Quarry Dust – An Old Problem Under a New Spotlight

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Overview

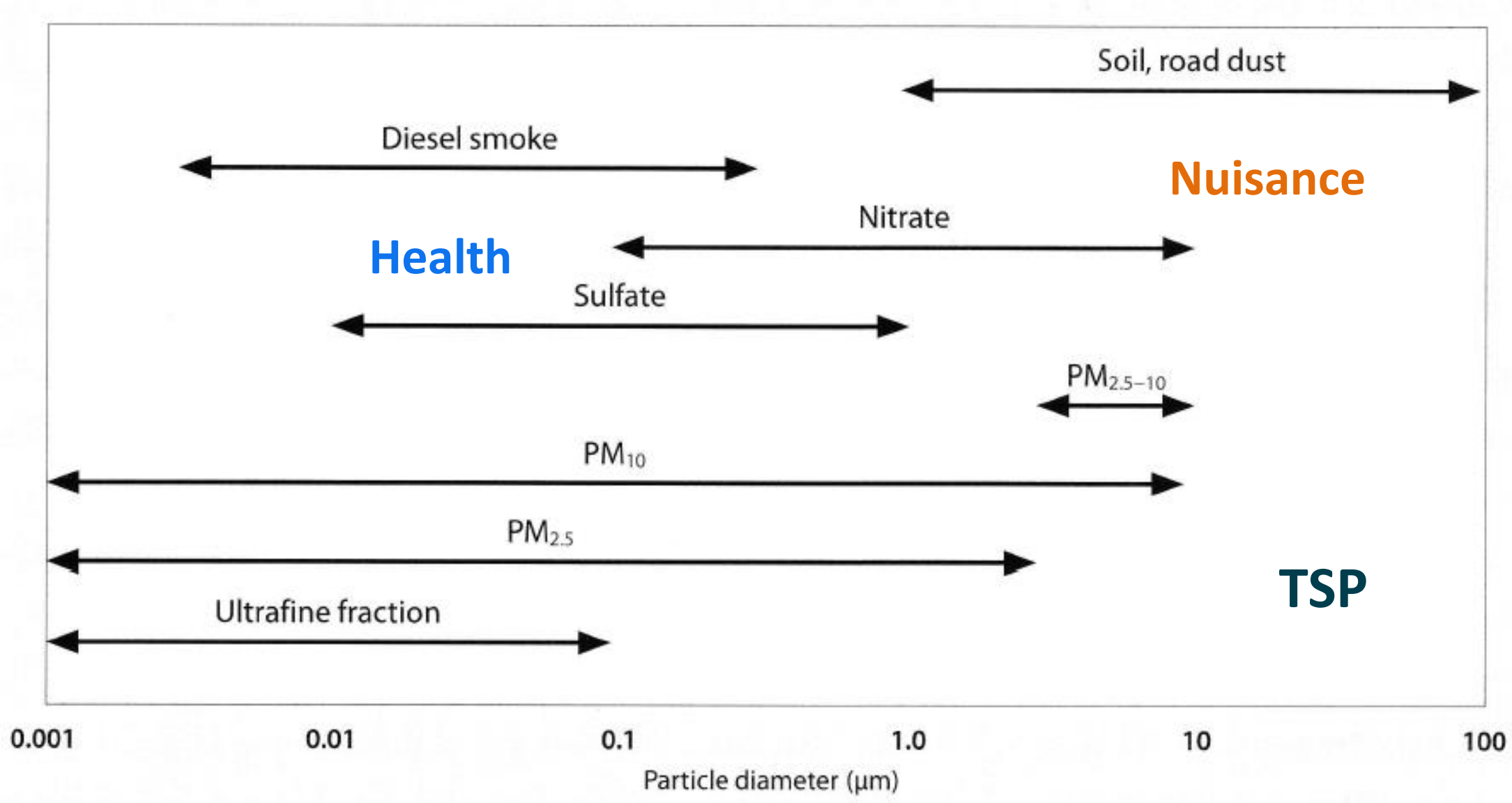
- PDP’s role
- Issues/effects
- Regulations
- Assessment
- Monitoring & management

PDP quarries and air quality

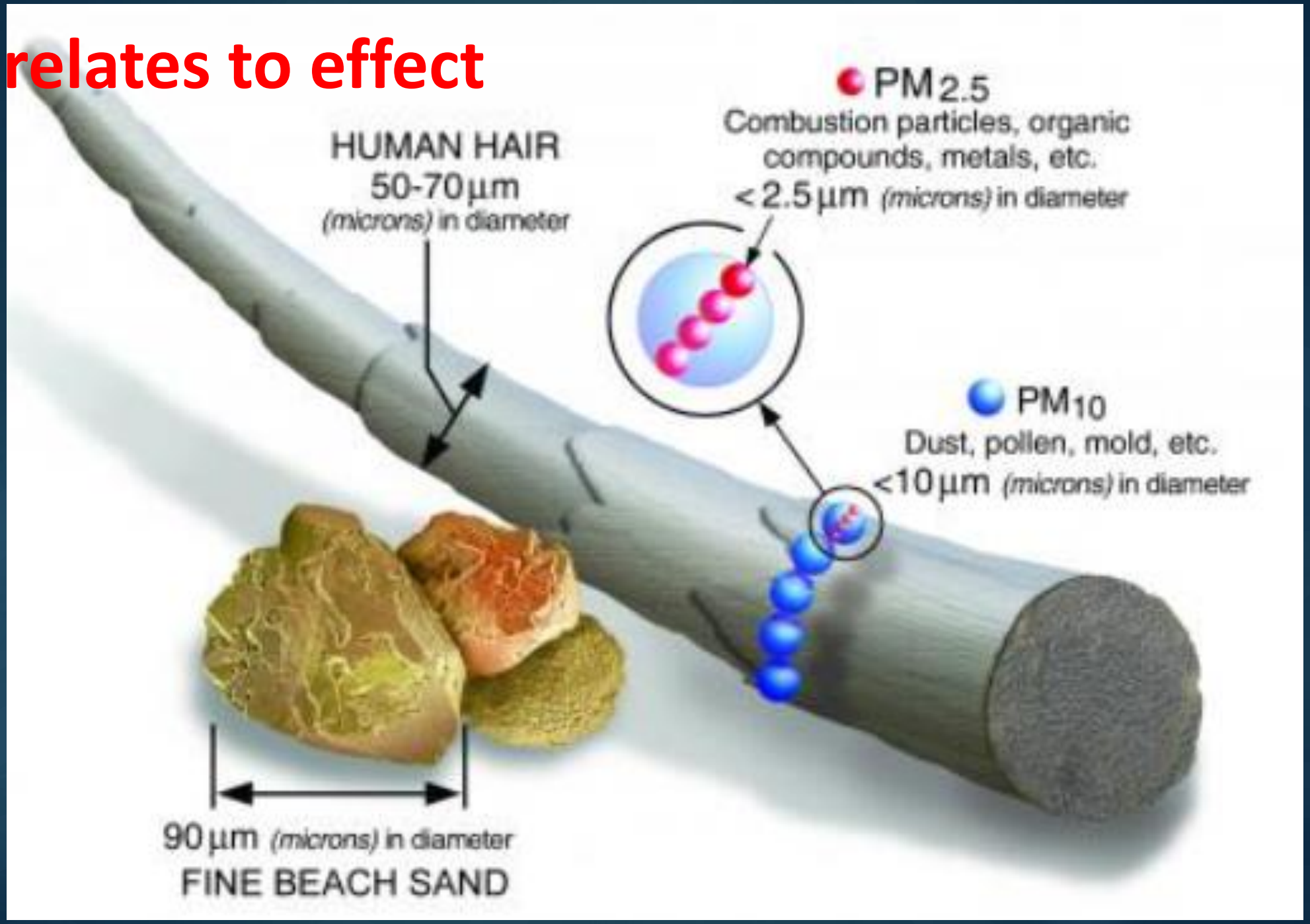
- Air quality effects assessments for quarries
- Technical reviews for councils

- Expert evidence
- Monitoring and management plans

Dust – size matters



Size relates to effect



Regulations and guidance: PM_{10}

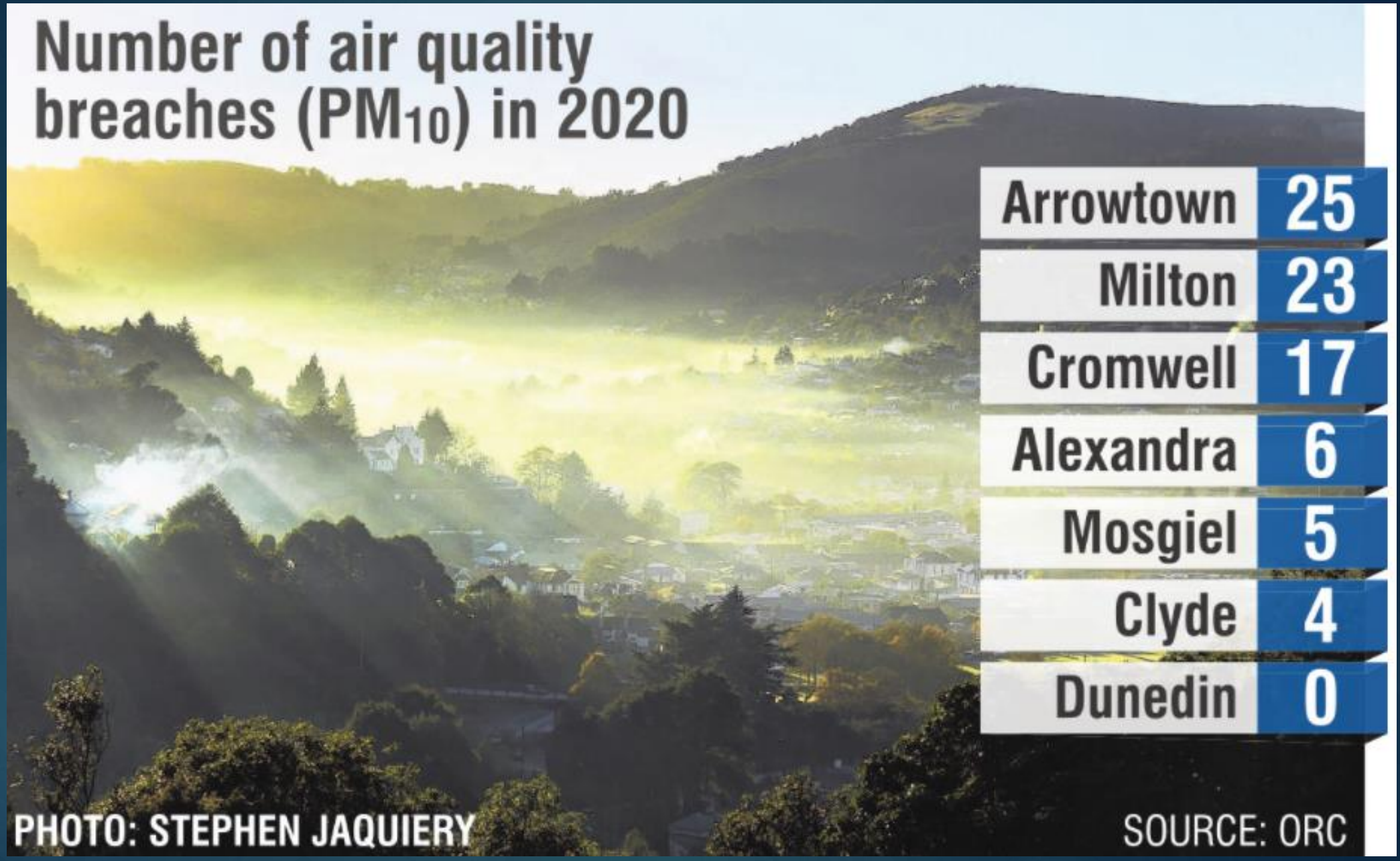
50 µg/m^3 24-hour average

(NESAQ- standard)

20 µg/m^3 annual average

(NAAQG - guideline)

> 50 µg/m^3 – polluted airshed


Number of air quality breaches (PM_{10}) in 2020
Arrowtown 25
Milton 23
Cromwell 17
Alexandra 6
Mosgiel 5
Clyde 4
Dunedin 0
PHOTO: STEPHEN JAQUIERY
SOURCE: ORC

$PM_{2.5}$

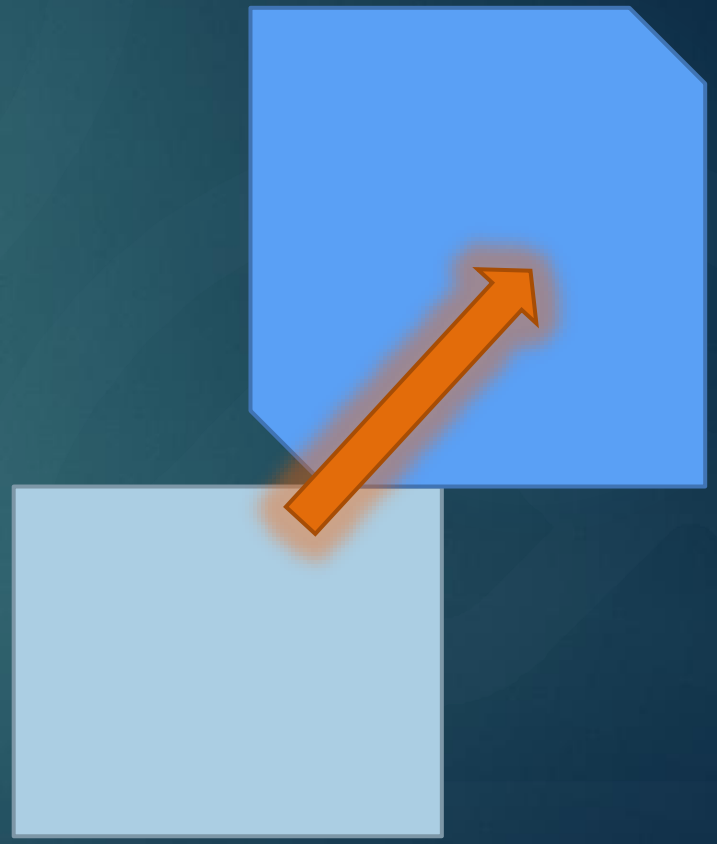
- More strongly associated with health impacts
- Controllable as linked with human activities
- Quarries not a significant source

$PM_{2.5}$	Daily average $PM_{2.5}$ standard – 25 µg/m³ (three or fewer exceedances allowed in a 12-month period) Annual average $PM_{2.5}$ standard – 10 µg/m³ Monitoring required in all airsheds Publicly notify breaches Replace PM_{10} with $PM_{2.5}$ for 'offset' and open fires provisions
PM_{10}	PM_{10} standard retained

Proposed

This is all a bit dry

Incremental concentration must be less than 2.5 µg/m^3 increase in PM_{10}



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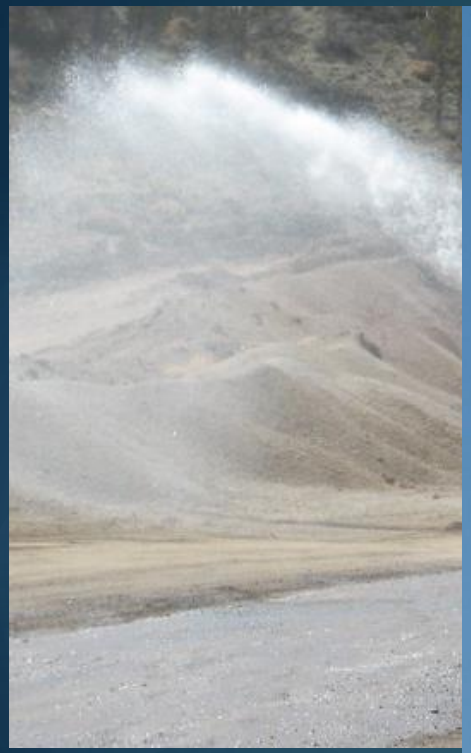
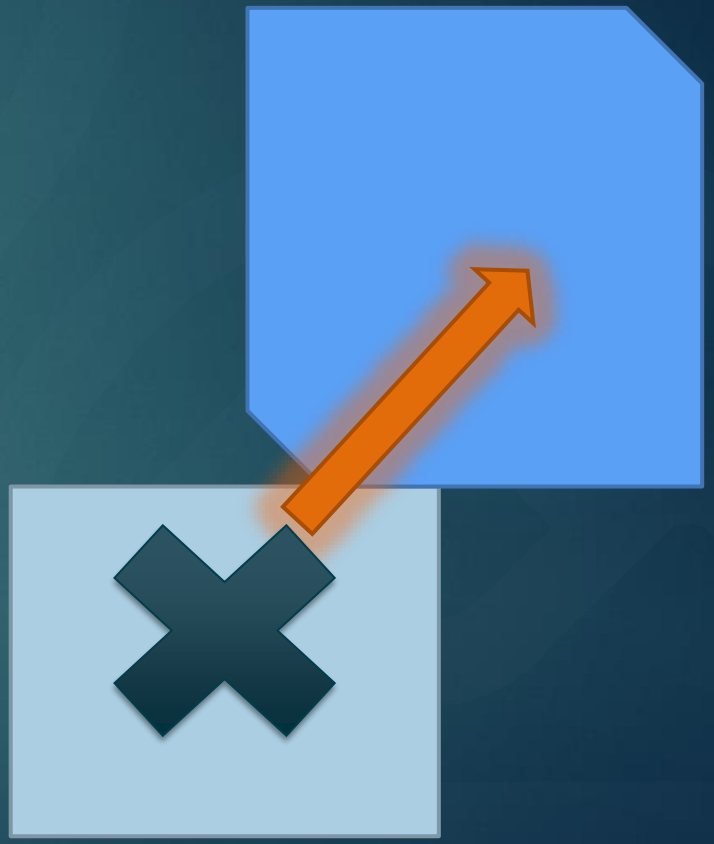
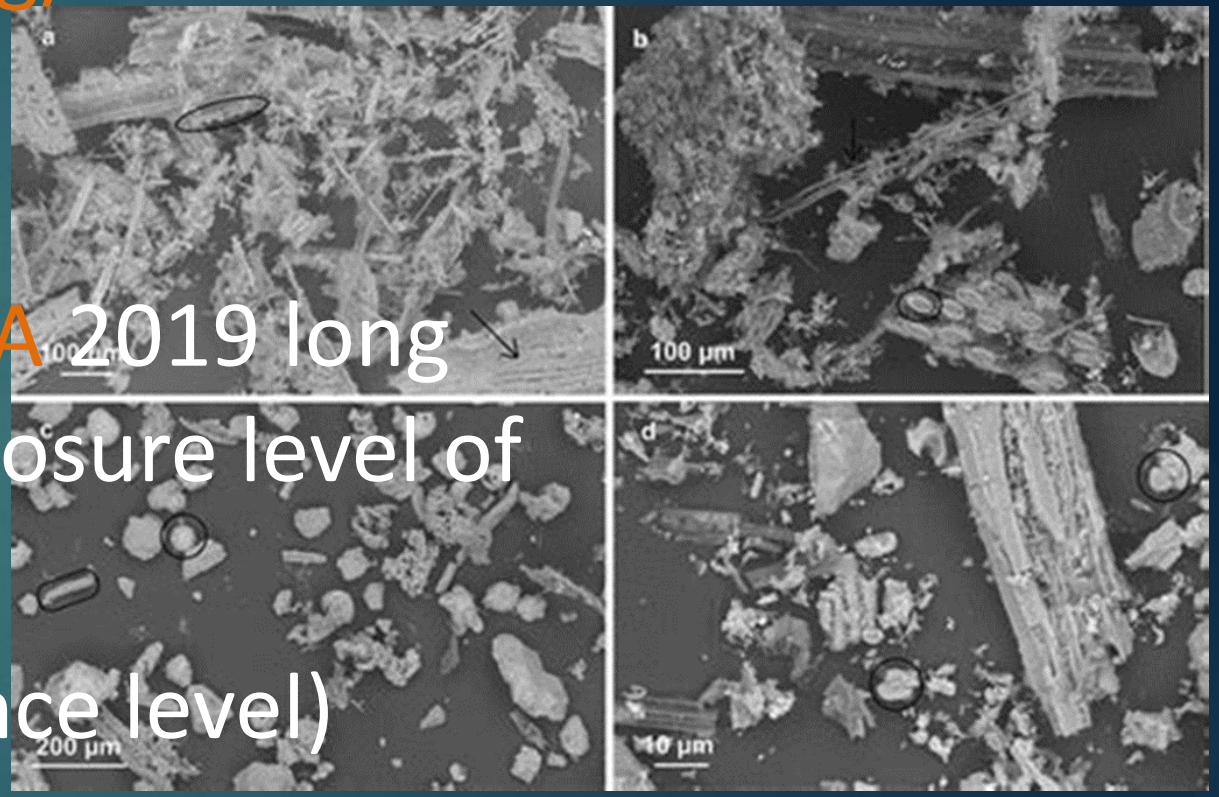




Respirable Crystalline Silica (RCS, PM_4)

- Worker health WES 0.05 mg/m^3 TWA for 8-hour shift
- Annual average criteria (chronic) Californian OEHHA 2019 long term chronic reference exposure level of 3 $\mu g/m^3$
- Texas 1-hour (acute reference level) 47 $\mu g/m^3$



What's not going away?

Dust nuisance/amenity impacts

That there shall be no noxious, dangerous, objectionable or offensive dust to the extent that the discharge causes an ***adverse effect*** *at or beyond the boundary of the site.*

FIDOL Definitions

Frequency

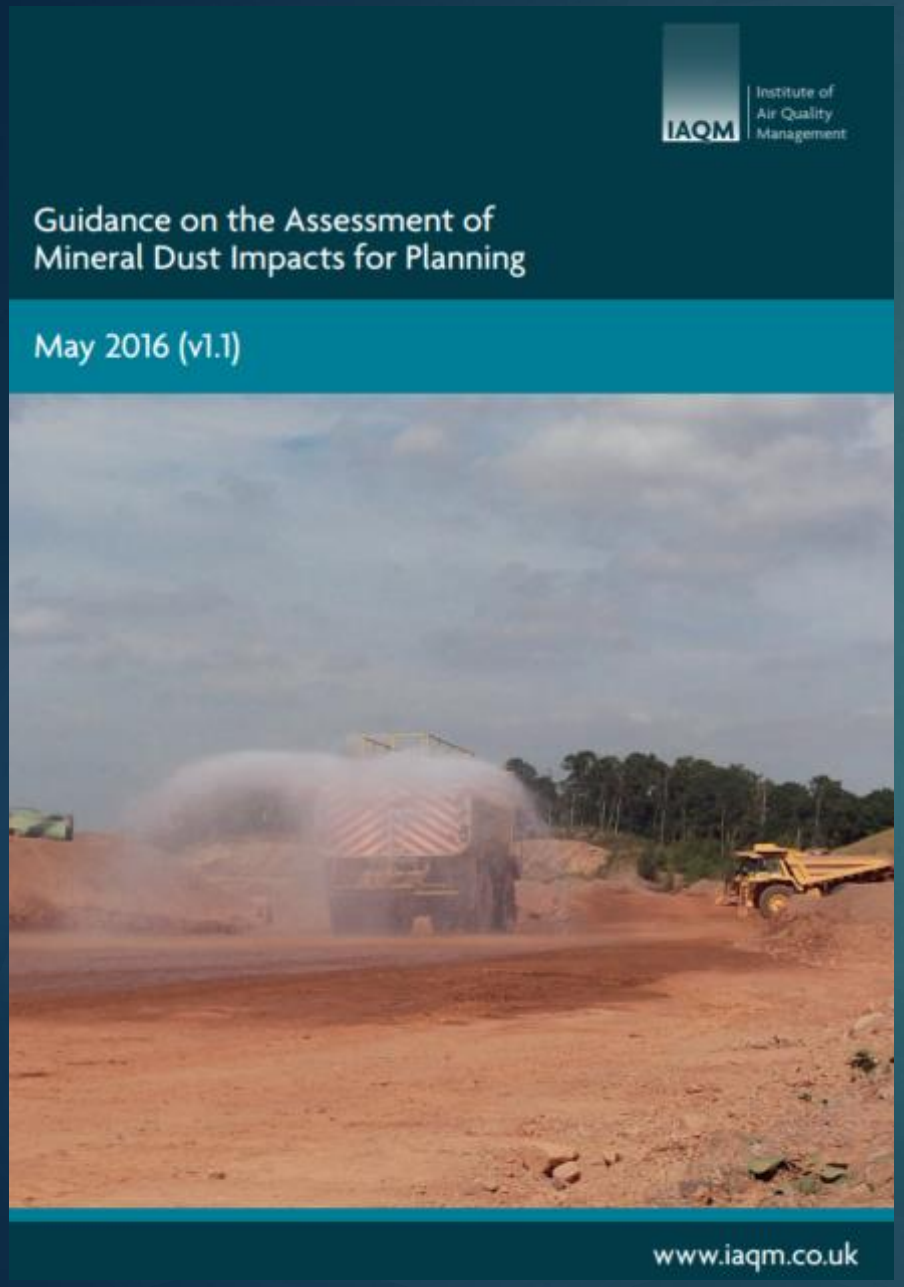
Intensity

Duration

Offensiveness/character

Location

Dust assessment



- FIDOL
- IAQM (S-R-P)
- Complaint data
- Experience elsewhere
- Air quality monitoring data

Dust sources

- Open areas
- Stripping
- Bund construction
- Stockpiles
- Material extraction
- Vehicles
- Processing plant
- Cleanfill
- Rehabilitation
- Material transfer/haul roads

Good Practice Mitigation

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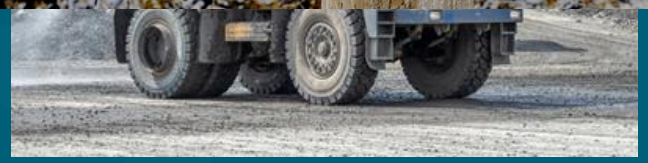


Monitoring

- weather stations
- visual daily checks
- ambient air and compliance monitoring stations
  - Continuous instrumental TSP, PM_{10}
  - Standard regulatory methods
  - Deposition

Deposition vs TSP vs PM_{10}

Historically

- TSP (24-hour) and dust deposition (30-day) for nuisance dust
- PM_{10} (24-hour) for health effects

Emerging

- Real-time monitoring for PM_{10}
- Deposition gauges are becoming less common as the cost of continuous dust monitoring equipment has come down in price.

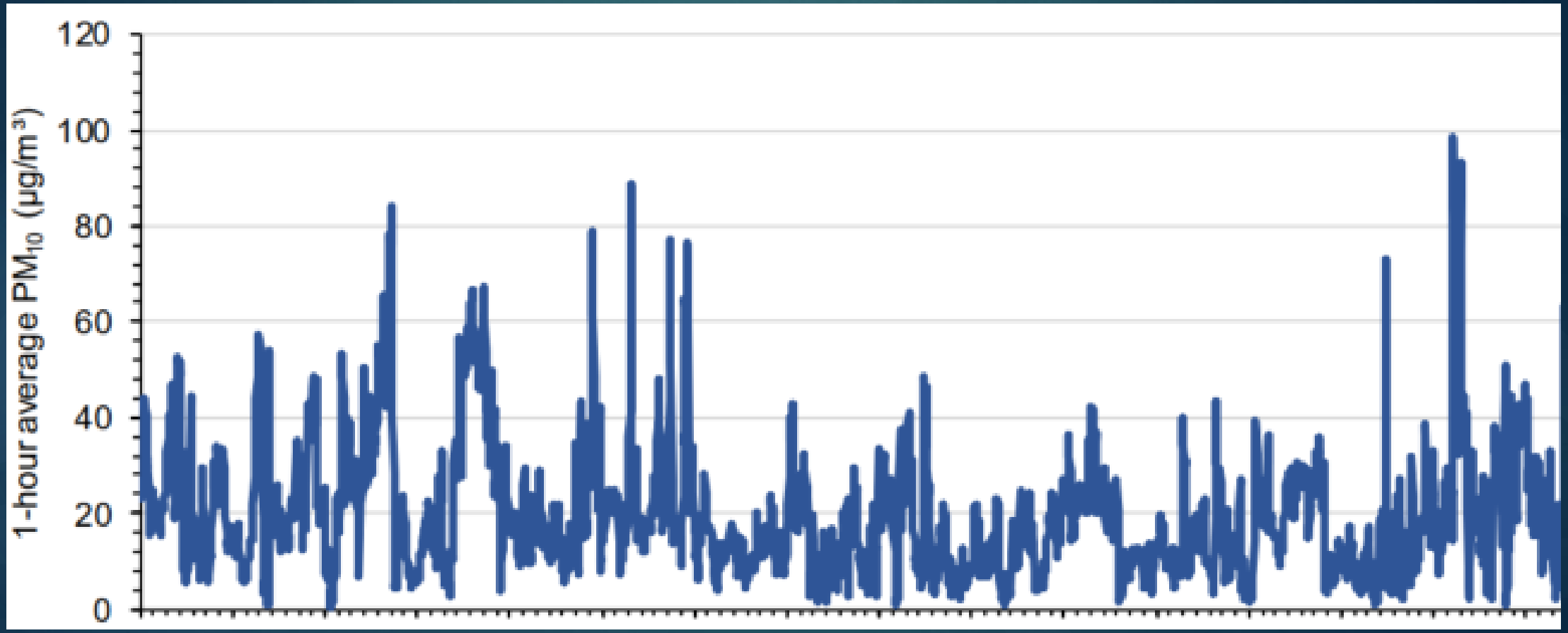
Deposition vs TSP vs PM_{10}

Monitoring type	Advantages	Disadvantages
Deposition Gauges	Low cost and low maintenance No power required	Cannot be used to determine nuisance short term dust events (averaging period ~30 days), data analysis by laboratory (retrospective)
Real time TSP	live data configured with telemetry can be used to actively control dust. Historical association of TSP with dust nuisance	Modern low-cost sensors currently do not have reasonable correlation with TSP so reliable instruments more costly Typically require power/solar Calibration and maintenance costs.
Real time PM_{10}	Provides live data which if configured with telemetry can be used as a management tool to control dust. Emerging as an indicator for managing dust impacts and provides an indicator of NES compliance	Some low-cost sensors that show good correlation with PM_{10} Typically require power/solar Calibration and maintenance costs.

Monitoring trigger values – adaptive mgmt

- PM_{10} as an indication of nuisance dust
  - MfE GPG 150 µg/m^3 as a 1-hour average
- PM_{10} investigate/cease work triggers
  - site specific 60 – 70 µg/m^3 as a 1-hour average
- Wind speed triggers
  - 7 to 10 m/s for ceasing works (depending on sensitivity)

Time series 1-hour average PM_{10} data



Data analysis

Monitoring Yaldhurst Quarries - Christchurch

Yaldhurst Air Quality Monitoring

Summary Report: 22 December – 21 April 2018

Summary Report

19 June 2018

Prepared for

Environment Canterbury

by Paul Baynham

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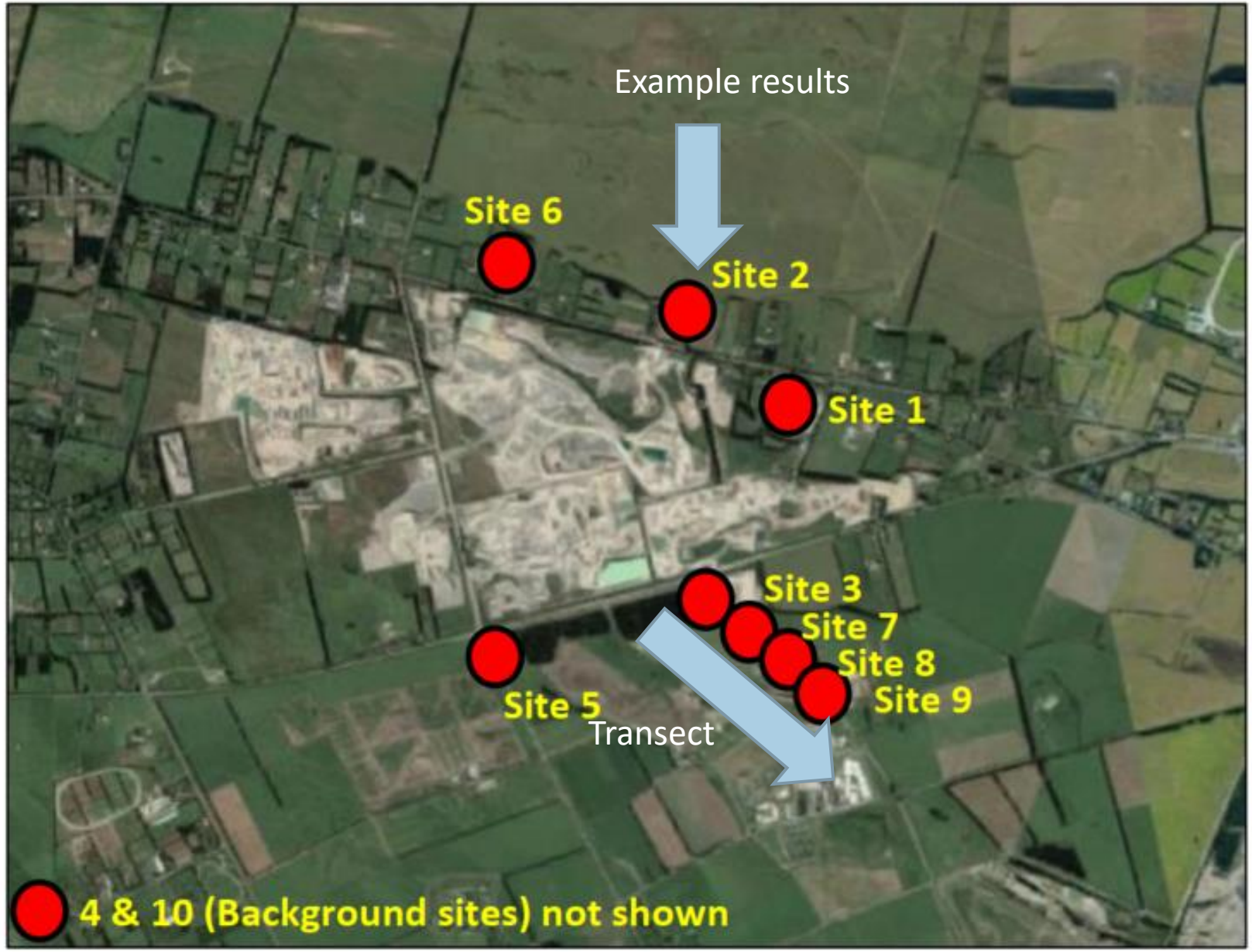
Yaldhurst Quarries

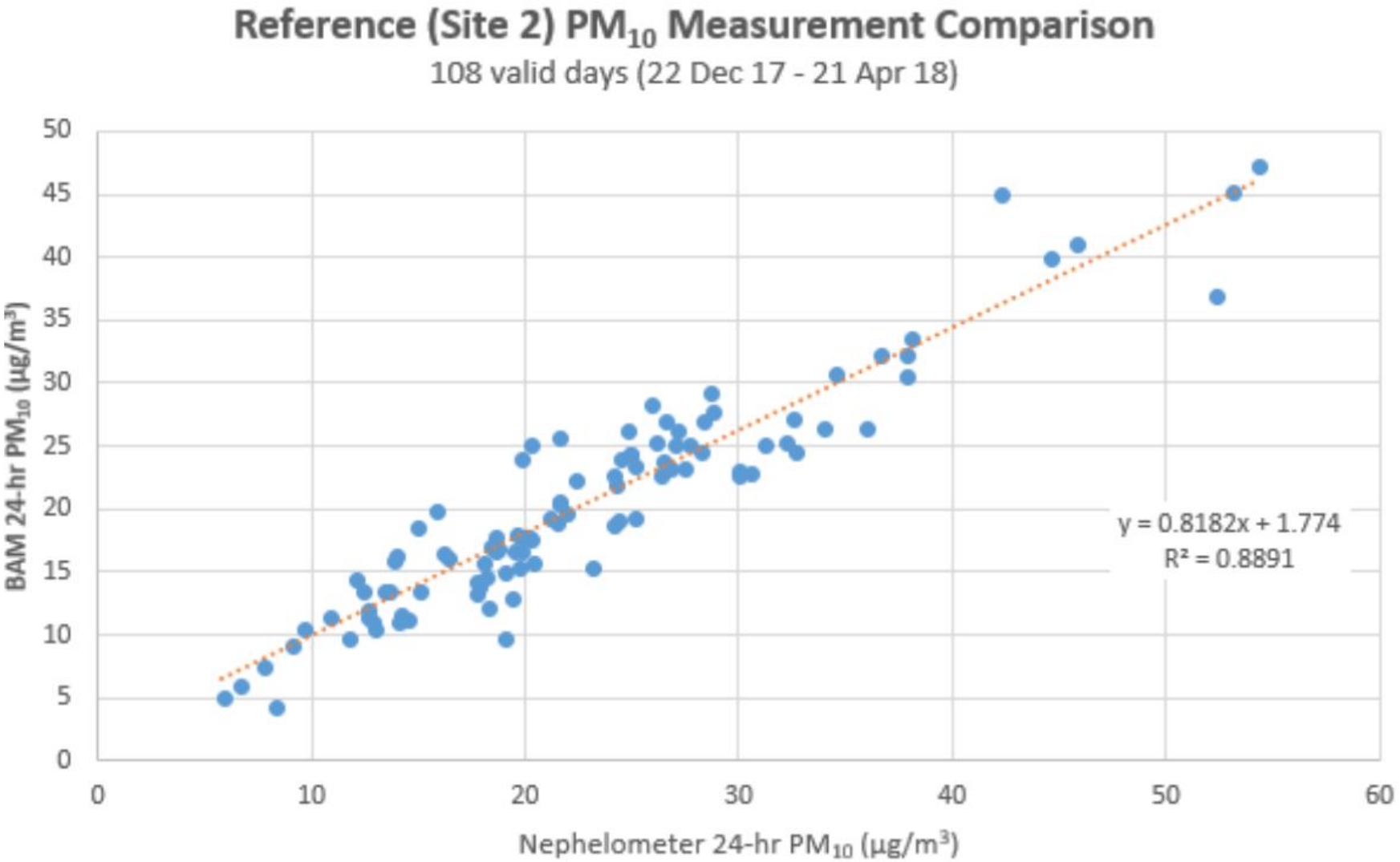
- Multiple operators
- Total 230 ha active open area
- Around 2 million tonnes per year of aggregate production
- Multiple crushers and screens

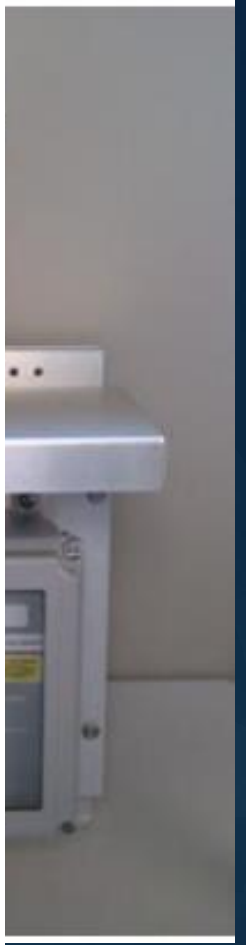
Yaldhurst monitoring programme

- Summer period (four months)
- RCS due to health concerns - six sites
- PM_{10} to understand NES compliance and nuisance – six sites
- PM_{10} & $PM_{2.5}$ to help understand and characterize the PM around quarries as a way of understanding short-term RCS - three sites
- Meteorology (windspeed, wind direction and rainfall)
- Transect of PM_{10} monitoring - measuring impact with distance downwind from quarry
- Background – locations not impacted by quarrying

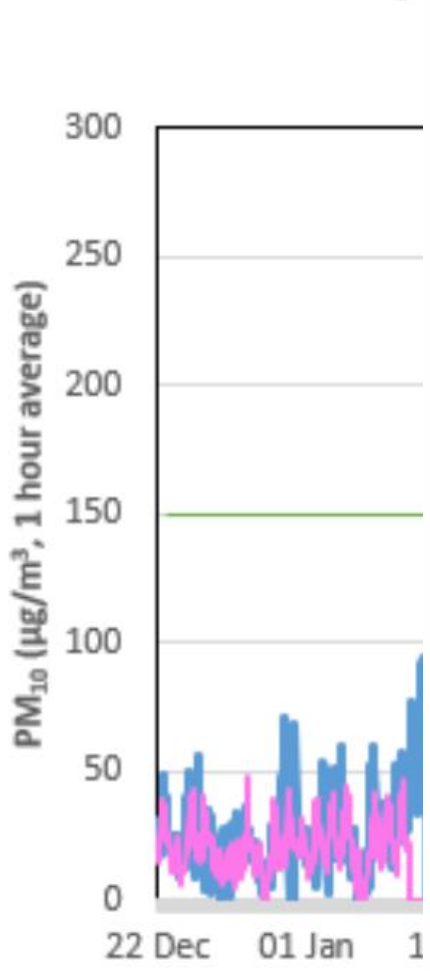

Example results
Site 6
Site 2
Site 1
Site 3
Site 7
Site 8
Site 9
Site 5
Transect
4 & 10 (Background sites) not shown

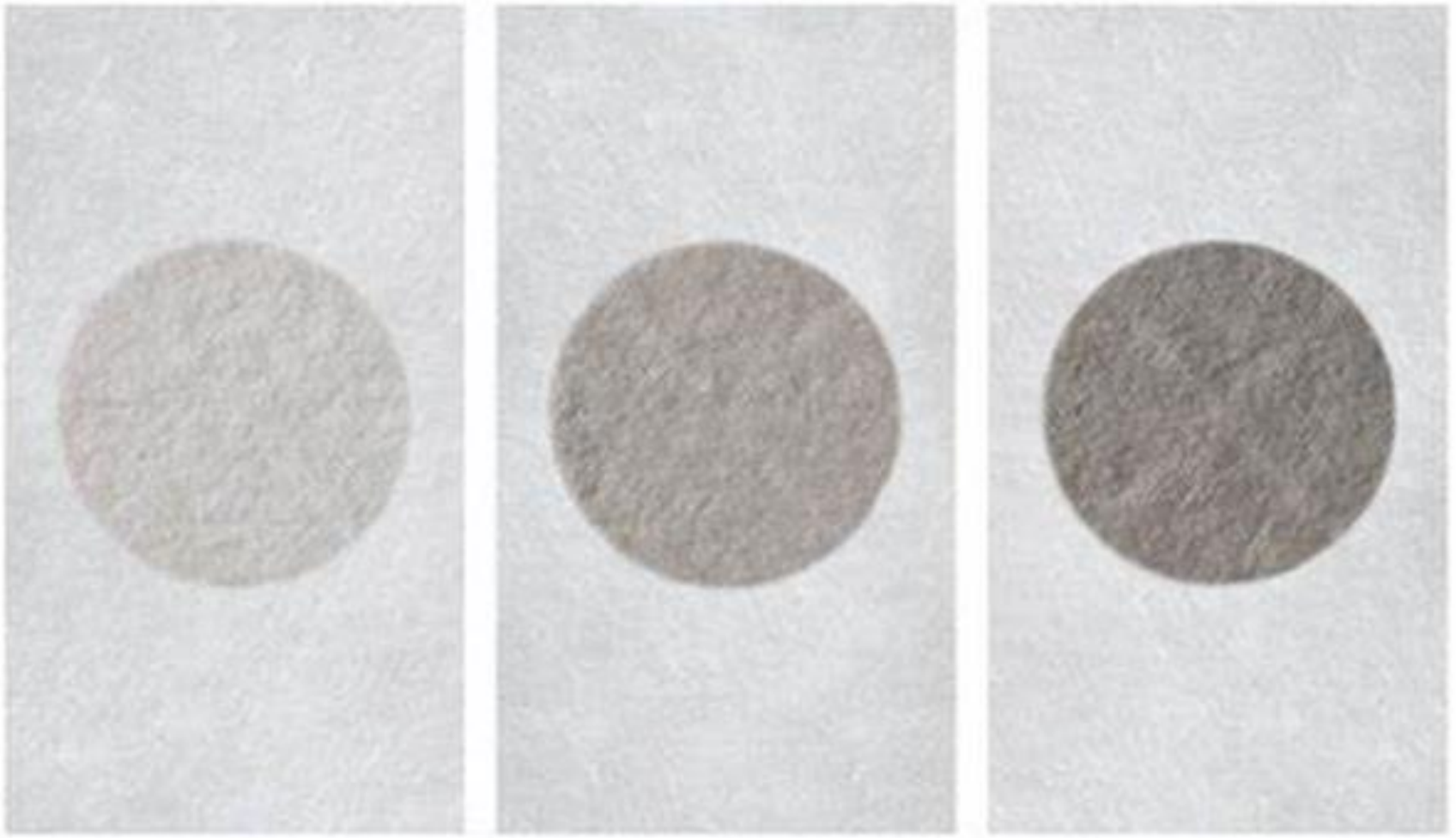
Monitoring Equipment PM_{10} NES vs low cost (





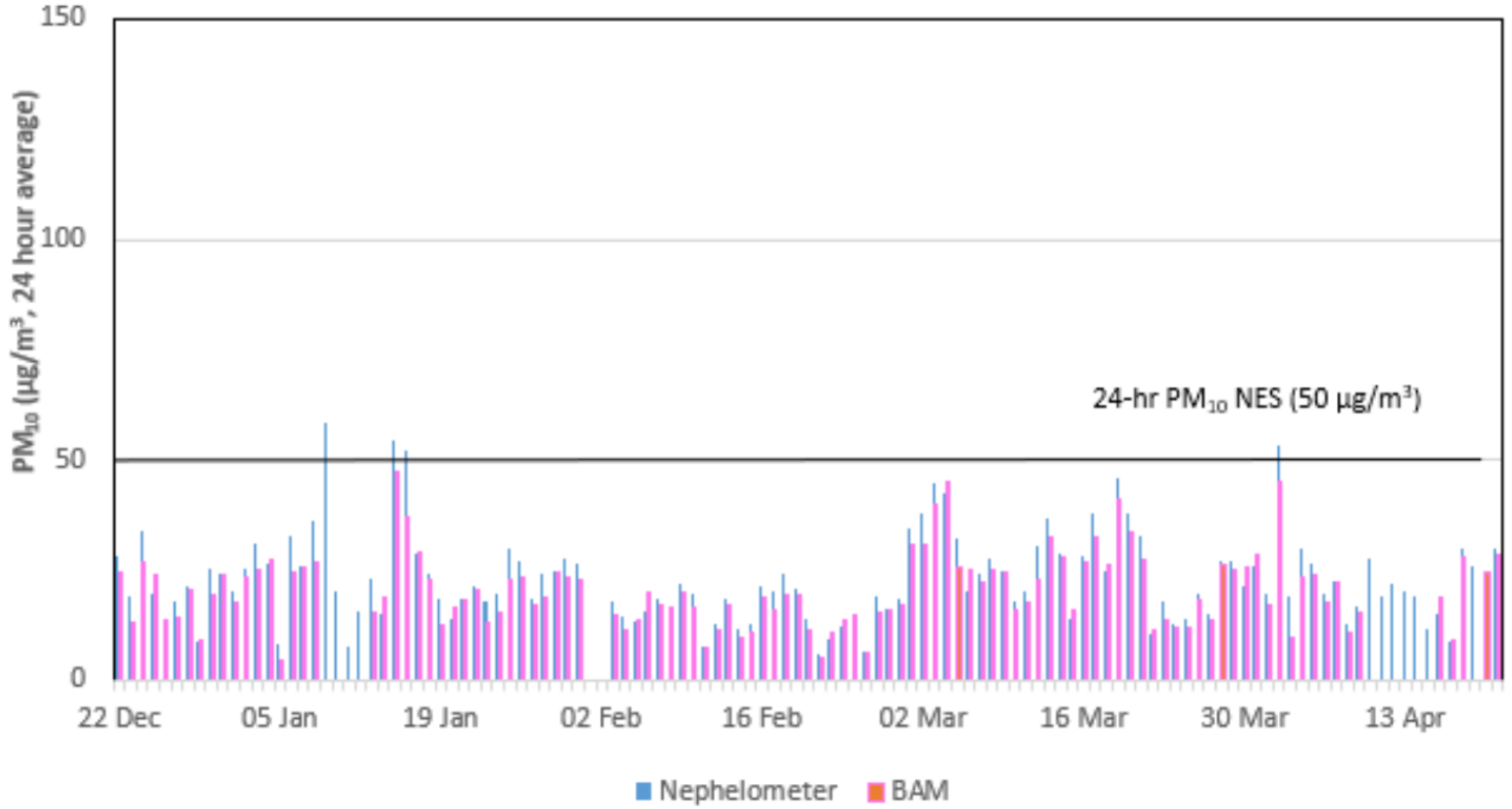
Site 2. BAM and Nephelometer PM_{10} results



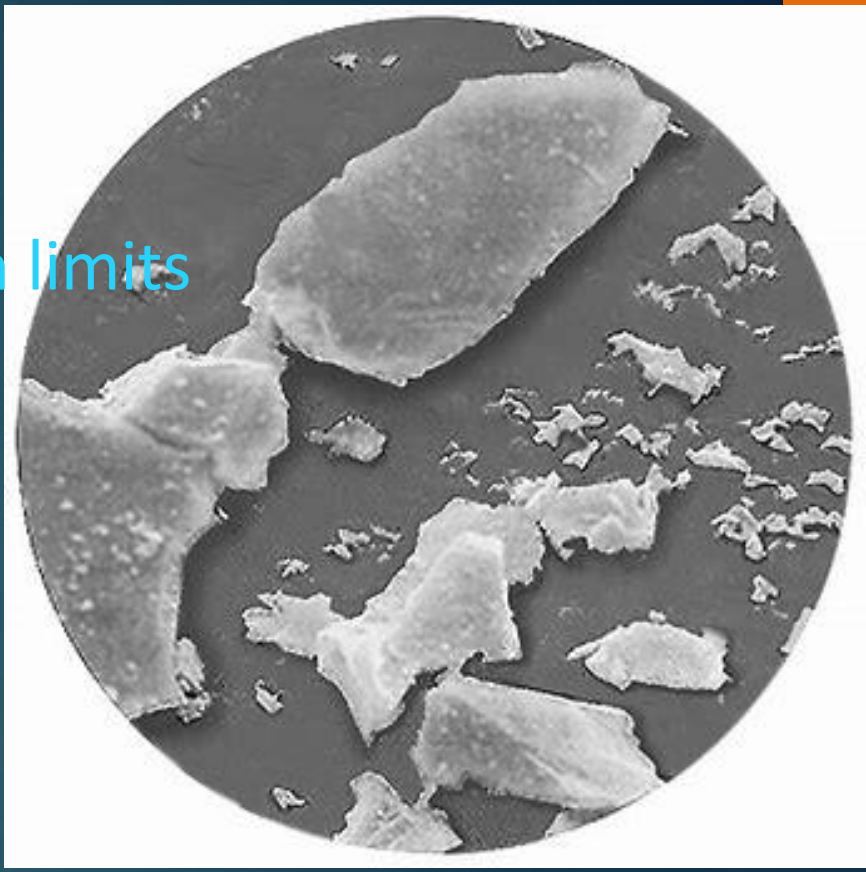


Nephelometer BAM

Site 2 BAM and Nephelometer 24-hour PM_{10}



Key Findings: RCS



- Total of 20 filters
- Only two filters had RCS above laboratory detection limits
- At site 3 (50 m from Southeast boundary)
- Three-month average at Site 3 was 0.4 µg/m^3
- Chronic reference level for RCS is 3.0 µg/m^3

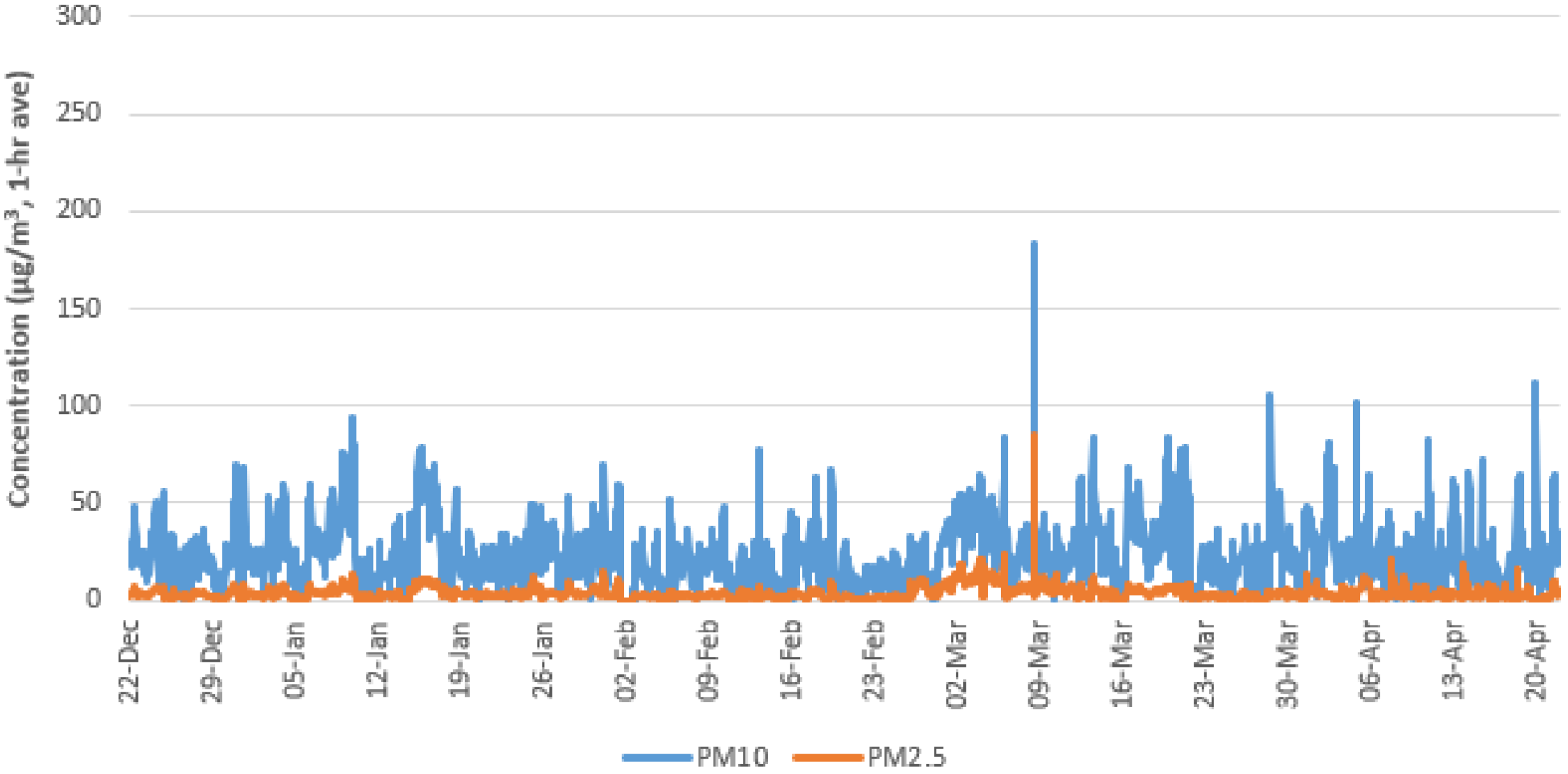
- Conclusion:
  - RCS emissions are unlikely to cause any adverse health impacts

Key Findings: PM_{10}

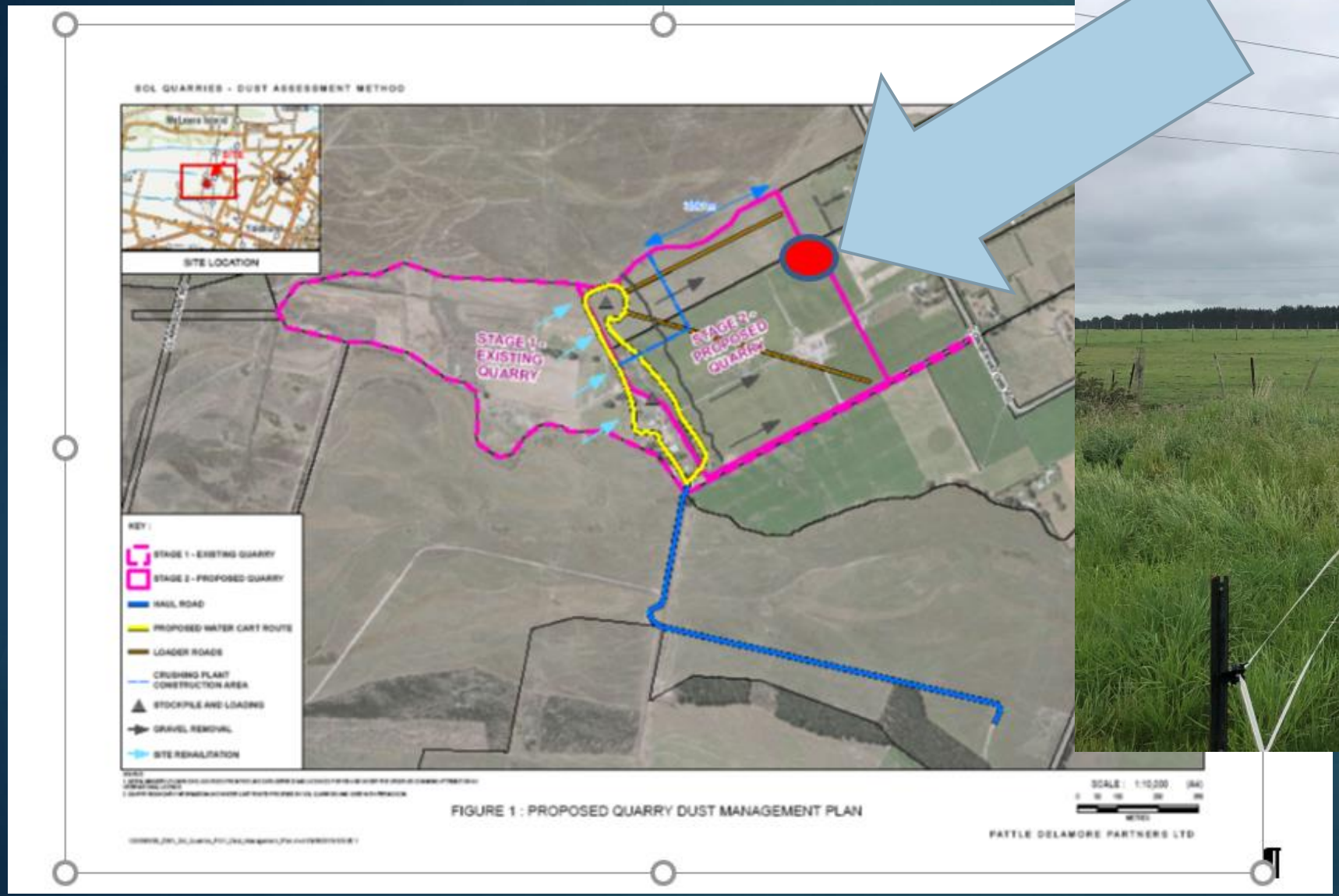
- No measured exceedances of 24-hour concentrations with BAM and peak similar to background site (45 µg/m^3) – no health impact
- Maximum hourly concentrations measured close to the quarries were higher (~200 µg/m^3) than those measured at background site (~100 µg/m^3) – some evidence of nuisance dust

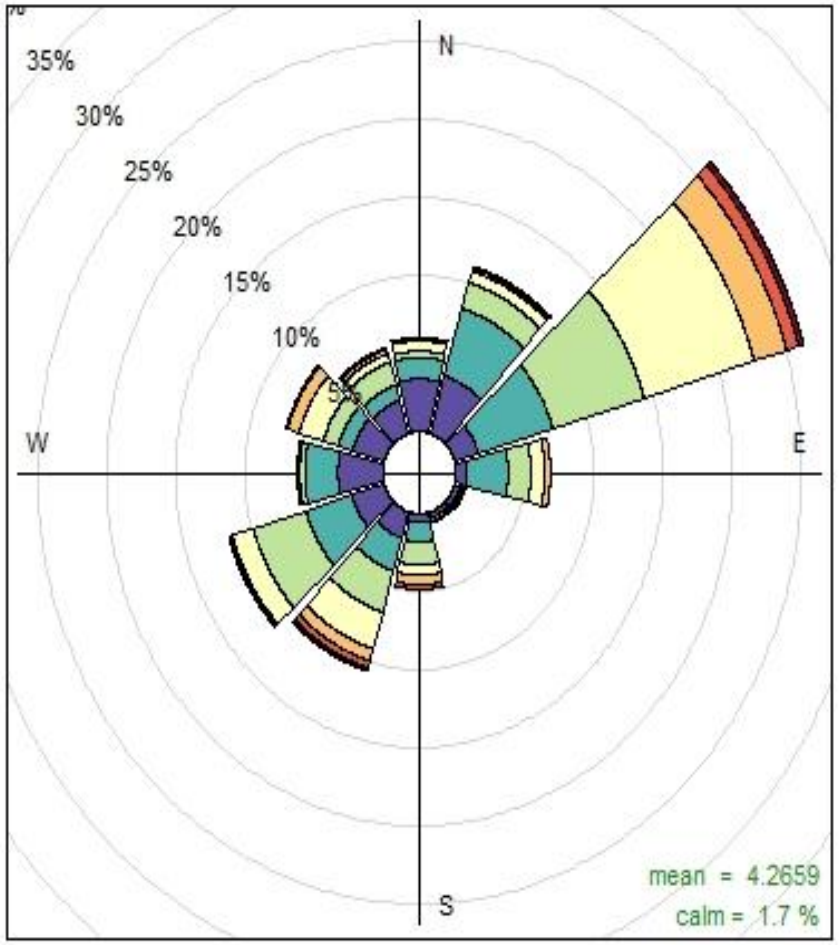
PM_{10} and $PM_{2.5}$ at Site 2: Rural/Residential

(1 hour average, 22 Dec 2017 - 21 Apr 2018)

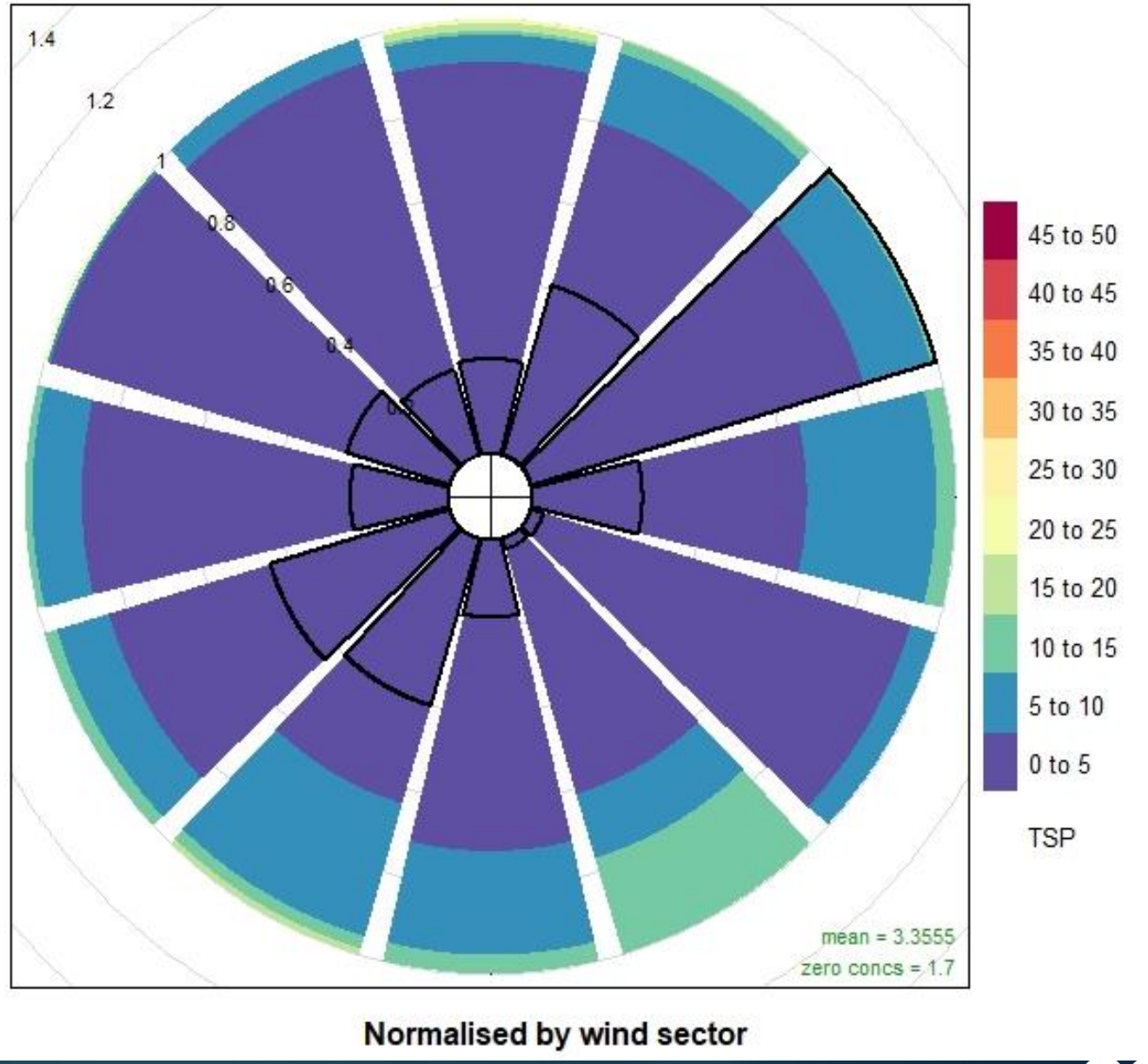


What does this all mean for other quarries?





Frequency of counts by wind direction (%)



Normalised by wind sector

On-site dust/PM_{10} and wind monitoring

- Leverage off Yaldhurst study findings
- Helped address subjective anecdotal evidence
- Very persuasive at hearings
- Enabled undertaking more limited onsite monitoring
- Provides value for investment

Key Takeaways

- Size matters
- Dust issues can be a subjective minefield
- Tools are available for semi-quantitative assessments
- $PM_{2.5}$ from quarries is very low
- Yaldhurst study is useful to understand the potential impacts of other quarries by extrapolation
- Monitoring data helps remove subjectivity and uncertainty

References

- Kuschel, G., et al, *Updated health and air pollution in New Zealand study 2012 - Summary report*, August 2020
- Institute of Air Quality Management, *Guidance on the Assessment of Mineral Dust Impacts for Planning*, May 2016
- Ministry for the Environment (MfE), *Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions*, 2016
- Mote Ltd, Yaldhurst Air Quality Monitoring Summary Report, 2018