Heath Impacts of dust from unsealed roads
An **important note** for the Audience

- The views expressed in research reports are the outcomes of the independent research, and should not be regarded as being the opinion or responsibility of the NZ Transport Agency.

- NZ Transport Agency and agents involved in the preparation and publication do not accept any liability for use of the research.
Research objectives

1. **Describe and quantify the impacts of dust** exposure from unsealed roads
2. **Collect new data** to characterise the dust and quantify the impacts of dust
3. Investigate **dust mitigation measures**.
4. Estimate the **costs of the health impacts** and the **benefits of mitigating the dust**
5. Tools to **support decision making** about mitigation options.
Monitoring Site Location:

- Number and type of vehicles passing the site each day
- Number of nearby dwellings
- Topography and meteorology (maximum frequency of cross-road winds)
- Cell phone coverage (ability to telemeter the data from site)
- Suitable locations to install equipment on roadside (requires permission from private land owners)
- Power supply available for equipment (solar powered equipment more expensive to install and problematic to run)

Permitted Activity – dust suppressants

Helpful and engaged TLA
Monitoring Site Location
Site geology, roadway construction and traffic

- Base geological material is **sedimentary rock**
- The **design and construction** is **typical of other unsealed roads** within the Northland Region.
- The **maintenance schedule is typical** of other unsealed roads in the FNDC.
- **Metal** used to cover the road bases in Northland **varies from road to road** with metals being supplied from close by sources.
- Logging **truck numbers are relatively high**
Monitoring equipment - Dust
Dust Suppression
Monitoring site layout and equipment network
Total suspended particulates and PM$_{10}$
Total suspended particulates and PM$_{10}$
PM$_{10}$ concentrations - untreated

24-hour average PM$_{10}$ conc. (µg/m$^3$)

Day / Month:
- Untreated North 5m
- Untreated North 30m

September 26, 2017
Treated section of road
PM$_{10}$ NES Concentrations - treated

24-hour average PM$_{10}$ conc. (µg/m$^3$) vs. Day / Month

- Treated North 5m
- Treated North 30m

September 26, 2017
Dust mitigation 1: Effectiveness of dust mitigation

Note: Top error bars represent 90th percentile values. Bottom error bars represent minimum values.
Dust mitigation 2: Longevity of dust mitigation

- No sign of reduced effectiveness of suppressant over the life of the monitoring programme.
- Qualitative assessment (multivariate statistics could be employed)
Vehicle speed as a dust mitigation measure
Dust deposition

- Deposited dust adjacent to the **untreated section** of the road was **much higher** than the MfE trigger level of 4 g/m$^2$/30 days

- A large variation was observed in the two results from the untreated section of the road (12 to 48 g/m$^2$/month)

- The deposited dust adjacent to the **treated section** of the road was **no greater than background levels** and consistent over both measurement periods
Respirable silica

- Potentially hazardous components of road dust
- Sampling undertaken at untreated, north 5 m site
- Simple pump and filter set up

Mass of respirable silica were below the detection limit

Preliminary conclusion - residents of Mataraua Road are unlikely to be exposed to annual average concentrations of greater than 5 μg/m³.

To confirm this conclusion, a more detailed monitoring programme of longer duration would be required.
### Benefit to cost ratio of dust mitigation

**Table 6.3: Benefit-to-cost ratio of treating and sealing sections of the road surface (annualised approach)**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Annual av. PM$_{10}$ conc. ($\mu$g/m$^3$)</th>
<th>Annual health cost ($000)</th>
<th>Annual health benefit of PM$_{10}$ mitigation ($000)</th>
<th>Annual roading costs ($000)</th>
<th>Annual additional cost of M&amp;M (a) ($000/km)</th>
<th>Benefit/cost ratio (mitigation vs no mitigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsealed and untreated road</td>
<td>72</td>
<td>NA</td>
<td>NA</td>
<td>10</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Unsealed and treated road</td>
<td>41</td>
<td>17</td>
<td>$20.2$</td>
<td>$15$</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Sealed road surface (40-yr life)</td>
<td>29</td>
<td>29</td>
<td>$20.6$</td>
<td>$15.4$</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Sealed road surface (10-yr life)</td>
<td>29</td>
<td>29</td>
<td>$37.9$</td>
<td>$32.7$</td>
<td>0.9</td>
<td></td>
</tr>
</tbody>
</table>

(a) M&M = maintenance and mitigation
Benefit to cost ratio of dust mitigation

Notes:
1) Only human health benefit included in BCR.
2) Mitigation cost is incremental when compared to an unsealed and untreated road.
3) BCR calculated based on the NPV of benefits/costs for the...
Dust mitigation - decision making process

**Figure 7.1 Dust mitigation - decision making process**

1. **Is there a need to mitigate road dust?**
2. **Calculate a site dust risk score.**
   - **Medium risk.** There may be some benefit from mitigation. Return to and repeat Decision Matrix 1 with refined site specific information.
   - **Low Risk.** Little or no benefit from mitigation. End of decision making process.
3. **High risk.** There is likely to be a benefit from mitigation. Complete assessment of suitable mitigation options.
4. **Assess which mitigation options are suitable?**
5. **Assess cost/benefit of available mitigation options.**

**Dust Risk assessment matrix**
## Dust risk matrix

<table>
<thead>
<tr>
<th>Risk factor/score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 day AADT of HDVs</td>
<td>0</td>
<td>1–5</td>
<td>6–10</td>
<td>11–25</td>
<td>26–50</td>
<td>More than 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed limit of HDVs (km/h)</td>
<td>No HDVs</td>
<td>20</td>
<td>≥50 km/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 day AADT of LDVs</td>
<td>&lt;100</td>
<td>101–300</td>
<td>&gt; 300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed of LDVs (km/h)</td>
<td>&lt; 50</td>
<td>50–70</td>
<td>&gt; 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptors (within 80m of roadway)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of dwellings (houses/km)</td>
<td>0</td>
<td>1</td>
<td>2–4</td>
<td>5–7</td>
<td>8–10</td>
<td>More than 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other sensitive human receptors (location/km)</td>
<td>None</td>
<td>1–2</td>
<td>3 or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecologically sensitive areas (sensitive locations/km)</td>
<td>None</td>
<td>1–2</td>
<td>3 or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horticultural sensitive areas such as fruit orchards (sensitive locations/km)</td>
<td>None</td>
<td>1–2</td>
<td>3 or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of roadway</td>
<td>Open plains or costal area</td>
<td>Some land features likely to slow winds</td>
<td>Inland enclosed valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of rain days (&gt;5mm) per week</td>
<td>&gt;2</td>
<td>0.5 to 2</td>
<td>&lt;0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longevity of intensive heavy duty vehicle use</td>
<td>1–2 years</td>
<td>&gt;3 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dust risk assessment (currently being trialled in New Zealand)

<table>
<thead>
<tr>
<th>Total dust risk score</th>
<th>Dust risk category</th>
<th>Potential benefit from dust mitigation</th>
<th>Action to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9</td>
<td>Low</td>
<td>Little or no benefit from mitigation.</td>
<td>End of decision-making process.</td>
</tr>
<tr>
<td>10 to 19</td>
<td>Medium</td>
<td>There may some benefit from mitigation.</td>
<td>Return to and repeat the ‘Site dust risk factors and scores’ with refined site-specific information.</td>
</tr>
<tr>
<td>20 to 30</td>
<td>High</td>
<td>There is likely to be a benefit from mitigation.</td>
<td>Complete assessment of suitable mitigation options.</td>
</tr>
</tbody>
</table>
Example – Dust Risk Assessment Matrix
<table>
<thead>
<tr>
<th>Risk Factor/Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Waikakaho Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 day AADT of HDVs</td>
<td>Less than 5</td>
<td>05-Oct</td>
<td>Oct-25</td>
<td>25-50</td>
<td>More than 50</td>
<td>60</td>
</tr>
<tr>
<td>Longevity of logging route use</td>
<td>Not a logging route</td>
<td>1 year or less</td>
<td>2 years or less</td>
<td>3 years or less</td>
<td>Longer than 3 years</td>
<td>1</td>
</tr>
<tr>
<td>Speed of HDVs</td>
<td>20 km/hr limit</td>
<td>50 km/hr limit or greater</td>
<td>30</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of dwellings within 80 m of roadway</td>
<td>none</td>
<td>1</td>
<td>02-Apr</td>
<td>05-Aug</td>
<td>More than 8</td>
<td>15</td>
</tr>
<tr>
<td>AADT of LDVs</td>
<td>Less than 50</td>
<td>50-100</td>
<td>100-200</td>
<td>200-400</td>
<td>More than 400</td>
<td>60</td>
</tr>
<tr>
<td>Speed of LDVs</td>
<td>Less than 50 km/hr</td>
<td>50-70 km/hr</td>
<td>Greater than 70 km/hr</td>
<td>70</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Location of roadway</td>
<td>Open plains or coastal area</td>
<td>Some land features likely to slow winds</td>
<td>Inland enclosed valley</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of rain days (&gt;5 mm)</td>
<td>More than 3 per week</td>
<td>More than 2 per week</td>
<td>More than 1 per week</td>
<td>Less than once per week</td>
<td>Less than once per month</td>
<td>3</td>
</tr>
<tr>
<td>Other locations where people are likely to be exposed. (e.g. schools, marae, or hospitals)</td>
<td>None</td>
<td>1 location</td>
<td>2 locations</td>
<td>3 or more locations</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Ecologically sensitive areas such as rare species habitats or wetlands</td>
<td>None</td>
<td>1 sensitive areas</td>
<td>2 sensitive areas</td>
<td>3 or more sensitive areas</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Nuisance effects for residents</td>
<td>No complaints</td>
<td>1 – 2 complaints total</td>
<td>More than 2 complaints per year</td>
<td>More than 6 complaints per year</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Horticultural sensitive areas such as fruit orchards</td>
<td>No</td>
<td>1 sensitive areas</td>
<td>2 sensitive areas</td>
<td>3 or more sensitive areas</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Waikakaho Valley Example - Result

Matrix Score of **26** -> **High Risk** from Dust

=> Benefit likely from mitigations. Assess suitable options
Recent Dust Mitigations in the Waikakaho

- 2014 - carried out prior to this research project
- 2.5 km of road treated
- In response to public concerns
- First water: – 90 days @$1000/day; $36,000 per km
- Then Otta Seal: (2.5km) @ $270,000; $68,000 per km
- [Suppressant at Mataraua Road: (MgCl2): $20,000 per km (pa)]
Trialling and Calibrating Risk Scores

- Council A - Total Length 840 km
- Combined Council B-F - Total Length 1030 km
- All Councils - Total Length 1870 km

100% (1870 km) of roads have a risk score ≥ 6

- 17% (320 km) of roads have a risk score ≥ 15
- 8% (155 km) of roads have a risk score ≥ 16
HOW COULD DUST MITIGATION BE FUNDED IN THE NLTP?

RCAs will be responsible for determining the optimal balance of the scope, timing and expenditure within their approved road maintenance allocation. Please discuss any proposed dust mitigation within your current approved road maintenance allocation (2015 – 2018) and the impacts on your wider network maintenance programme with your Regional Planning and Investment staff.

Should an RCA determine there is merit in investing in dust mitigation but that it does not have the ability to fund this within the current approved maintenance allocation then a cost scope adjustment must be applied for in the usual way. As with all cost scope adjustments the ability of the Transport Agency to support the request for additional funding in part or full will be subject to there being a robust case (based on the attached methodology and NPV calculation) for investment and funding being available in the relevant activity classes.

Requests for funding assistance for dust mitigation in future NLTPs will be considered as part of the overall road maintenance negotiations with each RCA and will be subject to all the applicable funding criteria for the relevant NLTP.

Any investment through the NLTP in dust mitigation will be at the RCA’s normal funding assistance rate.
Current work

- RCA road dust working group
- Work Programme
- Trialling and calibrating Risk Tool
- Mapping the risk
- Funding discussions
Proposed Work Programme

OUTCOMES
- Reduced impacts
- Legal compliance
- Efficient & effective mitigation
Links to Other LVR presentations

- **David Jones**
  - Road construction
  - Cannot make a bad road good?
  - Selection of suppression method

- **Jamie Cox**
  - Calibrating the risk tool
  - Mapping health risk Nationally
  - Example business cases for co-funding

- **Johnny Brown**
  - Similar findings but qualitative
Acknowledgements

- **NZTA:** Funding – Research project TAR14/31.
- **Project Steering Group:** Rob Hannaby (NZTA), Jon Cunliffe (Marlborough District Council), Frances Graham (Ministry for Health) Greg Haldane (NZTA) and Iain McGlinchy (Ministry of Transport)
- **Far North District Council:** for hosting the dust monitoring programme.
- **Transfield Services:** (Mike Grimshaw, Far North Branch) for applying the dust suppressant.
- **Air Quality Limited:** (Mark Bart and Paul Baynham) For commissioning and operation of the equipment and processing the monitoring data.
- **Dust Control Solutions:** (Anthony Stewart) for advice on dust suppressant type and for supplying the dust suppressant.
- **Equipment hosts:** Kaingahoa Marae (Jane Whiu), Tasha Whiu, Doug Boyd, Colin Pinkney for hosting the monitoring equipment on their Mataraua Road properties.
- **Northland Regional Council:** for assistance with clarifying the activity status of applying the dust suppressant
The primary purpose of this research was to improve our understanding of the impacts that dust emissions from unsealed roads have on people and investigate dust mitigation measures. The project’s key research objectives were:

1. Characterise the dust and quantify the impacts of dust from unsealed roads on people.
2. Determine the effectiveness and cost of dust mitigation measures.
3. Estimate the costs of the health impacts of dust and estimate the benefits of mitigating the dust.
4. Propose a methodology to support decision making about mitigation options.

A two month road dust monitoring campaign was undertaken on a section of Mataraua Road, 10km southwest of Kaikohe in the Far North District, during February, March and April 2015.

The monitoring results indicated that potential adverse human health impacts might occur due to the dust discharged from untreated unsealed roads. A comparison of the PM$_{10}$ concentrations monitored at the untreated and treated sites showed that the application of a dust suppressant significantly reduced the impact of dust discharged from the road.

Keywords: dust PM$_{10}$, dust suppression, health effects, unsealed roads.
Questions?

It's QUESTION TIME!!