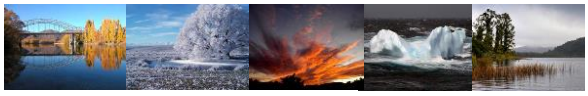

Air Quality for Civil Engineers

NIWA
Taihoro Nukurangi

Guy Coulson
www.niwa.co.nz

Air Quality for Civil Engineers

Part 1

Introduction to NIWA – resources available to engineers

Introduction to air quality management
- What is "air quality"
- Common pollutants
- Regulation
- Management measures

Air Quality Management in NZ
- AQ in NZ
- Regulations - NES and the RMA

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Air Quality for Civil Engineers

Part 2

Impact assessments
- AEE – general
- AQ Impact Assessment
- Requirements
- Steps
- Data sources
- Screening assessment
- Scoping assessment
- Detailed assessment

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* NIWA's purpose

NIWA
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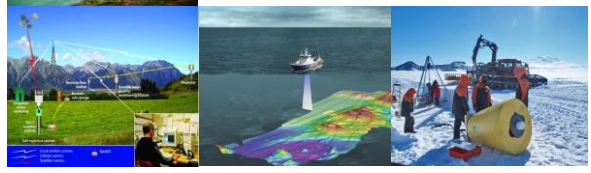
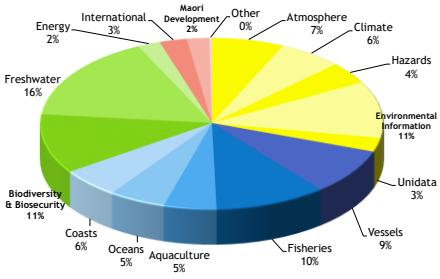
- Enhance economic value & sustainable management of NZ's freshwater and marine resources
- Leverage the benefits of New Zealand's climate
- Increase resilience to weather and climate hazards to improve the safety and wellbeing of New Zealanders



NIWA's services arranged around 'National Science Centres'



NIWA
Taihoro Nukurangi

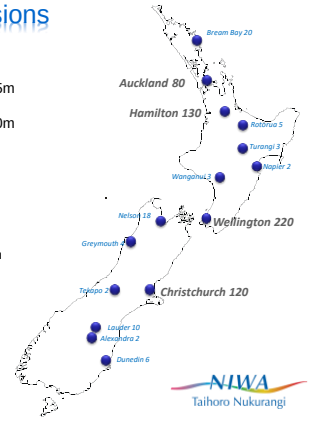
* Dimensions

Revenue: $125m

Assets: $130m

Employees: 600

Main locations:
- Auckland
- Hamilton
- Wellington
- Christchurch



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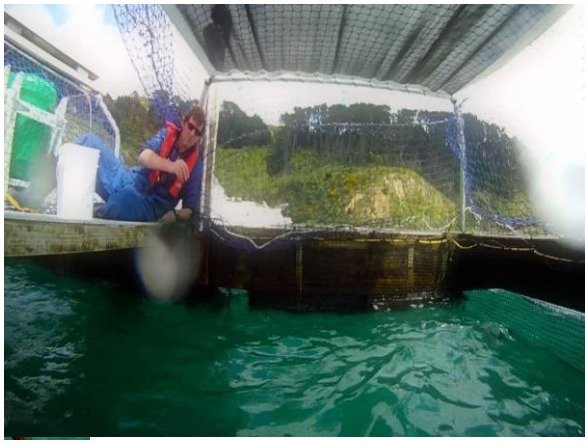
* Key Assets

- People: includes 450 scientists and technicians, 70 science support and 80 administration staff
- National environmental monitoring network (climate, hydrological, satellite, sea-level, mesosphere lasers & balloons)
- Nationally significant collections & databases (e.g., climate, water, atmosphere, marine invertebrates)
- Internationally significant data records (ozone, GHGs, climate, etc.)
- Variety of specialist laboratories
- NZ's largest finfish aquaculture research facilities
- IBM Super computer
- Large array of specialty freshwater and marine research vessels



AIR POLLUTION AND HEALTH - AN INTRODUCTION

	Airborne pollution	Road accidents
Deaths per year	1100	400
Cost to NZ economy	$4.28 billion	4.15 billion
Research budget?	$1 million	?

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

Air quality

What do we mean by air quality?
What causes air quality?
Where?
What is pollution?
Where does it come from?
What does it do?
How do we know?
How do you measure it?
What are the risks?
Who is at risk?
What can you do about it?

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What do we mean by air quality?

Bad
Low quality
High concentrations

Good
High quality
Low concentrations

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What do we mean by air quality?

a measurement of the pollutants in the air;

a description of healthiness and safety of the atmosphere

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What causes air quality?

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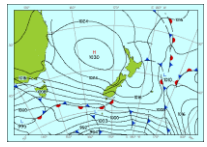
AIR POLLUTION AND HEALTH - AN INTRODUCTION

What causes air quality?



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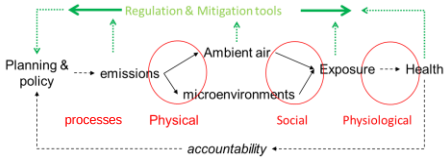
AIR POLLUTION AND HEALTH - AN INTRODUCTION

What causes air quality?



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AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where?

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

The wrong stuff in the wrong place at the wrong time

Anthropogenic Pollution

– Substances that are not naturally occurring in the Earth/ocean/atmosphere system

– Substances that cause harm

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

The wrong stuff in the wrong place at the wrong time

Gas

- carbon monoxide
- carbon dioxide
- nitrogen dioxide
- ozone
- sulphur dioxide
- CFCs
- Organics
  - Benzene,
  - 1,3-Butadiene,

Plus a cast of thousands…

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

The wrong stuff in the wrong place at the wrong time

Particulates

industrial dust
mining
quarrying
Soot/carbonaceous
sulphates from SO_2
nitrates from NOx
(primary, secondary)

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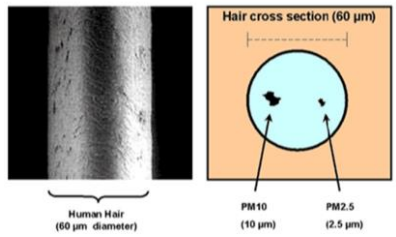
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Particles

PM_{10} $PM_{2.5}$ Ultrafine (UFP) Black Carbon (BC)



All definitions of particles are operational
i.e. defined by the measurement technique

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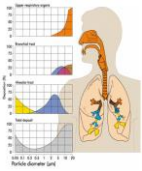
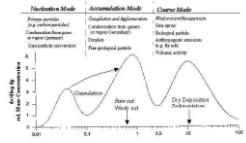
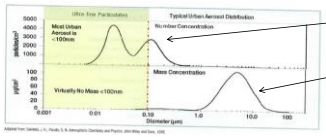
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Particles – size matters







UFP (Number)

PM (Mass)

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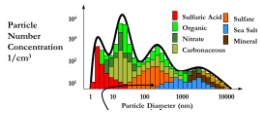
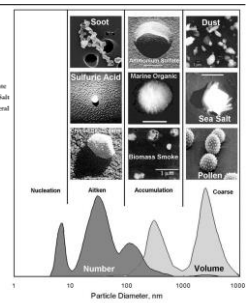
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Particles – composition and shape also matter





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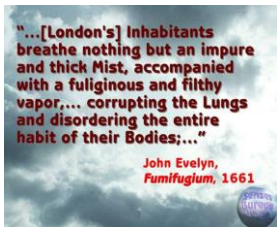
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where does it come from?



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AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where does it come from?

Industrial
- Mining/quarrying - dust, heavy metals
- Manufacturing - gasses, particulates,
- Power generation - soot, NOx and SOx
- Agriculture - pesticides, fertilisers

Transportation
- Traffic
- Aviation (contrails – global dimming)
- Shipping

Domestic - Indoor/outdoor
- Heating
- Cooking
- Refuse – landfill
- cleaning products - sewerage

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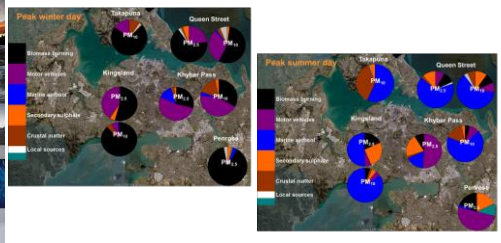
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where does it come from?



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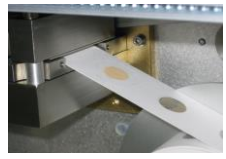
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where does it come from?

22nd to 25th September 2010



Courtesy Janet Petersen – Auckland Regional Council

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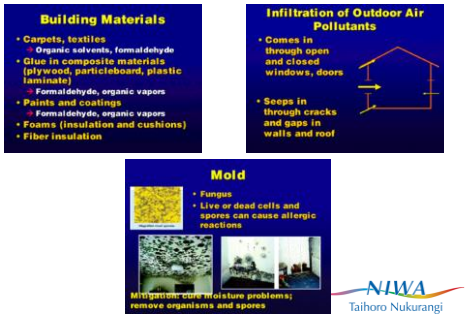
AIR POLLUTION AND HEALTH - AN INTRODUCTION

Where does it come from?



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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What does it do?

Degraded visibility
Acid rain
Climate change (global warming)
Ozone holes
Kills plants and animals
Illness (including death) in humans

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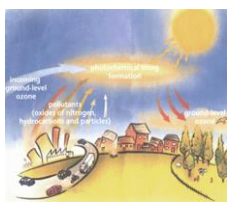
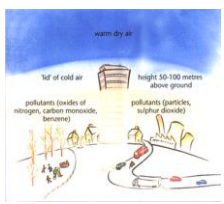
AIR POLLUTION AND HEALTH - AN INTRODUCTION

What does it do?





Photochemical smog

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What does it do? Particles

Health effects	Study References
• Increased hospital admissions	Pope (1989) Am. J. Public Health Pope (1991) Arch. Environ. Health
• Increased respiratory symptoms	Pope, Dockery, Spengler, Raizenne (1991) Am. Rev. Resp. Dis.
• Reduced lung function	Pope, Dockery (1992) Am. Rev. Resp. Dis.
• Increased school absences	Pope, Kanner (1993) Am. Rev. Resp. Dis.
• Increased respiratory and cardiovascular deaths	Ransom, Pope (1992) Environ. Res Pope, Schwartz, Ransom (1992) Arch. Environ. Health Pope, Kalkstein (1996) Environ. Health Perspect. Pope, Hill, Villegas (1999) Environ. Health Perspect.

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

How do we know?

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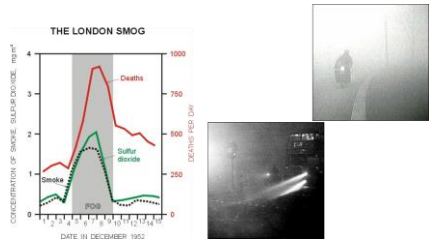
AIR POLLUTION AND HEALTH - AN INTRODUCTION

How do we know?



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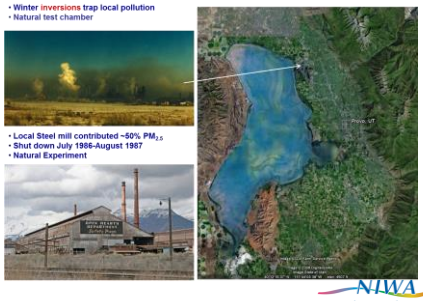
How do we know?



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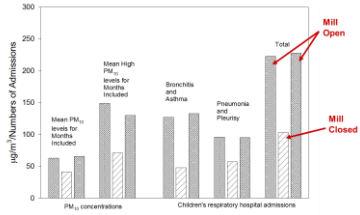
How do we know?

When the steel mill was open, total children's hospital admissions for respiratory conditions **approx. doubled.**



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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What are the risks?


The New Zealand Herald

Air pollution claims 1100 lives each year

Open fires in homes, dirty vehicle exhaust fumes and factories the main culprits

DEADLY TOLL

Friday, July 13, 2007

1. Where does this number come from?
2. What can we do about it?
3. How does this happen?

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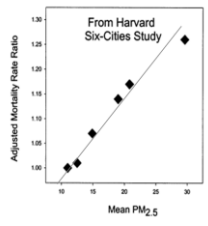
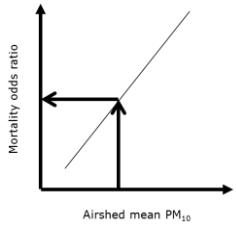
AIR POLLUTION AND HEALTH - AN INTRODUCTION

What are the risks? Calculating health risk for NZ





Then multiply by airshed population....

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What are the risks?

The economic argument

Effect	Domestic	Industrial	Vehicle	Total
Mortality	$93.0M	$13.5M	$12.0M	$118.5M
Cancer	$0.8M	$0.2M	$0.2M	$1.2M
Chronic bronchitis	$2.7M	$0.7M	$0.6M	$4.0M
Admission - cardio-vascular	$0.1M	$0.05M	$0.05M	$0.2M
Admission - respiratory	$0.4M	$0.1M	$0.1M	$0.6M
Restricted activity days	$30.0M	$7.0M	$6.0M	$43.0M
Minor hospital costs	$0.15M	$0.03M	$0.02M	$0.2M
Total	**$127M**	**$22M**	**$19M**	**$168M**

Table 11-7. Summary valuation of health effects of PM_{10} pollution in Christchurch.

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What can you do about it?

Air Pollution and Control

Air pollution and its effects are not a recent occurrence, as evidenced by the following quote:

". . . whosoever shall be found guilty of burning coal shall suffer the loss of his head."

King Edward II, circa 1300 a.d.

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

What can you do about it?

Towards the ambient management paradigm

Management of chimney emissions

Clean Air Acts 1956, 1963 (UK)
Clean Air Acts 1963, 1970 (US)

Smokeless Zones, Industry re-location

1959: California AQS incl. Oxidants, SO_2, visibility
1969: California AQS TSP, O_3, SO_2, NO_2, CO
1971: NAAQS (US) as above, plus HC
1980: EU Directive: SO_2 and TSP
1987: 1st WHO AQ Guidelines

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

NZ National Environmental Standards for Air Pollution

Contaminant	Standard	Time Average	Allowable exceedences per year
Carbon monoxide (CO)	10 mg/m^3	8 hours	1
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour	9
Ozone (O_3)	150 µg/m^3	1 hour	0
Particles (PM_{10})	50 µg/m^3	24 hours	1
Sulphur dioxide (SO_2)	350 µg/m^3	1 hour	9
	570 µg/m^3	1 hour	0

Ambient only

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AIR POLLUTION AND HEALTH - AN INTRODUCTION

24 hr PM_{10} Standards

WHO IT-1	150 µg m^{-3}
WHO IT-2	100 µg m^{-3}
WHO IT-3	75 µg m^{-3}
WHO AQG	50 µg m^{-3}

	limit	Permitted exceedences	introduced
US	150 µg m^{-3}	1 per year (avg over 3 yrs)	1987
EU	50 µg m^{-3}	35 per year	1999
Australia	50 µg m^{-3}	5 per year	1998
NZ	50 µg m^{-3}	1 per year	2004

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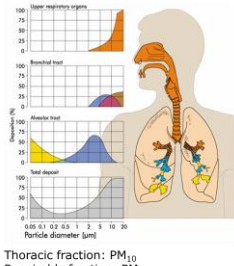
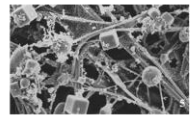
AIR POLLUTION AND HEALTH - AN INTRODUCTION

PM_{10} and $PM_{2.5}$ Standards



- US NAAQS switched from TSP to PM_{10} in 1987
- 24 hr standard 150 µg m^{-3}
- US introduced $PM_{2.5}$ standard in 1997



Thoracic fraction: PM_{10}
Respirable fraction: $PM_{2.5}$

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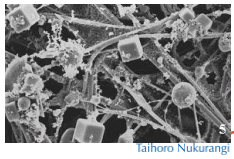
Ultrafine Particles (<0.1 μm)

WHO (2006):

- "While there is considerable toxicological evidence of potential detrimental effects of UF particles on human health, the existing body of epidemiological evidence is insufficient to reach a conclusion on the exposure–response relationship of UF particles. Therefore no recommendations can be provided as to guideline concentrations of UF particles at this point in time."



Ultrafine particles – epidemiology & Standards

Fixed Monitoring Stations – little/no association with impacts

Studies underway based on more appropriate exposure assessment

Vehicle UFP (particle number) emission standards: Euro VI (from 2012) for diesels

WHO to reconsider UFP/PNC Standards in next AQG Update

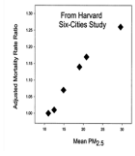
Single Limit Value unlikely

Exposure Reduction/Backstop/Avoidance approach likely

The Future of Air Quality Standards?

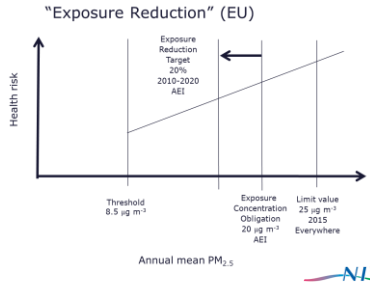
"Exposure Reduction" (EU)

- Recognises lack of zero-effects threshold
- Effect of reducing exposure of 10 million by 1 μg m^{-3} is 100x greater than reducing exposure of 10,000 by 10 μg m^{-3}
- Adopted into UK Air Quality Strategy 2007
- EU AQ Directive 2008



Exposure more explicit
Going beyond single-point monitoring
Particle number Standards - Unlikely to be Limit Value
Achieving compliance through land-use, transport and building policies
Co-pollutant Standards

The Future of Air Quality Standards?



Air Quality for Civil Engineers

Air Quality Management in NZ
- AQ in NZ
- NES and the RMA
- Consents
- Regulations
- AEE

Air Quality for Civil Engineers

AQ in NZ? All local

woodburners and ageing car fleet

Industry < 10%

Little trans-boundary pollution
– can't blame the neighbours

Little long range transport
– some Aus bush fires and dust storms

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Air Quality for Civil Engineers

Photo GWRC

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Air Quality for Civil Engineers

	Airborne pollution	Road accidents
Deaths per year	**1100**	**400**
Cost to NZ economy	**$4.28 billion**	**4.15 billion**
Research budget?	**$1.2 million**	**?**

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Air Quality for Civil Engineers

NES and the RMA

National Environmental Standards for Air Quality 2004

Amended 2011
AQNES or simply NES

Part of the…

Resource Management Act 1991
Consent to discharge
Permitted activity
Assessment of Environmental Effects (AEE)

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Air Quality for Civil Engineers

Structure of the RMA – Hierarchy

National Policy Statements (including the New Zealand Coastal Policy Statement) – which state objectives and policies for matters of national significance that are relevant to achieving sustainable management.

National Environmental Standards – which are regulations that prescribe technical standards, methods or other requirements for environmental matters.

Regional policy statements – which must give effect to national policy statements and enable regional councils to provide broad direction and a framework for resource management within their regions.

Regional plans – which must give effect to national policy statements (including the New Zealand Coastal Policy Statement) and regional policy statements.

District plans – which must not be inconsistent with regional plans and must give effect to national policy statements (including the New Zealand Coastal Policy Statement) and regional policy statements.

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Resource consents and activities

- Permitted activity
- Controlled activity
- Restricted discretionary activity
- Discretionary activity
- Non-complying activity
- Prohibited activity
- Restricted coastal activity
- Protected customary right

Resource consents and activities

If you need a Resource Consent, you need an Assessment of Environmental Effects

Under section 88 of the RMA, an AEE should be provided "in such detail as corresponds with the scale and significance of the effects that the activity may have on the environment".

Section 88 and Schedule 4 of the RMA describe matters that should be included in an AEE.

- A description of your proposed activity.
- An assessment of the actual and potential effects on the environment of your activity.
- Where the above effects are likely to be significant, a description of available alternatives.
- A discussion of the risk to the environment from hazardous substances and installations.
- For contaminants, an assessment of the nature of the discharge and sensitivity of the receiving environment to the adverse effects and any possible alternative methods of discharge, including discharge into any other receiving environment.
- A description of how the adverse effects may be avoided, remedied or mitigated.
- Identification of the persons affected by the proposal, the consultation undertaken, if any, and any response to the views of any person consulted.
- Where an effect needs to be controlled, a discussion of how it can be controlled and whether it needs to be monitored. Where appropriate, a description of how this will be done and by whom.

"**Environment**" includes—

(a) Ecosystems and their constituent parts, including people and communities; and

(b) All natural and physical resources; and

(c) Amenity values; and

(d) The social, economic, aesthetic, and cultural conditions which affect or are affected by the above

Air
Water – fresh and marine
Land - Soil,
Ecosystems
Built environment
People
Wildlife
Domestic animals
Anything else you can think of…

Section 3 of the RMA defines the meaning of "effect":

(a) Any positive or adverse effect; and
(b) Any temporary or permanent effect; and
(c) Any past, present, or future effect; and
(d) Any cumulative effect which arises over time or in combination with other effects – regardless of the scale, intensity, duration, or frequency of the effect, and also includes—
(e) Any potential effect of high probability; and
(f) Any potential effect of low probability which has a high potential impact.

National Environmental Standards

- seven **standards** banning activities that discharge significant quantities of dioxins and other toxics into the air
- five **ambient air quality standards** for carbon monoxide (CO), particulate matter less than 10 micrometres in diameter (PM_{10}), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3)
- a **design standard** for new woodburners installed in urban areas
- a requirement for landfills over 1 million tonnes of refuse to collect greenhouse gas emissions.

National Environmental Standards

The Regulations prohibit:

- landfill fires (Regulation 6)
- burning of tyres in the open (Regulation 7)
- bitumen burning (Regulation 8)
- burning of coated wire in the open (Regulation 9)
- burning of oil in the open (Regulation 10)
- school and healthcare incinerators unless a resource consent is obtained (Regulation11)
- high temperature incinerators (Regulation 12).

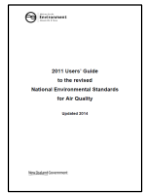
National Environmental Standards

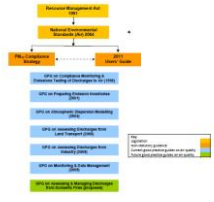
Contaminant	Standard	Time Average	Allowable exceedences per year
Carbon monoxide (CO)	10 mg/m^3	8 hours	1
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour	9
Ozone (O_3)	150 µg/m^3	1 hour	0
Particles (PM_{10})	50 µg/m^3	24 hours	1
Sulphur dioxide (SO_2)	350 µg/m^3	1 hour	9
	570 µg/m^3	1 hour	0

Ambient Air Quality Guidelines (MfE 2002).

Contaminant[a]	Value	Averaging Time
Carbon monoxide	30 mg/m^3 10 mg/m^3	1-hour 8-hour
Fine particles (PM$_{10}$)	50 µg/m^3 20 µg/m^3	24-hour Annual
Nitrogen dioxide	200 µg/m^3 100 µg/m^3	1-hour 24-hour
Sulphur dioxide[b]	350 µg/m^3 120 µg/m^3	1-hour 24-hour
Ozone	150 µg/m^3 100 µg/m^3	1-hour 8-hour
Hydrogen sulphide[c]	7 µg/m^3	1-hour
Lead[d]	0.2 µg/m^3	3-month moving average, calculated monthly
Benzene (After 2010)	10 µg/m^3 (3.6 µg/m^3)	Annual
1,3-Butadiene	2.4 µg/m^3	Annual
Formaldehyde	100 µg/m^3	30 minutes
Acetaldehyde	30 µg/m^3	Annual
Benzo(a)pyrene	0.0003 µg/m^3	Annual
Mercury (inorganic)[e]	0.33 µg/m^3	Annual
Mercury (organic)	0.13 µg/m^3	Annual
Chromium VId	0.0011 µg/m^3	Annual
Chromium metal and chromium III[e]	0.11 µg/m^3	Annual
Arsenic (inorganic)[e]	0.0055 µg/m^3	Annual
Arsine[e]	0.055 µg/m^3	Annual

2011 users' guide to the revised National Environmental Standards for Air Quality: Updated 2014





http://www.mfe.govt.nz/publications/rma-air/2011-users-guide-revised-national-environmental-standards-air-quality-updated

Air Quality Impact Assessment

Information sources

RMA
http://www.mfe.govt.nz/rma
Guides to assessment
AEE general guide
http://www.mfe.govt.nz/publications/rma/aee-guide-aug06/

Air Quality Assessments
MfE good practice guides
http://www.mfe.govt.nz/air/improving-air-quality/good-practice-guides-councils
NZTA guide to AQ assessment of road projects
http://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Air-and-climate/Air-pollution/Air-quality-assessment-guide-v2.0-Draft.pdf
UK Design Manual for Roads and Bridges vol 11- environmental assessment
http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/index.htm

What requires an Air Quality Impact Assessment?

Any process that discharges pollutants to the air e.g.

- industrial boilers
  - But not domestic heating
- Manufacturing processes
  - Chemical – agricultural
  - Paint spraying/coating

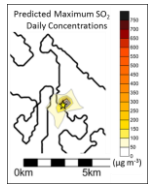
Any changes to the way pollutants are emitted or dispersed

- Infrastructure
- Roads
- Ports
- Warehousing/logistics/

When is a consent to discharge required?

Boilers etc
Chemical processes
Manufacturing - odour

New building, particularly industrial
New process
Change in a process



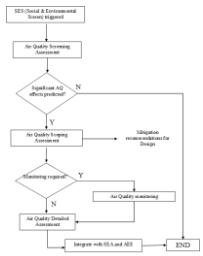
Emissions must not cause a breach of NES

May require monitoring and modelling to estimate dispersion and concentrations

Many consents then require continuous monitoring to ensure compliance

The main steps of the assessment are;

- The **Screening Assessment** – is air quality a potential problem in the project and will a detailed assessment be necessary?
- The **Scoping Assessment** – if a detailed assessment is necessary, what should it contain?
- The **Detailed Assessment** – the assessment of effects that will become part of the AEE.



Might also be referred to as Tier1, 2, 3 etc

Screening Assessment – decide if a full assessment is needed

"Is this development likely to lead to improved or degraded air quality when compared to other options (including "do nothing" and "do minimum")?"

potential risks or opportunities from different project options

identify topics for further consideration.
no need for quantitative analysis,

identify the most feasible options based on the social and environmental effects (adverse and beneficial).

project options that should be avoided or actively pursued due to permanent and widespread (adverse or beneficial) social and environmental effects; and

project options that may require significant mitigation or may produce significant social and environmental benefits."

Screening Assessment – decide if a full assessment is needed

- Are there any residences closer than 200m to any part of the development?
- Are there any sensitive receptors (schools, early childhood centres, hospitals, clinics, care homes, maraes etc.) within 200m of the development?
- What is the background air quality? (Is the development within a gazetted airshed?)
- Is any part of the development in an area likely to be in a valley in a built up area, an urban canyon or any other sheltered spot?
- Will this development change the traffic volumes or congestion of other roads in built up areas? (Will these changes be significant?)

Scoping Assessment

The Scoping Assessment will

- Identify and obtain existing data
- Assess the ability of existing data to provide a quantitative assessment
- Provide a qualitative overview of the differential impacts (positive and negative) of the Project on emissions and human exposure
- Provide a qualitative overview of the impacts of the Project on absolute concentrations and compliance with the NES, AAQG and RAQT
- Consider whether additional modelling and/or monitoring will improve the confidence in a quantitative assessment and reduce overall uncertainty
- Prepare a scope for Detailed Assessment.
- Prepare an initial report on Mitigation Options for the purpose of feedback into the design process.
- Support decision-making by Project Managers on agreement regarding the scope and extent of any Detailed Assessment

Detailed Assessment

Need to define

- Assessment scenarios (e.g. build, no-build, do-minimum etc) used for comparison
- Extent of the Project
- Emission (and/or traffic) scenarios. Two scenarios are required for an assessment
  - Best Guess
  - Highest expected
- Assessment Receptors & Pollutant Criteria must be defined using three receptor types
  - Standard receptors
  - Peak baseline receptors
  - Sensitive receptors
- Monitoring objectives. If monitoring is deemed necessary
- Meteorological data. The choice of meteorological data used must be justified
- Emission modelling. The choice of emissions factors data used must be justified
- Baselines. Two baselines should be assessed, a "typical" and a "high"

Detailed Assessment

Data Requirements…

- air quality,
- traffic,
- meteorology,
- census,
- topography,
- land-use,
- emissions inventory

and the required format, coverage, duration, resolution, etc.

Data sources…measured, modelled, proxy…etc…

Detailed Assessment

Data Sources

- air quality data - Regional Councils, NZTA, consent monitoring
  - https://www.lawa.org.nz/
  - https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/air-quality-climate/research-and-information/
- traffic, - Regional and local Councils, NZTA
- meteorology, - NIWA, Metservice
  - https://cliflo.niwa.co.nz/
- census, StatsNZ
- topography, land-use, - LINZ
- emissions inventory - Regional and local Councils, NZTA

Detailed Assessment

Baseline

What is the current air quality?
Used for comparing effects of different scenarios
Long-term e.g. annual average
Peak – local, short term, variable
Lots of assumptions

Background

Often used interchangeably
More regional – larger scale
From other sources/locations
Regional background
Urban background

Can be derived from existing measurements (Regional Council)
Project specific monitoring
Modelling

Detailed Assessment

AQ models

Traffic
Predict traffic volumes and speed/congestion given use scenarios
ART3, EMME,

Emission
Predict traffic emissions from traffic scenarios
VEPM, Copert,

Meteorological
Define most likely met conditions
CalMet

Atmospheric dispersion (+/- chemistry)/Concentrations
Predict (average) pollutant concentrations at given receptors
CalPuf, CalLine, AusRoads, Graal,

Project Assessment Receptor:

Standard receptors
Eg 50m, 200m, 1km

Peak baseline receptors
Is the local area already polluted?

Sensitive receptors
- people with respiratory or cardiovascular disease,
- children (up to age 18, but especially younger than 2),
- the elderly
- pregnant mothers.

In practice 'sensitive receptors' includes
- early childhood education centres
- schools
- hospitals
- clinics
- care homes

Monitoring

When, where, what, why?
- Timing and duration – how long do you need?
- Location(s) peak, background, receptors
- Which pollutants are you interested in?
- Data gaps, exposure,
- Should be informed by scoping assessment

Before – baseline
After – consent compliance – might be a condition of the consent

Need to establish objectives –

Need to plan early! If monitoring is likely to be needed make sure it is included in the plans and costs

Impacts

Exceedances of NES or guidelines
Population exposed

"best guess" and "high" values

- For all emission/traffic scenarios
- At the project receptors
- Using pollutant criteria identified in the scope.

Mitigation and management options

Reduce emissions
Reduce exposure

- Redesign
- Move
- barriers (walls, vegetation, trenches, tunnels)
- Traffic management options (e.g. speed or capacity restrictions)

Putting it all together

Baseline
Emissions/meteorology/dispersion
Pollutant concentrations at receptors
- Before
- After
- Scenarios
  - Low, high, worst-case

Impacts
Mitigation

Reporting results

The report for the AEE should be a summary of the analysis. The exact format will depend on the circumstances but in general a report should contain:

- Executive summary
- Introduction and scope, including a description of the project, the location and the options considered
- Method, including a description of the data used and identification of the most significant and sensitive assumptions and uncertainties
  - Models used including justification/appropriateness
  - Model validation if necessary
- Effects – results for all options assessed, including errors and uncertainties
  - Key results for decision-making.
  - Implications of results,
  - Uncertainties and reliance on assumptions.
  - Possible mitigation options and associated emissions reduction.
- Summary and conclusions

report should be fully referenced
reference material must be made available for the peer reviewing process.
Any detailed results or methods or model input files can be contained in appendices

Any Questions?