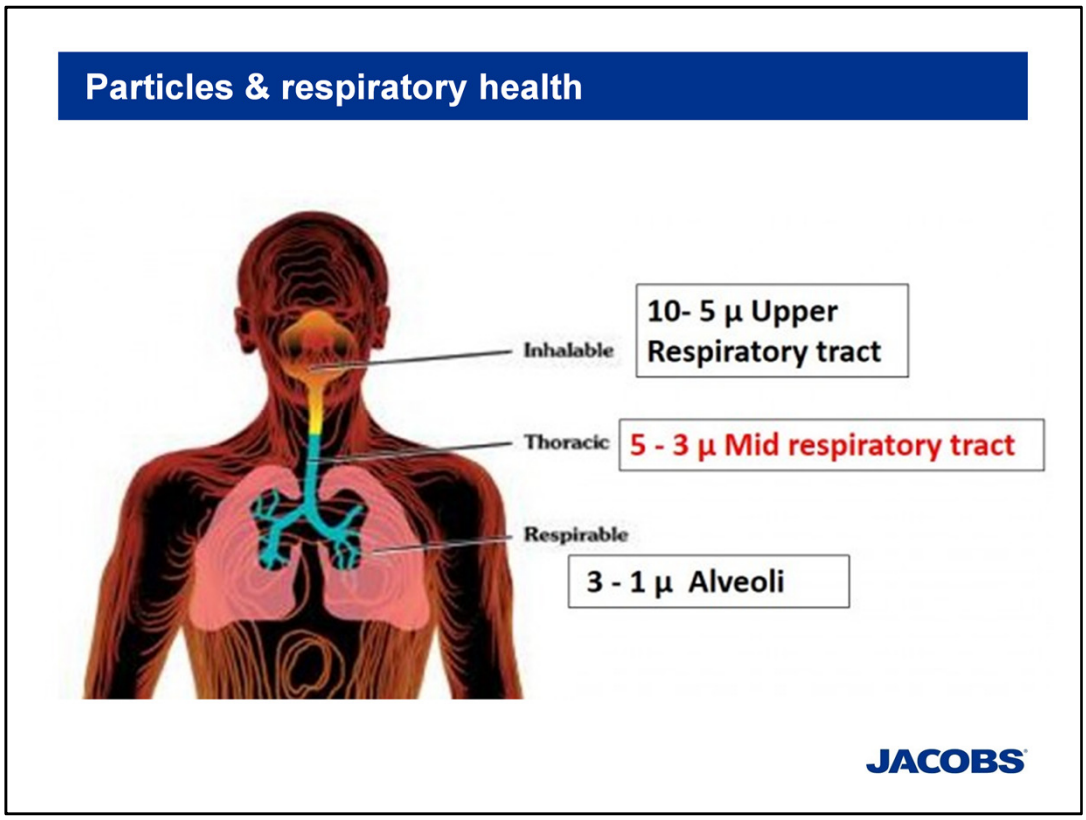
Examples of airborne dust particles

- **Electron microscope illustrates complexity:**
  - **Size distribution**
  - **Shape**
  - **Composition (mineral dust, sea salt, soil salt, soot, biological)**









Notes

The smaller the dust particle, the further into the human body it can travel which can lead to health issues. This is why industry and the EPA monitor specifically for PM10 and PM2.5.

Australian air quality standards

- PM_{10} and $PM_{2.5}$ standards are primarily focussed on health effects of airborne particles
  - Regulated at National (NEPM) and State (EPA) level
- TSP and dust deposition, indicators of nuisance dust
  - Not covered by National Standards (NEPM)

Pollutant	Averaging period	Maximum concentration	Goal within 10 years Maximum allowable exceedances	Source
PM_{10}	24 hr	50 µg/m^3	5 days per year	NEPC, 2003
$PM_{2.5}$	24 hr	25 µg/m^3	Advisory reporting standard	NEPC, 2003
	Annual	8 µg/m^3		(update by NEPC, 2011)
TSP	Annual	90 µg/m^3		Department of Environment and Conservation (DEC, 2005)
Dust Deposition	Annual	4 g/m^2/month	Maximum Total Deposited Dust Level	Department of Environment and Conservation (DEC, 2005)
		2 g/m^2/month	Maximum Increase in Deposited Dust Level	

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Notes

Limits are set by the state EPA based on the National Environmental Protection Measures (NEPM) which considers international science.

Part 2. Scientific Studies – Dust Modelling

- Simulated dust emissions scenarios
- Meteorological modelling
- Dust modelling

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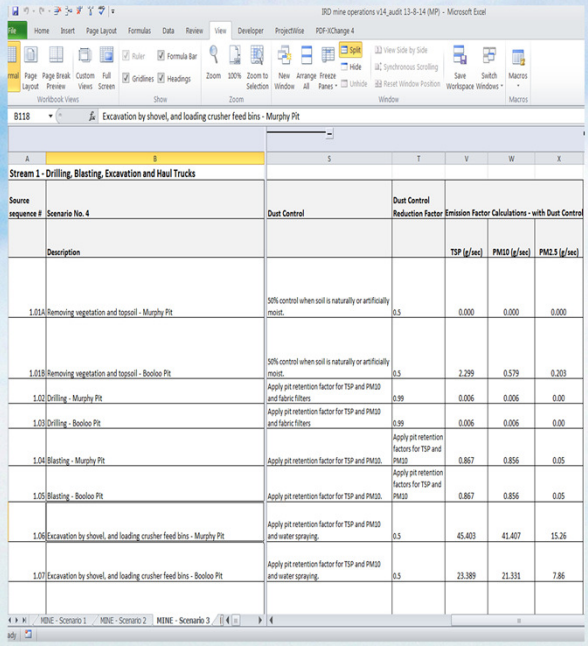
Dust emissions estimates for input to modelling

- **Dust emissions calculations in accordance with Australian Government procedures set out for National Pollutant Inventory**
- **Plus review of literature (drawing on previous research studies)**



B118 Excavation by shovel, and loading crusher feed bins - Murphy Pit

Stream 1 - Drilling, Blasting, Excavation and Haul Trucks

Source sequence #	Scenario No. 4	Dust Control	Dust Control Reduction Factor	Emission Factor Calculations - with Dust Control		
	Description			TSP (g/sec)	PM10 (g/sec)	PM2.5 (g/sec)
1.01A	Removing vegetation and topsoil - Murphy Pit	50% control when soil is naturally or artificially moist.	0.5	0.000	0.000	0.000
1.01B	Removing vegetation and topsoil - Booloo Pit	50% control when soil is naturally or artificially moist.	0.5	2.299	0.579	0.203
1.02	Drilling - Murphy Pit	Apply pit retention factor for TSP and PM10 and fabric filters	0.99	0.006	0.006	0.00
1.03	Drilling - Booloo Pit	Apply pit retention factor for TSP and PM10 and fabric filters	0.99	0.006	0.006	0.00
1.04	Blasting - Murphy Pit	Apply pit retention factor for TSP and PM10.	Apply pit retention factors for TSP and PM10	0.867	0.856	0.05
1.05	Blasting - Booloo Pit	Apply pit retention factor for TSP and PM10.	Apply pit retention factors for TSP and PM10	0.867	0.856	0.05
1.06	Excavation by shovel, and loading crusher feed bins - Murphy Pit	Apply pit retention factor for TSP and PM10 and water spraying.	0.5	45.403	41.407	15.26
1.07	Excavation by shovel, and loading crusher feed bins - Booloo Pit	Apply pit retention factor for TSP and PM10 and water spraying.	0.5	23.389	21.331	7.86

Notes

Theoretical modelling is undertaken based on what we know about the proposed operation and it's potential sources of dust emissions.

Simulated dust emissions scenarios

- Construction phase (Year 0–1): 108Mtpa
  - highest haul truck fleet size
  - vegetation clearing
  - topsoil removal
  - infrastructure development
- Early mining phase (Year 2): 323Mtpa
  - fast ramp up rate from Murphy pit only
  - early pit development (shallow and small extent)
  - initial development of integrated land form
- Peak mining phase (Year 18+): 347Mtpa
  - mature development of both Murphy and Booloo pits
  - deep and near maximum extent
  - mature development of integrated land form

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Notes

Dust emissions can vary during different phases of the project, therefore three different scenarios have been modelled accordingly.

Airborne dust modelling

- **Inputs:**
  - Meteorological modelling results (3D, hourly-varying)
  - Digital terrain elevations model
  - Results from dust emissions calculations
- **Outputs:**
  - Contour plots showing predictions at ground level in accordance with SA EPA procedures:
    - Airborne particle concentrations
    - Dust deposition
    - See printouts
- Compliance with SA EPA and national air quality standards & guidelines
- Compliance achieved by simulating shut-down of some operations during certain times identified as higher risk

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Notes

The model is very detailed and results from other mines have shown the model outputs to be accurate.

Part 3. Scientific Studies – Dust Monitoring

- How do we measure dust
- Monitoring program
- Dust deposition
- Continuous airborne TSP
- Active Dust Management Plan
  - Dust controls and links with operations
  - Dust forecasting
  - Site monitoring

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How do we measure dust?

Australian Standards for Particulate Monitoring

- Continuous Compliance Analysers
  - Beta Attenuation Analyser (BAM)
    - PM_{10} AS/NZS 3580.9.11:2008
    - $PM_{2.5}$ AS/NZS 3580.9.12:2013
- Continuous TSP Analyser
  - Beta Attenuation Analyser (BAM)
    - No Australian Standard for Continuous Measurements
- Dust Deposition
  - Dust Fall out Gauges
    - AS/NZS 3580.10.1:2003
- Meteorology
  - Wind Speed / Wind Direction / Temperature / RH
    - AS/NZS 3580.14-2011

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How do we measure dust?

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Notes

This is an example of a continuous dust and weather monitoring station.

Monitoring program

Background monitoring commenced in November 2013.

- Continuous TSP and meteorology at 2 sites. (hourly measurements)
  - Total suspended particulates
  - Wind speed / wind direction & temperature
- Dust deposition at 3 sites. (monthly measurements)
  - Total deposited particulates.
    - Soluble Matter
      - Chemical analysis of soluble solids for salts.
    - Insoluble matter
      - Combustible matter
      - Ash (material left after combustion)
      - Chemical analysis of Insoluble solids for metals.

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Monitoring results – dust deposition

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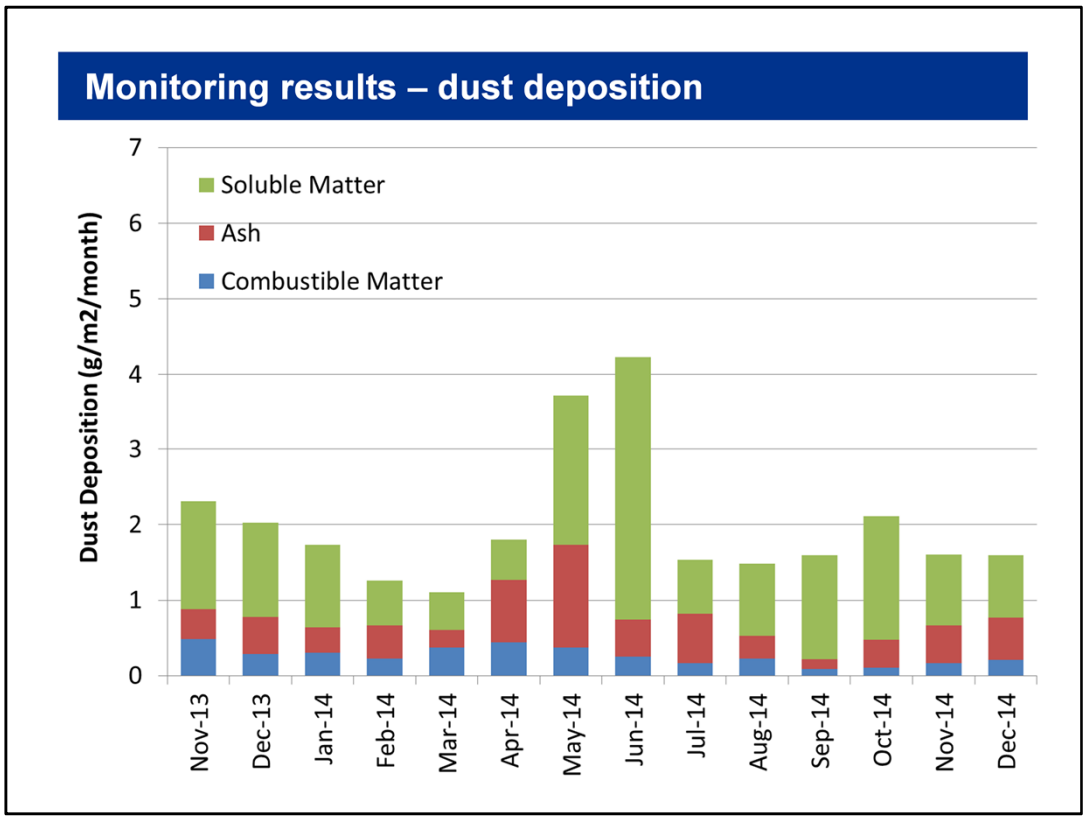
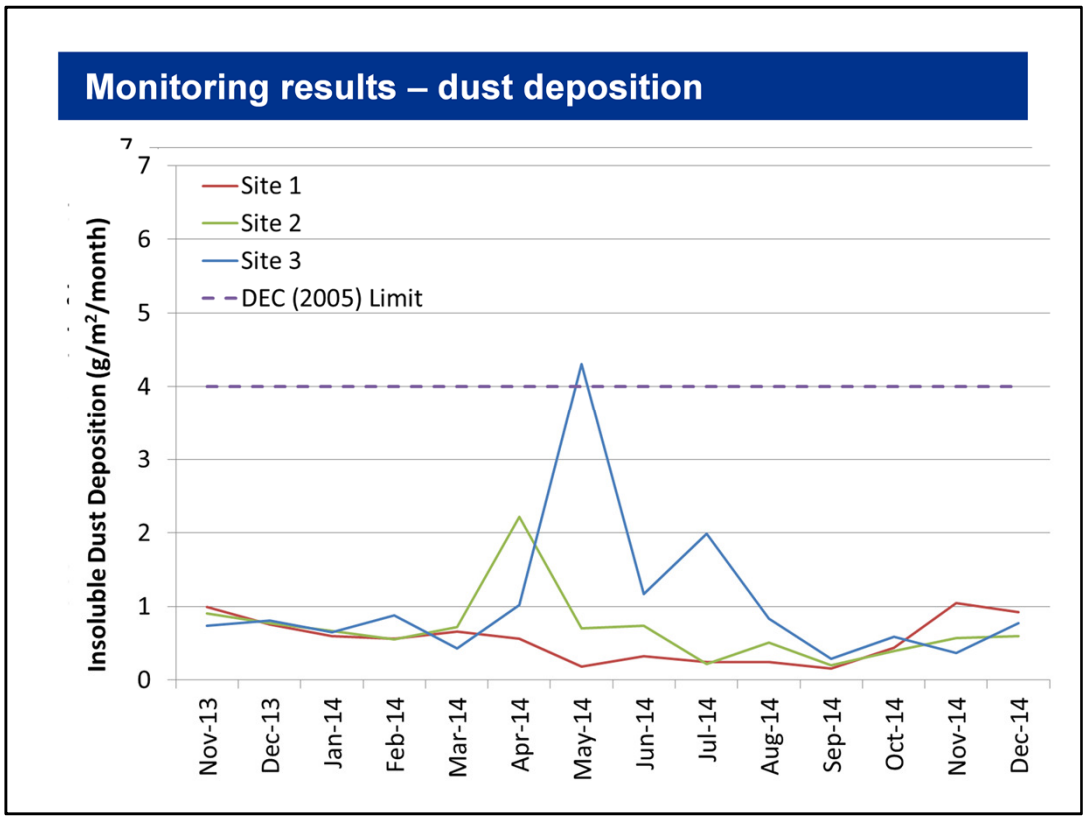
Notes

This are dust deposition gauges. They are simply glass funnels, of known diameter, in glass bottles that capture particulate matter (and rain). These are collected every month and the content is analysed to give a dust deposition rate, usually reported in grams per square metre per month. The dust can be analysed for chemical composition.



Notes

This shows data from the proposed mine site. Dust deposition rates vary through the year based on seasonal factors such as rainfall and prevailing winds, as well as agricultural activities.



Notes

Background dust deposition rates on average are relatively low when compared to EPA limits, though occasionally high levels can be experienced e.g. May 2014.

Monitoring results – TSP

Beta Attenuation Monitor (BAM)

- Solar Powered.
- Does not require air conditioned enclosure.
- Currently configured for Total Suspended Particulates (TSP), but can be easily converted to measure PM_{10} or $PM_{2.5}$.

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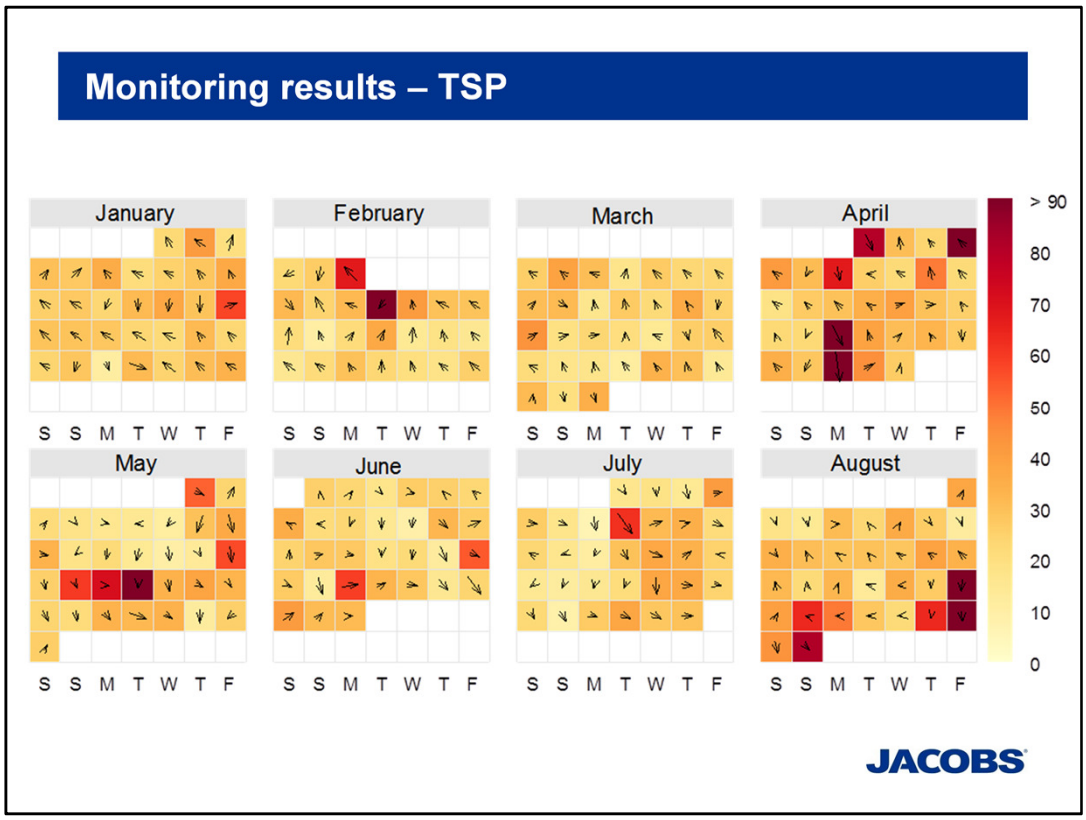
Notes

These instruments accurately measure different size dust concentrations. Measurements are taken every 10 minutes and averaged over the hour. The data can be remotely transmitted or a recording device (data logger) can be attached.



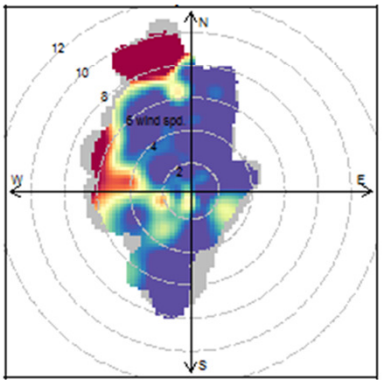
Notes

This is a summary of total suspended particulate background data collected from the proposed mine site. The small arrow shows the prevailing wind direction on that day and the colour indicates the corresponding dust level.

Monitoring results – TSP

- Some existing high dust conditions
- Nov 2013 to Dec 2014, there were 13 days when the 24hr average TSP measurement exceeded 90 µg/m^3

- On two days in April 2014:
  - Daily avg. TSP>2000 µg/m^3
  - Hourly avg. TSP>10,000µg/m^3
  - Wind speeds high
  - Hourly avg. wind speed peaked ~36 km/h (~10 m/s)



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Notes

Large areas of cleared land in conjunction with high winds and low humidity/rainfall means the region is prone to high dust conditions on occasions.

Active Dust Management Plan – controls & links

- **Dust controls and links with operations:**
- **Mine design optimised to minimise dust emissions:**
  - **Enclosed conveyors instead of haul trucks**
  - **In-pit / on-site crusher and ore processing (not transporting large quantities of raw materials)**
  - **Enclosed rail cars and loading facility**
- **Forecasting of dust risk meteorological conditions to assist forward planning of mining activities and mitigation measures**
- **Operations management: near real-time, continuous dust monitoring used as control inputs to dust mitigation measures to prevent exceedences of air quality standards**
- **Identified higher risk mining activities halted during periods of forecast or monitored dusty periods**

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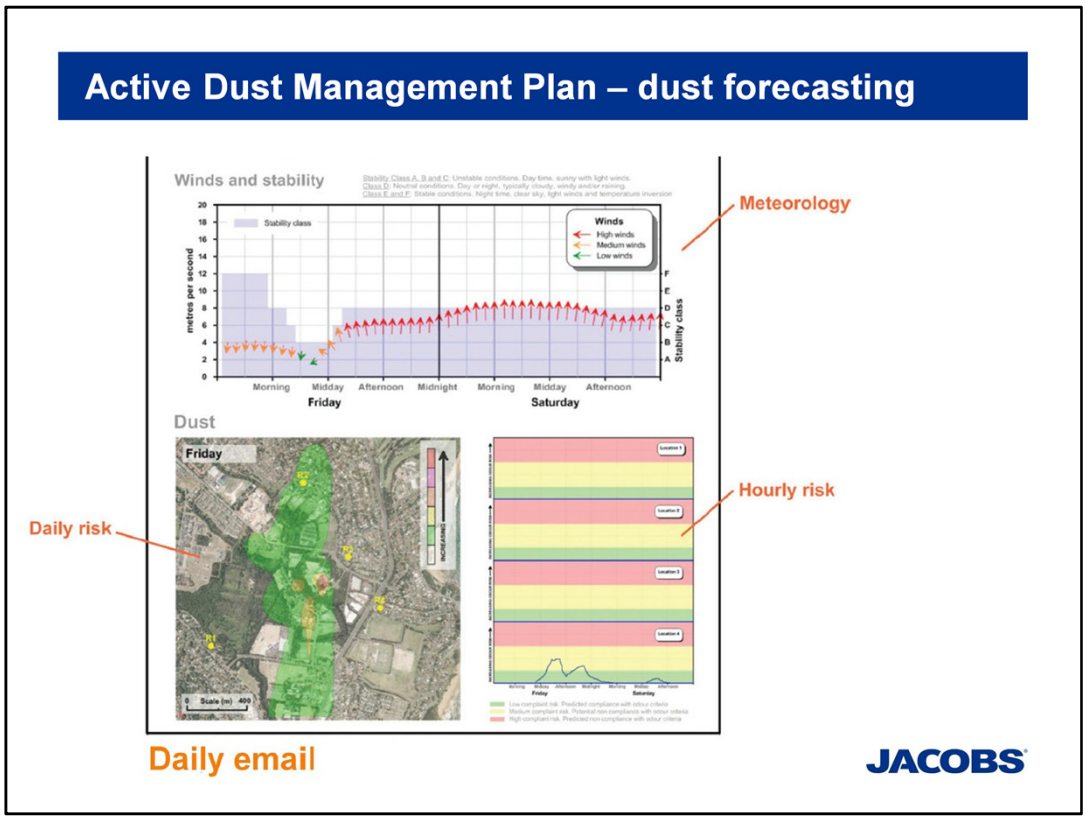
Notes

It is much more effective to "design out" a risk upfront than it is to try and "manage it" during operation. Wherever possible, IRD have designed it's operation to minimise the creation of dust at the source.

However, it is unrealistic to expect no dust, so many dust mitigation strategies will be employed to ensure the operation can meet the regulatory conditions imposed.



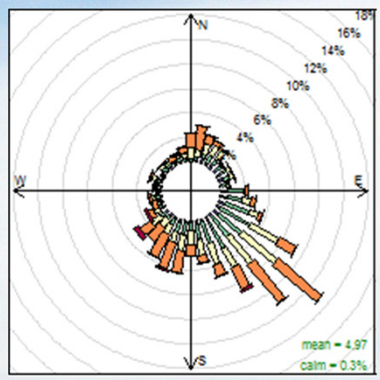
Notes

Proven technology is in use at many sites across Australia which gives communities and regulators access to real-time air quality data. This allows the general public to monitor the performance of the operation.

Active Dust Management Plan – site monitoring

Construction and operation phases of the project will have a monitoring program to ensure governmental compliance and to provide guidance for daily operational activities, including:

- **Continuous monitoring of PM_{10}, $PM_{2.5}$, TSP, wind speed, wind direction, temperature, & humidity**
- **Dust deposition (monthly)**
- **Crop yield analysis, minimum of 2 long term sites (separate discussion)**
- **PM_{10} main input parameter for mine management decisions**



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Notes

All Australian mines are required to monitor and report dust levels. CEIP will have a comprehensive monitoring and reporting requirement which will be developed further during the Program for Environmental Protection and Rehabilitation (PEPR) process, should the mining lease be granted.

Active Dust Management Program – Summary

- Iron Road commits to achieving air quality compliance at sensitive receptor locations based on continuous monitoring during construction and mining operations
- Extensive dust controls program
  - Large water volumes allocated for dust control
  - Minimal dewatering of pit to be undertaken (water used for dust control)
- Comprehensive monitoring network
  - Particle monitors and wind sensors installed at sensitive receptor locations and at strategic locations around the mine site
- Continuous, real-time results from continuous PM_{10} monitoring will be used by mine controllers
  - Selected mining activities ceased when hourly average PM_{10} data exceed limits

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Control of salt emissions

- The Active Dust Management Program will also minimise salt particle emissions from the site
  - Salt particles will be part of the measured PM_{10} and TSP emissions
- Extensive dust controls program – pit will be moist
  - High water use and moist CEIP surface areas will minimise salt emissions in the same way that dust emissions will be minimised
- Salt components of measured deposited dust will be recorded and reported as a part of the ADMP
  - Elemental analysis of soluble solids component of dust deposition will include markers for common salt (sodium & chloride)

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Questions

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