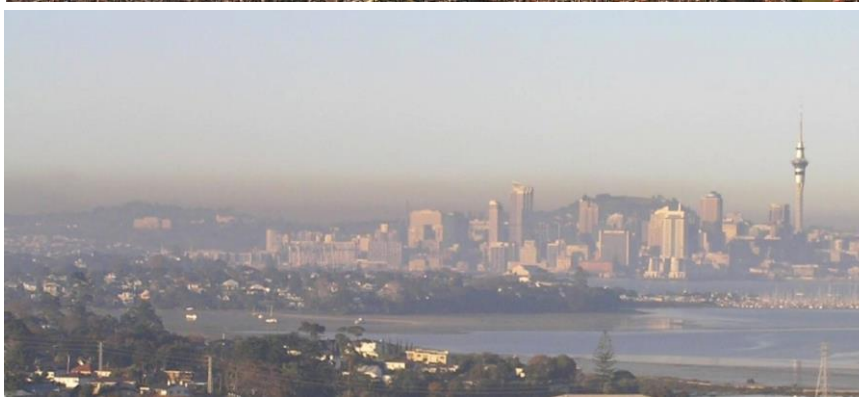


# Today's evidence for tomorrow's environment



# Outline

- Intro & RIMU environmental monitoring
- Case study 1 – Whau contaminants project
- Case study 2 – Auckland's air quality
- Case study 3 – Urban forest
- Case study 4 - Auckland records and the future of data reporting
- Questions
- 60 second wrap-up



*Today's evidence for tomorrow's environment*



# Environment

- We live in it
- Part of Auckland's identity – high community values
- Ecosystem services underpin our culture and economy
- Legislative requirement (RMA, WRHAA, Env. Report Act)
- Resilient Auckland



# RIMU Environmental Monitoring

Air Quality: 1993+

Forests and  
wetlands: 2009+

Climate & tides:  
1872 (Albert Park),  
1898 (Waitemata)

Freshwater  
Ecology. MCI etc.  
1999+, SEV  
2009+

Contaminants in  
sediments: 1998+

Freshwater  
Chemistry: 1978+  
(Cascades, Wairoa,  
Opunuku)

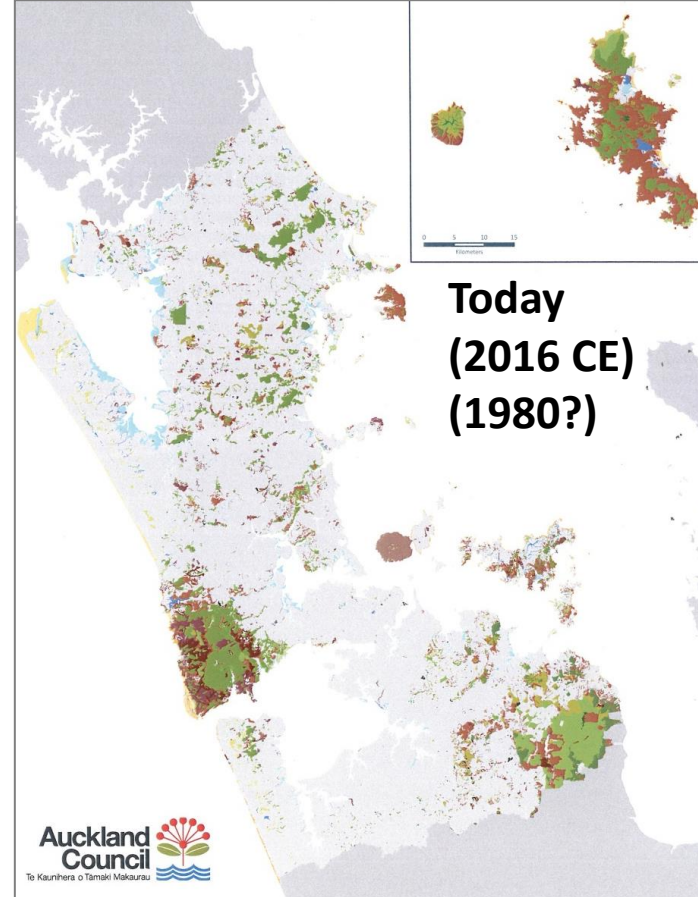
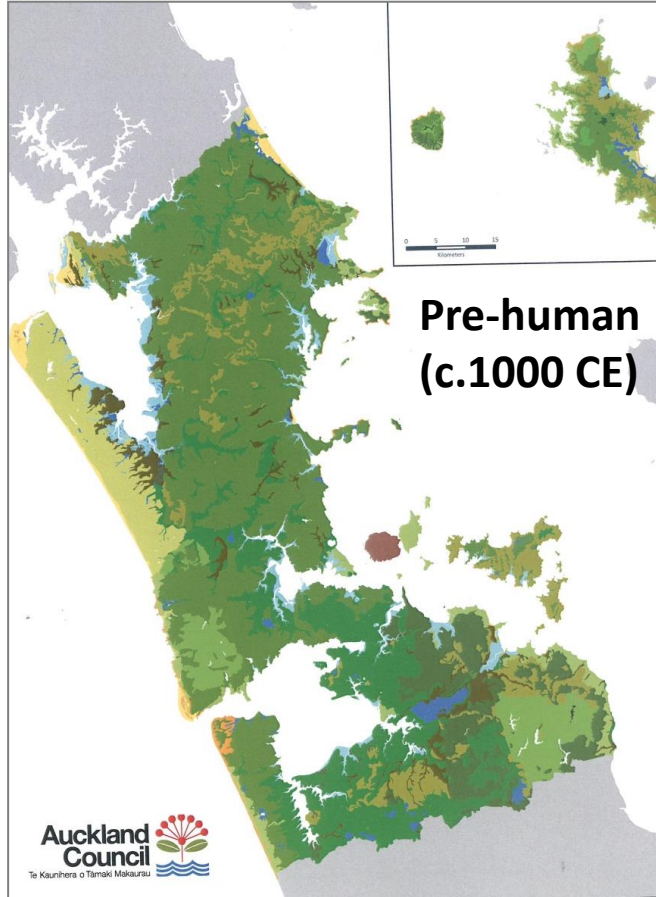
Marine ecology:  
1987+ (Manukau  
Harbour)

Soils: 1995 – 2001, 2005+





# Terrestrial changes – 1,000 years



# Changing Auckland

- Increasing and changing population
- Expanding and changing land use
- Environment is also not static
  - Natural patterns of variation
  - Climate change
- Long term, consistent monitoring provides a road map

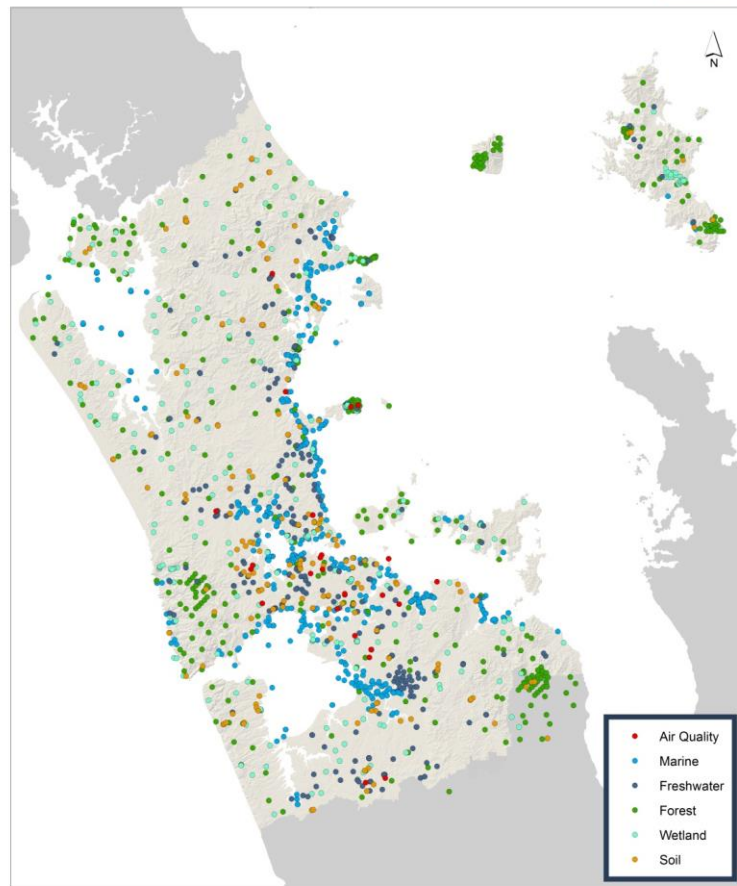




# Data to decision

Provide robust, timely information on environmental state (health) and trends (change) to:

1. Identify emerging issues and possible implications and causes
2. Build and validate model predictions
3. Inform decision making and policy development
4. Raise public awareness and understanding
5. Understanding long-term change



DISCLAIMER:  
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**RIMU**  
Environmental Monitoring Sites

0 1,250 2,500 5,000  
Metres  
Scale @ A4  
= 1:650,000  
Date Printed:  
16/06/2017

# Whau River Investigation

RIMU Symposium: 4 July 2017

Marcus Cameron, Kristi Holland



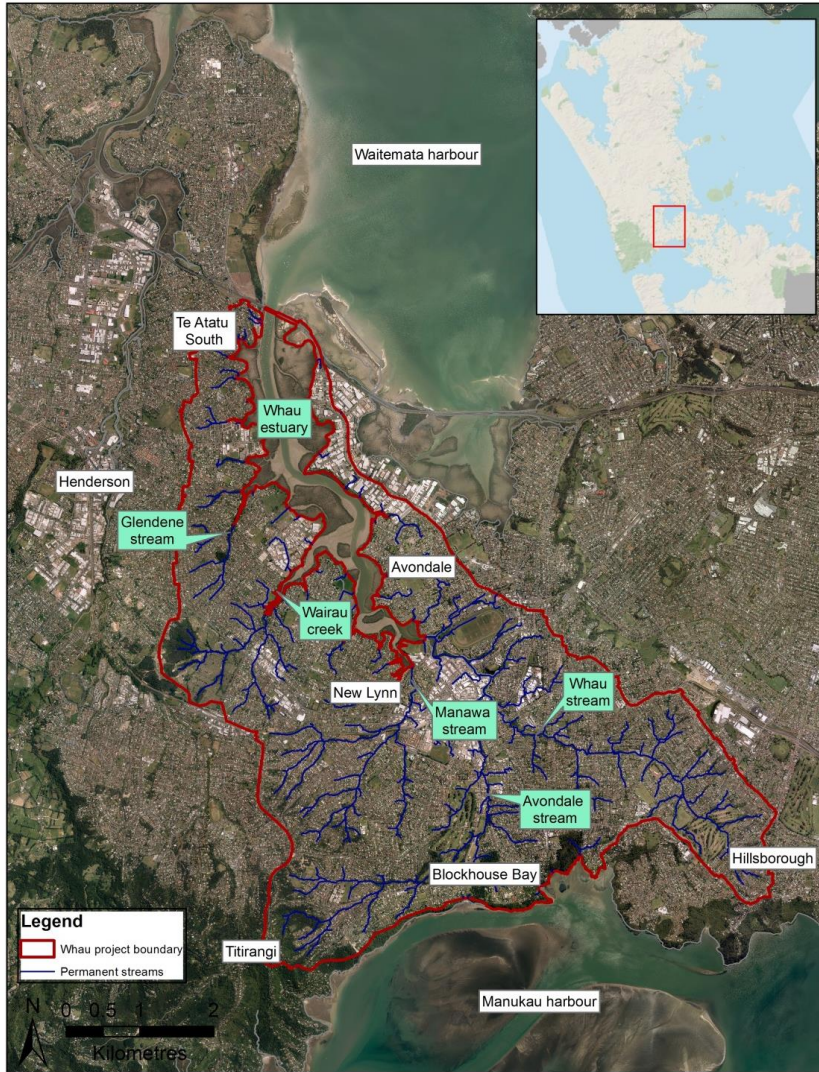


# The Whau River Catchment

- Fully urbanised catchment draining to a low energy tidal creek
- Long history of commercial and industrial landuse

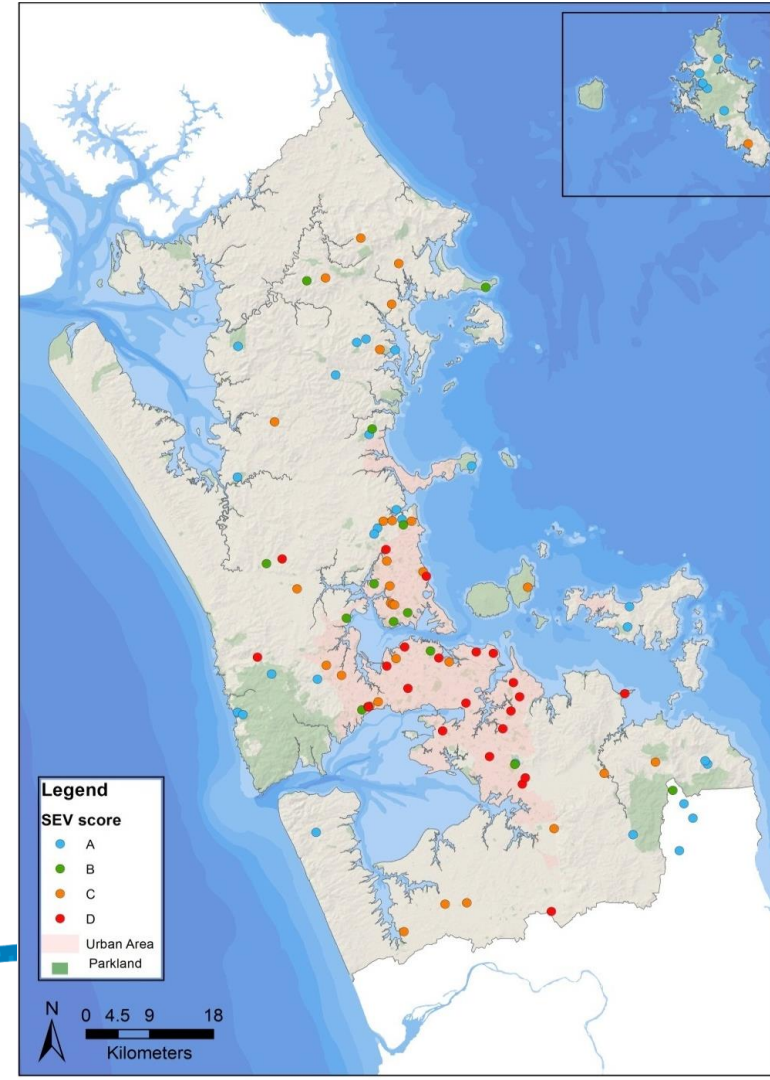
Identified as a priority catchment for contaminant management

...lets take a look at the long term monitoring picture



# Freshwater regional picture

- State of Environment monitoring (SOE)
- Stream ecology is a good indicator of stream health - integrates multiple stressors
- In general:
  - Excellent:** Native forest catchments
  - Good-Fair:** Rural and exotic forest
  - Poor:** Urban catchments





# Freshwater monitoring in the Whau catchment:

- One SOE stream chemistry site:

★ Avondale @ Shadbolt park

- Three SOE stream ecology sites:

★ Avondale Reserve

★ Avondale @ Thuja Place

★ Avondale @ Shadbolt Park

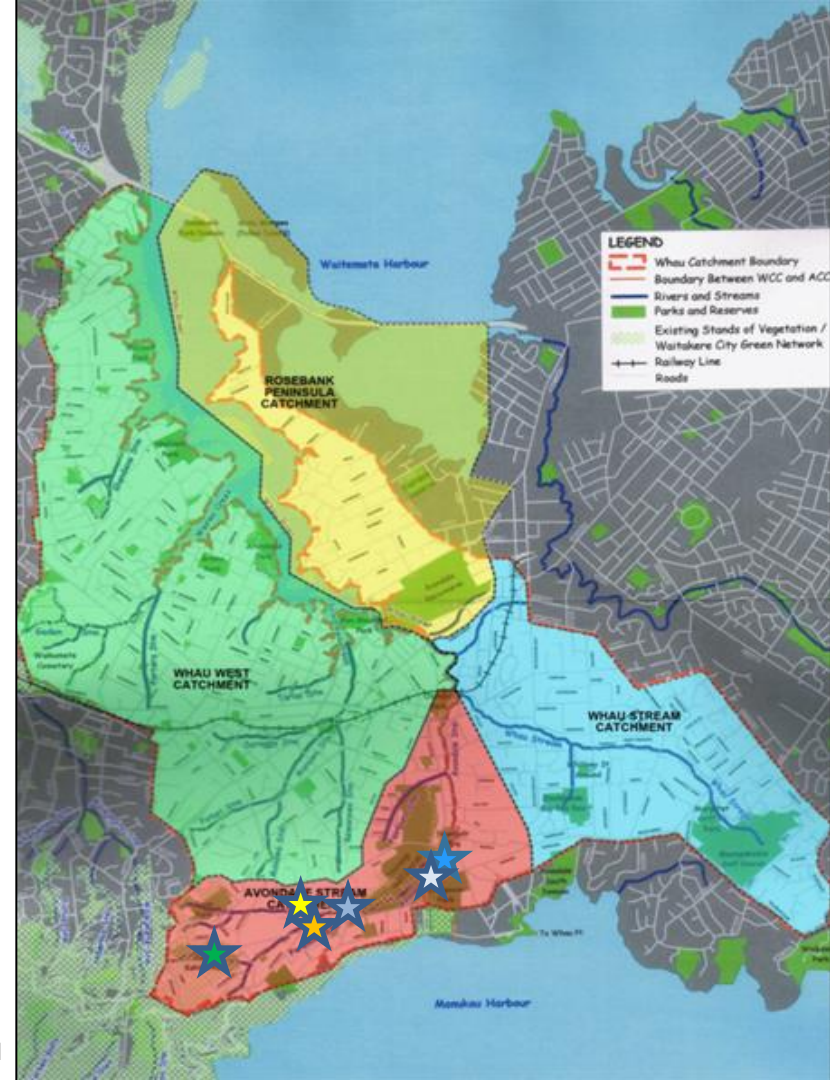
- Two project stream ecology sites:

★ La Rosa Reserve North

★ La Rosa Reserve South

→ All in the Avondale stream sub-catchment

Whau sub-catchments with monitoring sites marked



# Whau catchment water quality sites

Ecology Sites (catchment cover)	Average MCI	Class	Average WQI	Class
Avondale Reserve (native)	102	Good	Not sampled	-
Avondale Thuja (urban)	69	Poor	Not sampled	-
Avondale Shadbolt (urban)	72	Poor	58	Fair



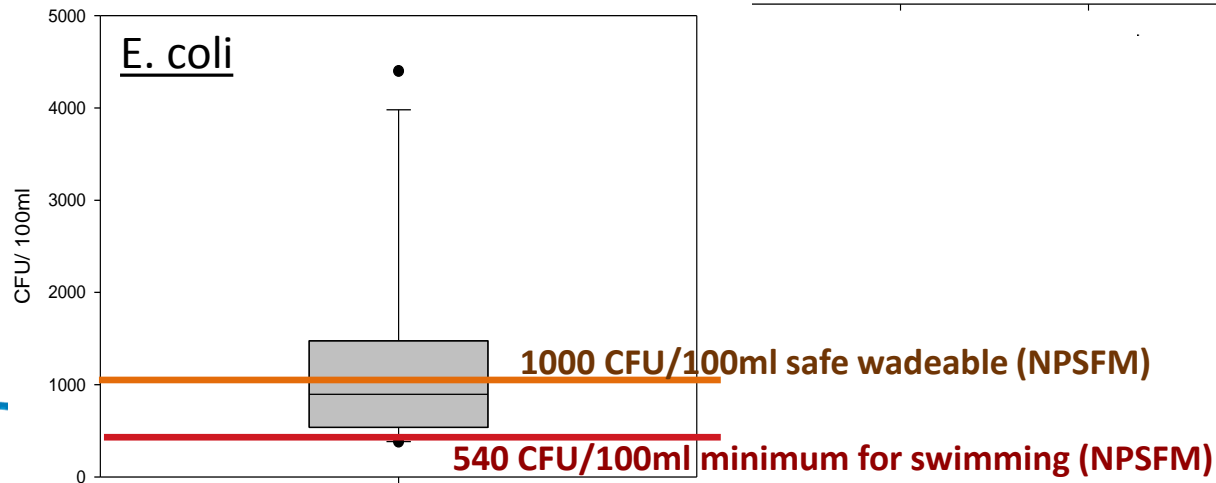
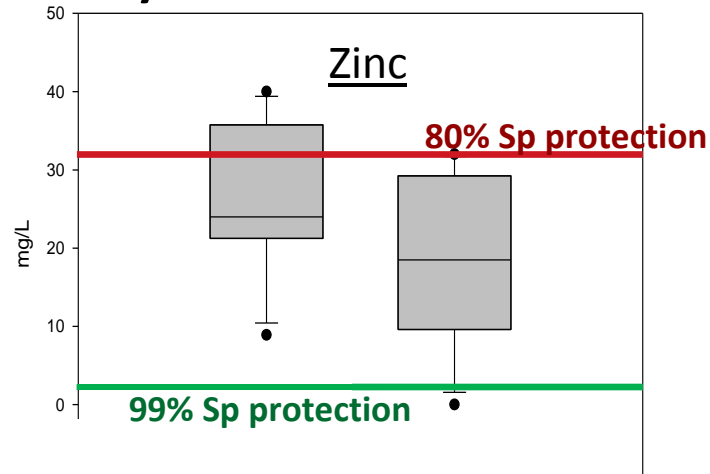
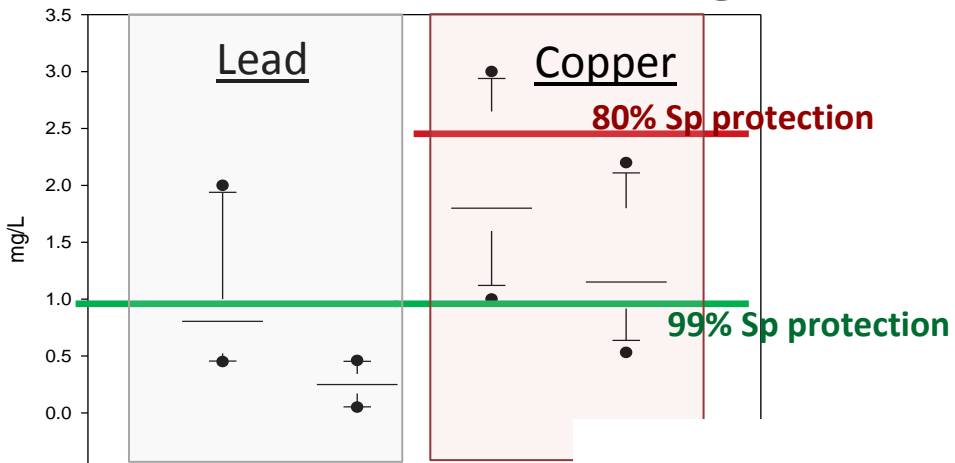
## Pressures on the urban sites:

- Metals: copper, zinc and lead
- *E. coli*





# Avondale @ Shadbolt Stream chemistry site



# Urban Stream Syndrome

- Often little habitat in-stream and on margins
- Streams often altered/engineered (affects flow)
- Less shade and greater temperatures (less bugs)
- Sediment from urban development earthworks
- Metals (Copper, Zinc, Lead from vehicles, roofs, industry)
- Nutrients (upper rural catchments, golf courses)
- Stormwater and wastewater (contaminants and bacteria).



# La Rosa Reserve day-lighting ecology sites

Pre day-lighting



Post day-lighting



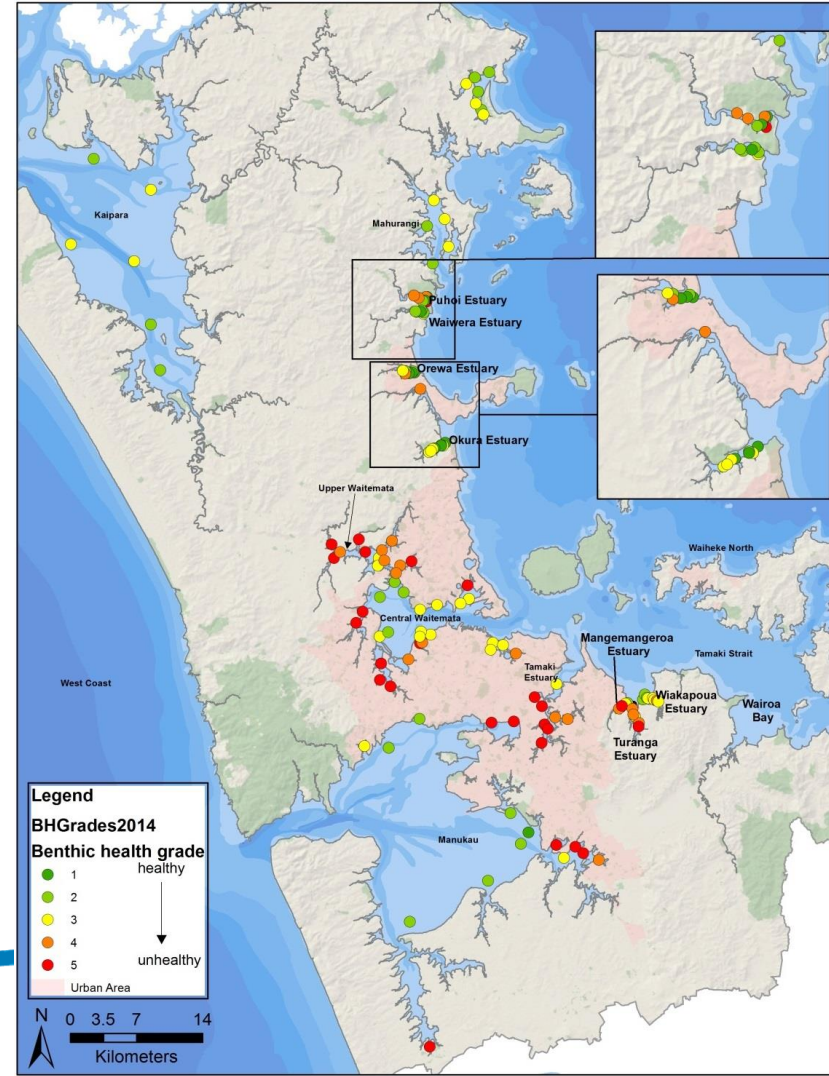
- Day-lighted in 2013
- MCI scores yet to improve: hovering between 65 and 85
- BUT, indicator taxa like Stoneflies, Mayflies and Caddisflies now being recorded
- Beds of water plants establishing
- Native fish recorded
- Monitoring continues every 3 months





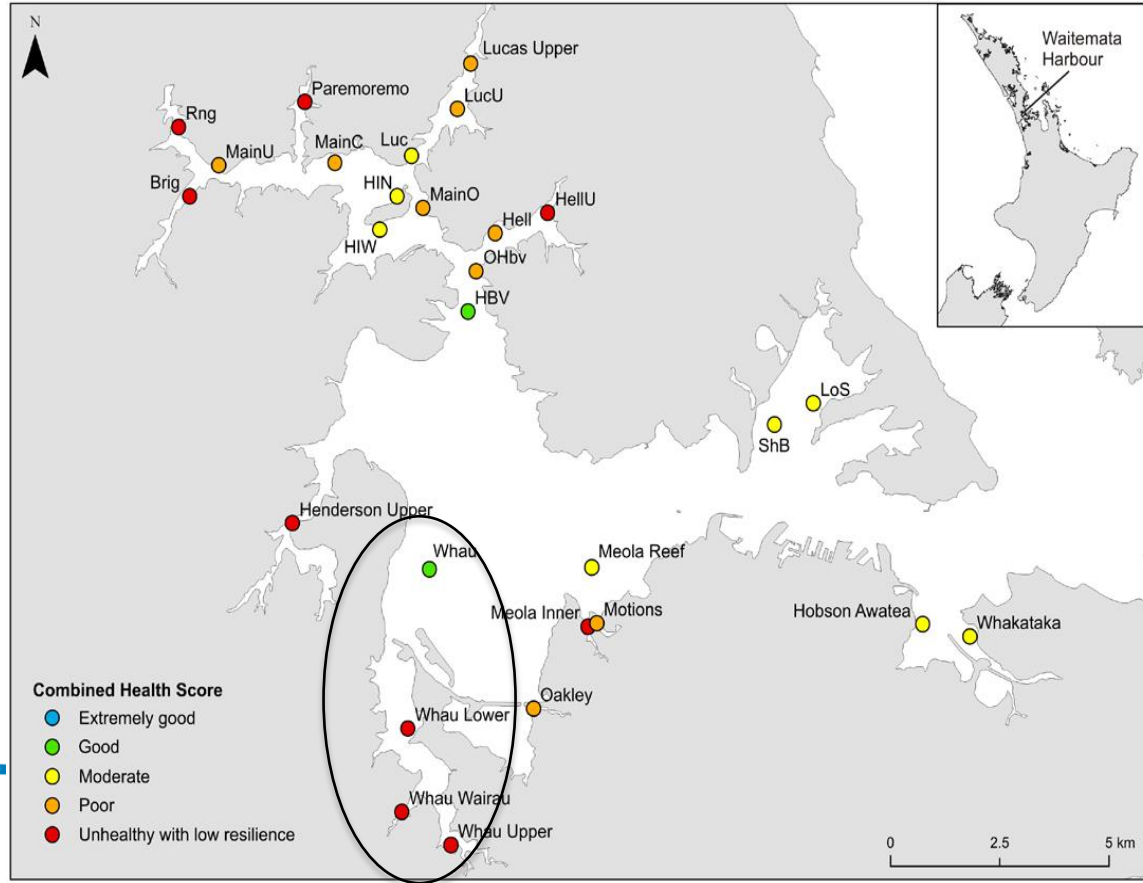
# Marine Regional picture

- Ecology a good integrator of multiple stressors
- Tidal arms degraded, especially in older urban Auckland
- Generally healthy in outer areas
- Mostly holding the line: Some improvements (from degraded base), some declines...
- Similar patterns across all indicators



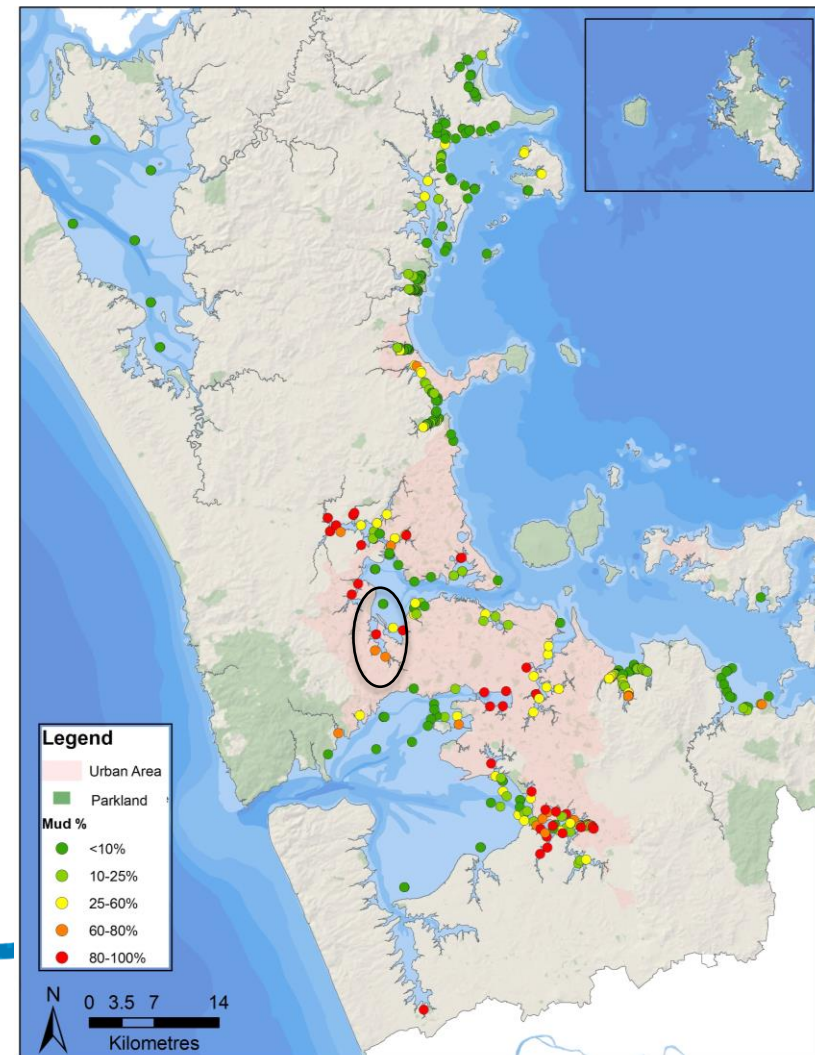
# Marine ecology monitoring in the Whau

- Consistent with regional pattern:
  - Relatively healthy just outside
  - Decreasing health up the river
- All sites in tidal creek ranked as unhealthy
- No major changes since 2005



# Muddiness in the Whau

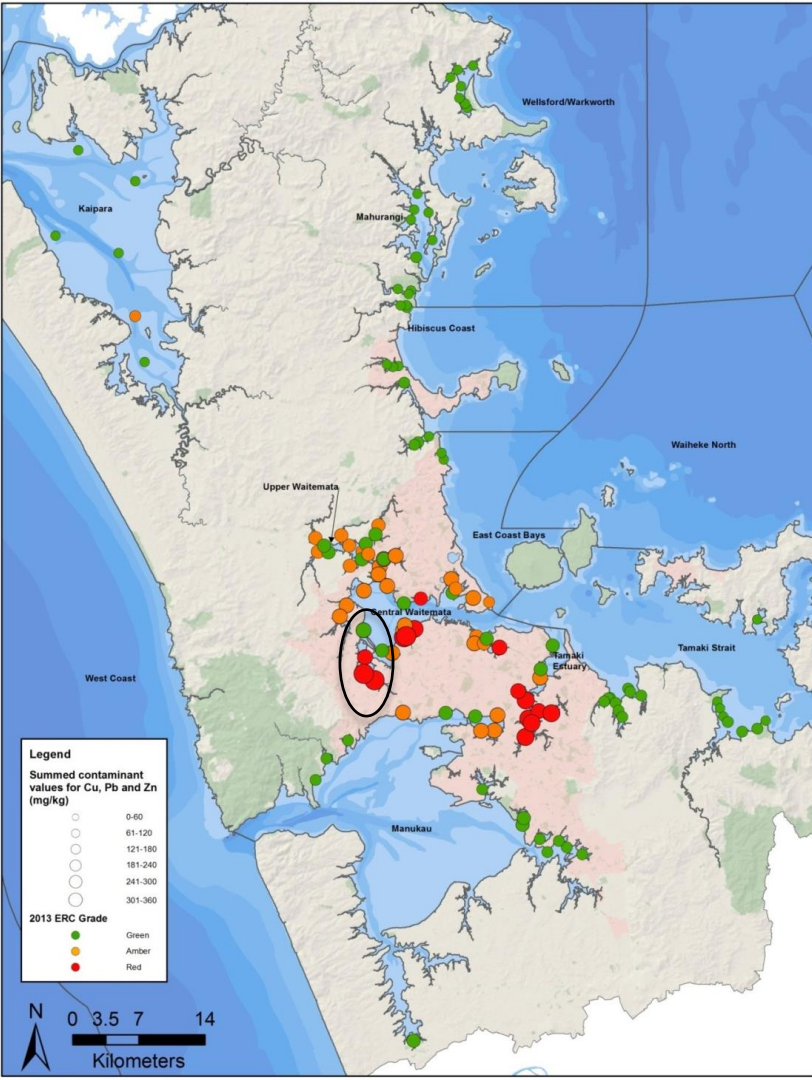
- Fine sediments can have a large impact on ecosystem health
- Muddiness measured by grain size from sediment cores
- Whau at muddier end of the scale  
→ Consistent with other tidal creeks in Auckland
- Outer site may be getting muddier





# Contaminants in sediment

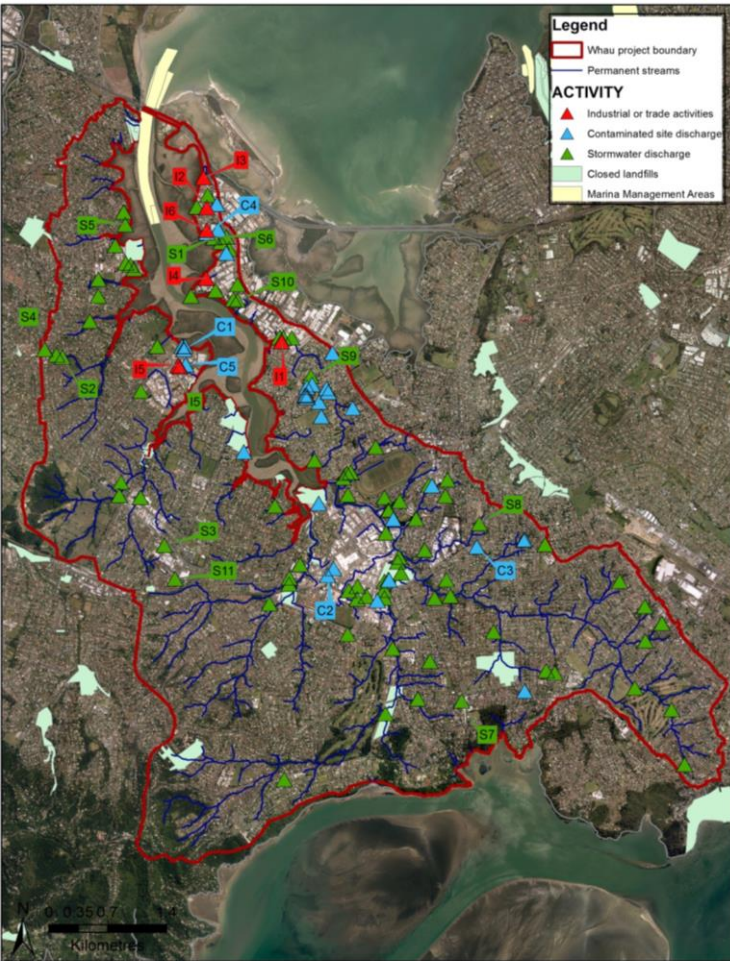
- Most red values driven by zinc (Zn), amber values by copper (Cu) or lead (Pb)
- Consistent with regional pattern - highest values in muddy estuaries with older urban and industrial catchments
- Gradient from upper estuary settling zones to outer estuary, harbour and open coastal zones
- Upper Whau sites decreasing for Pb, stable for Cu and Zn. Whau entrance increasing Cu, Zn and muddiness – exporting?



# Overall state of the Whau - heavily impacted

- Freshwater quality and ecology scores show typical urban impacts
- Higher quality habitats still exist in some headwater streams, restoration at La Rosa
- Copper, lead and zinc stable or decreasing in upper estuary sediments, may be increasing at entrance
- Marine ecology impacted by both muddy sediment and contaminants
- Current state of the Whau River reflects a long history of human impact and the form and flushing of the tidal creek

→ *Need to understand which land uses and activities are driving current effects to target appropriate management actions*



# Initial Whau investigation

Desktop study highlighted multiple contaminant sources:

- Industrial activities
- Landfills
- Wastewater overflows
- Stormwater discharges
- Roads
- Contaminated sites
- Mooring areas
- Pollution incidents

...provided the road map for a targeted sampling programme



# The Whau contaminants project

Led by Healthy Waters (Tim Hopley) and aims to:

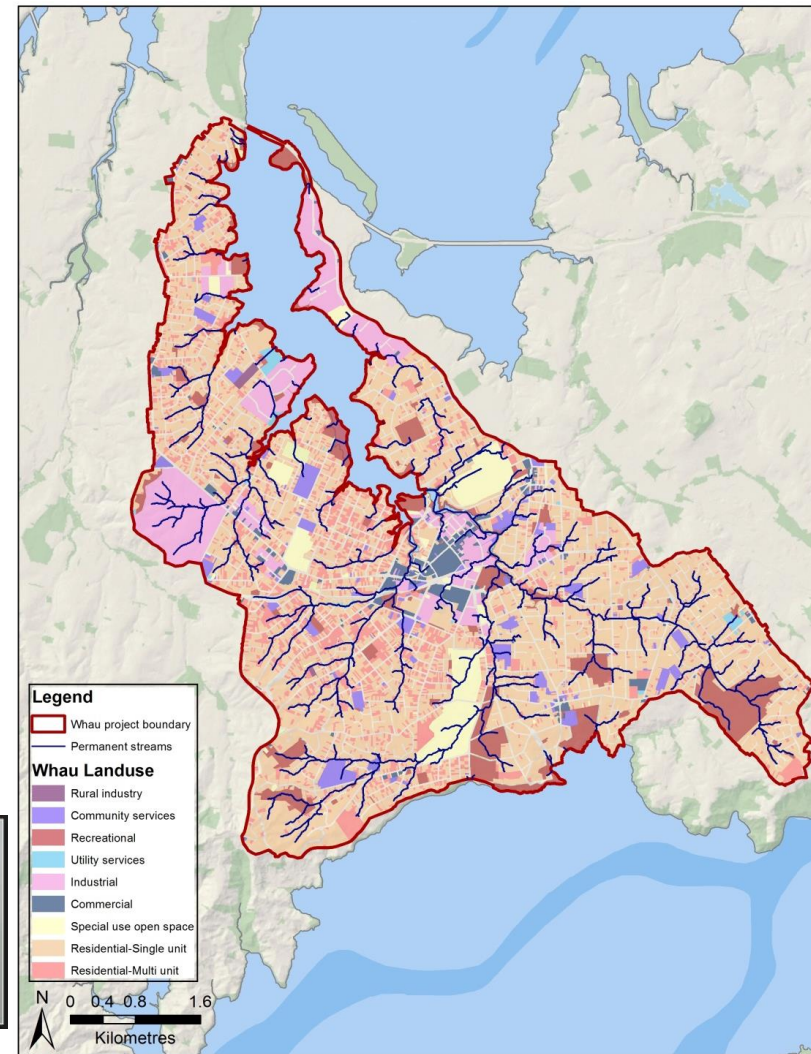
- Quantify risks from specific land uses
- Inform more targeted management action

Info will also feed into:

- Calibrating contaminant load models
- National Policy Statement for Freshwater Management (NPSFM) – contaminant accounting
- Assisting a highly engaged community

Research opportunities:

- Utilise new landuse data
- Trial passive samplers, new low cost method



# Where can you find more info?

- 2015 SoE report
- Report cards
- Data requests
- Friendly RIMU staff!

## Technical Publications:

- Environmental condition and values of Māngere Inlet, Whau Estuary and Tāmaki Estuary, TR2008/031
- State of the Environment Monitoring: River Water Quality Annual Report 2015, TR2016/034
- Central Waitematā Harbour Ecological Monitoring: 2000-2014, TR2015/006
- Auckland marine sediment contaminant monitoring: 2015 data, TR2016/020
- Marine sediment contaminants: Status and trends assessment 1998 to 2010, TR2012/041



# Developing a High Air Pollution Prediction Index Model

Nick Talbot

*Air Quality Scientist: RIMU*

This model has been developed in collaboration with

Jenny Salmond

School of Environment, University of Auckland,

Kim Dirks

School of Population Health, University of Auckland

Georgina Griffiths

Metservice New Zealand

James Scarfe

Bay of Plenty District Health Board, Tauranga Hospital



1

## Takapuna Camera

Position of the sun at 6am



Takapuna 07/02/2006 06:00 NZST  
Auckland Regional Council



**The Takapuna camera faces south**

**From this angle the camera can detect morning light absorption and scatter**

1

## Takapuna Camera



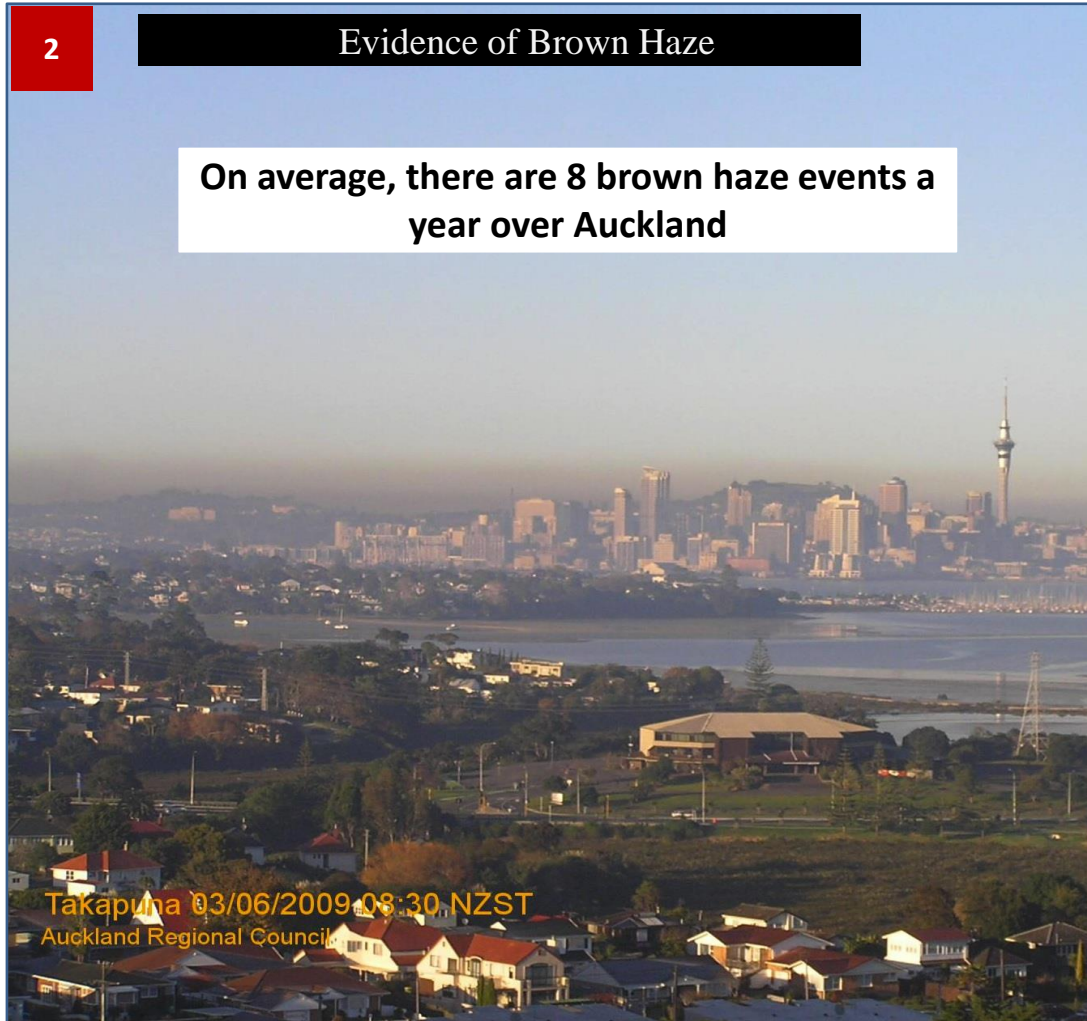
The Takapuna camera faces South, perfect to detect morning light absorption and scatter



2

## Evidence of Brown Haze

On average, there are 8 brown haze events a year over Auckland



1

## Takapuna Camera



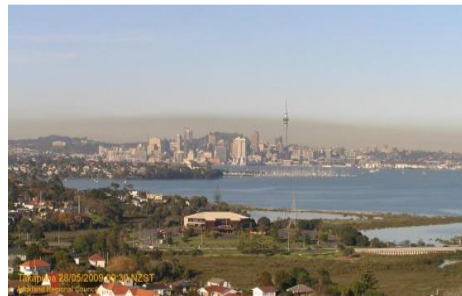
The Takapuna camera faces South, perfect to detect morning light absorption and scatter



2

## Evidence of Brown Haze

On average, there are around 10 brown haze events a year over Auckland



3

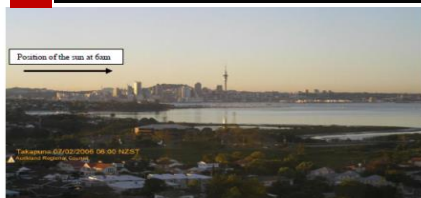
### 90 – 99<sup>th</sup> Percentile Air Pollution Values Occurs on Haze Days

Haze Days	PM2.5	Percentile	PM10	Percentile	NO2	percentile
27/05/2014	13	95	23	99	120	
28/05/2014	27	99.9	42	99.9	306	99.9
14/06/2014	18	99	22	95	170	90
15/06/2014	21	99	26	99	247	99
23/06/2014	12	95	27	99.9	185	90
29/06/2014	10	90	26	99	137	
14/07/2014	15	95	21	95	206	99.9
28/07/2014	17	99	18	95	129	90



1

## Takapuna Camera



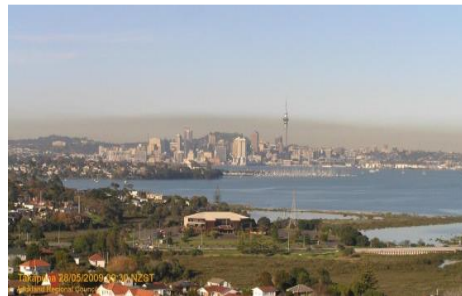
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4

## Article Linking Brown Haze with Increase Respiratory Hospital Emissions



# A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand\*

Kim Natasha Dirks<sup>1</sup>\*, James Scarfe<sup>2</sup>, Nicholas Philip Tait<sup>3</sup>

<sup>1</sup> School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, New Zealand

<sup>2</sup> Bay of Plenty District Health Board, Tauranga Hospital, New Zealand

<sup>3</sup> Research and Investigations, Auckland Council, New Zealand

<sup>4</sup> School of Environment, Faculty of Science, University of Auckland, New Zealand

Email: \*k.dirks@auckland.ac.nz

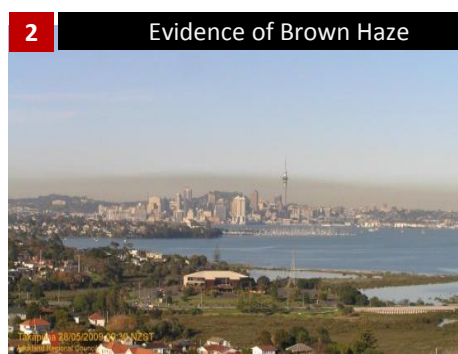
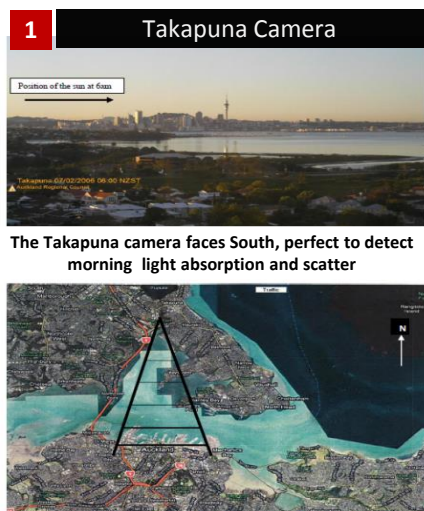


How to cite this article:  
Dirks, K., Scarfe, J., Tait, N. (2017) A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand. *Journal of Environmental Protection*, 8(1): 1-10. doi:10.4236/jep.2017.81001

Received: April 10, 2017  
Accepted: April 10, 2017  
Published: April 10, 2017

More young and older people are admitted to hospital for breathing complaints after these events

surface air pollution, and on years of admissions data for a detailed record of haze events occurred. Haze is a significant indicator of poor air quality, with high levels of nitrogen oxide (NO<sub>x</sub>), nitrogen dioxide (NO<sub>2</sub>), and particulate matter less than 10 µm in diameter (PM<sub>10</sub>). Taking into account the daily average temperature and humidity, the incidence of hospital admissions for respiratory complaints was significantly increased during haze events.



**3** 90– 99<sup>th</sup> Percentile Air Pollution Values Occurs on Haze Days

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**4** Article Linking Brown Haze with Increase Respiratory Hospital Emissions



Journal of Environmental Protection, 2013, 5, 1-7  
<http://www.iiste.org/Journal>  
ISSN Online: 2152-2128  
ISSN Print: 2152-2137

A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand\*

Kim Nakashima Dicks<sup>1</sup>\*, James Scarfe<sup>2</sup>, Nicholas Philip Talbot<sup>3</sup>, Roger Marshall<sup>4</sup>, Jennifer Anne Salmeron<sup>5</sup>

<sup>1</sup> School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Private Bag 92019, Auckland, New Zealand

<sup>2</sup> Bay of Plenty District Health Board, Taranaki Hospital, 329 Cameron Road, Private Bag 10204, Taranaki 3102, New Zealand

<sup>3</sup> Research and Investigation Auckland Council, Private Bag 92101, Auckland, New Zealand

<sup>4</sup> School of Environment, Faculty of Science, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand

Email: \*k.dicks@auckland.ac.nz

How to cite this paper: Dicks, K.N., Scarfe, J., Talbot, N.P., Marshall, R., Salmeron, J.A. (2013) A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand. Journal of Environmental Protection, 5(1), 1-7. doi:10.4236/jep.2013.51001

Received: November 14, 2012; Accepted: November 27, 2012; Published: December 1, 2012

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Abstract

This paper reports on the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand.

Keywords: Brown haze, surface air pollution, respiratory hospital admissions, Auckland, New Zealand.

1. Introduction

Brown haze is a common phenomenon in Auckland, New Zealand, and is associated with increased respiratory hospital admissions.

The purpose of this study was to investigate the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand.

The study was conducted using data from the Auckland Council's Air Quality Monitoring Network and the Auckland District Health Board's Respiratory Hospital Admissions Database.

The results of the study show that there is a significant positive relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand.

The study also found that the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand, is stronger for older people than for younger people.

The study has important implications for public health and for the development of policies to reduce the incidence of respiratory hospital admissions.

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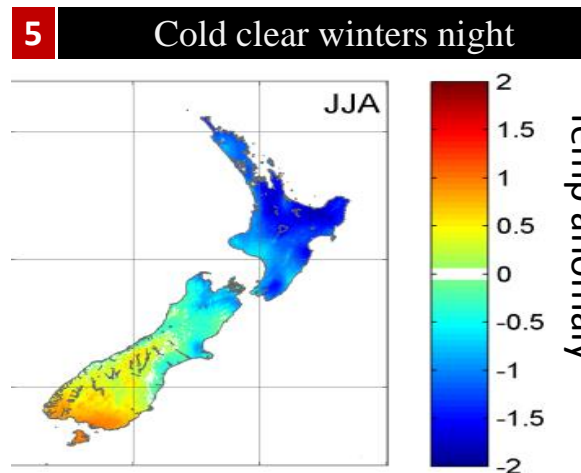
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More young and older people are admitted to hospital for breathing complaints after these events

1

## Takapuna Camera



The Takapuna camera faces South, perfect to detect morning light absorption and scatter



2

## Evidence of Brown Haze

On average, there are around 10 brown haze events a year over Auckland



3

90–95<sup>th</sup> Percentile Air Pollution Values Occurs on Haze Days

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4

## Article Linking Brown Haze with Increase Respiratory Hospital Emissions



Journal of Environmental Protection, 2012, 3, 1-7  
<http://dx.doi.org/10.4236/jep.2012.31001>  
 ISSN Online: 2152-2218  
 ISSN Print: 2152-2207

**A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand\***

Kim Natasha Dirks<sup>1</sup>, James Scarfe<sup>2</sup>, Nicholas Philip Talbot<sup>3</sup>, Roger Marshall<sup>4</sup>, Jonathan S. Salmond<sup>5</sup>

<sup>1</sup> School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Private Bag 92019, Auckland, New Zealand

<sup>2</sup> School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Private Bag 92019, Auckland, New Zealand

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<sup>4</sup> School of Environment, Faculty of Science, University of Auckland, Private Bag 92019, Auckland, New Zealand

<sup>5</sup> School of Environment, Faculty of Science, University of Auckland, Private Bag 92019, Auckland, New Zealand

Email: \*N.dirks@auckland.ac.nz

**Abstract**

Brown haze is a visible manifestation of air pollution, and it is a doublet event of haze events occurring on the same day.

High levels of air pollution, and high rates of admissions data for respiratory hospital admissions, are a significant indicator of poor air quality.

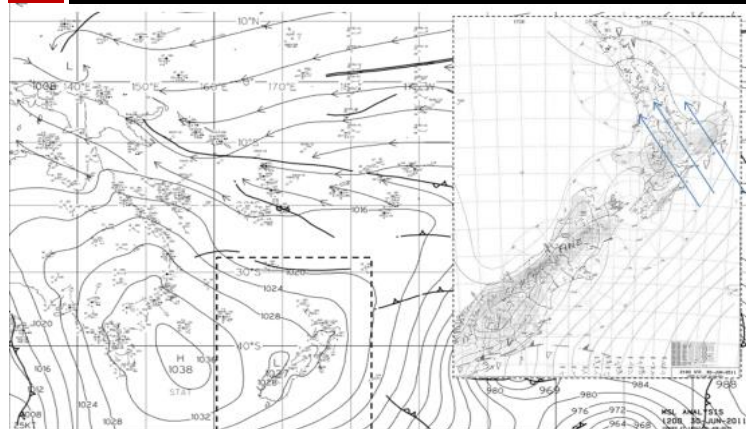
There is a significant indicator of poor air quality, and high rates of admissions data for respiratory hospital admissions, are a significant indicator of poor air quality.

CO<sub>2</sub> and particulate matter less than 10 µm in diameter (PM<sub>10</sub>) are the most common pollutants, and the incidence of respiratory hospital admissions is linked to significant increases in hospital admissions for respiratory

**More young and older people are admitted to hospital for breathing complaints after these events**

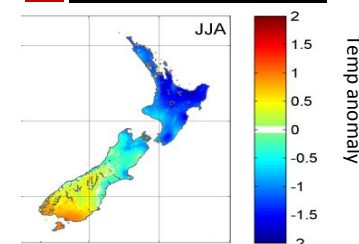
6

## South-East Airflow



5

## Cold winters night





## 1 Takapuna Camera



The Takapuna camera faces South, perfect to detect morning light absorption and scatter



## 2 Evidence of Brown Haze

On average, there are around 10 brown haze events a year over Auckland



## 3 90– 95<sup>th</sup> Percentile Air Pollution Values Occurs on Haze Days

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## 4 Article Linking Brown Haze with Increase Respiratory Hospital Emissions



Journal of Environmental Protection, 2017, 7, 1-7  
<http://dx.doi.org/10.4236/jep.2017.71001>  
ISSN Online: 2152-2129  
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**A statistical analysis of the relationship between brown haze and surface air pollution levels on respiratory hospital admissions in Auckland, New Zealand\***

Kim Natasha Diriba<sup>1\*</sup>, James Scarfe<sup>2</sup>, Nicholas Philip Talbot<sup>3</sup>, Roger Marshall<sup>4</sup>, John

<sup>1</sup> School of Population Health, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand

<sup>2</sup> Bay of Plenty District Health Board, Taranaki Hospital, 120 Cameron Road, Poverty Bay

<sup>3</sup> Paediatric and Neonatal Intensive Care Unit, Auckland Children's Hospital, 1200 Auckland Street, Auckland, New Zealand

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Email: \*k.diriba@auckland.ac.nz

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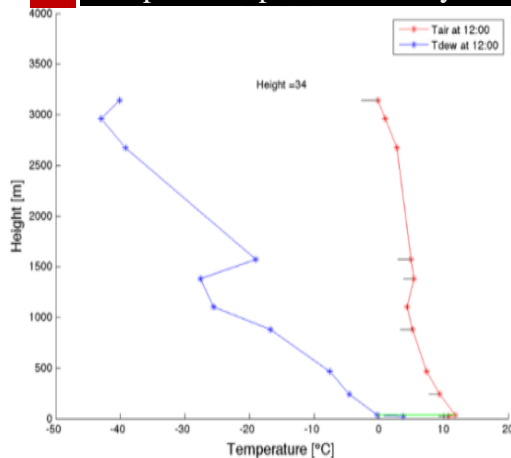
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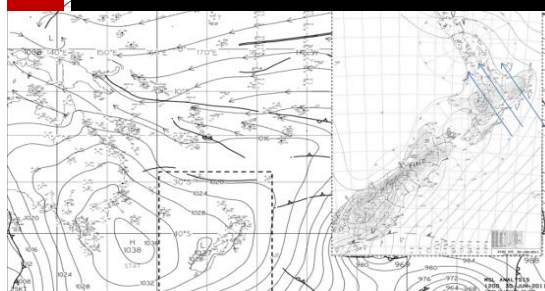
Abstract: Brown haze, surface air pollution, and respiratory hospital admissions data for Auckland, New Zealand, were analyzed to determine if there was a significant association between brown haze and respiratory hospital admissions. The results showed that there was a significant association between brown haze and respiratory hospital admissions. The incidence of brown haze was linked to significant increases in hospital admissions for respiratory

**More young and older people are admitted to hospital for breathing complaints after these events**

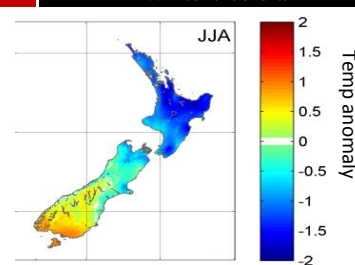
## 7 Up. Atmospheric Stability Essential



## 6 South-East Airflow



## 5 Winter / cold air



8

# High Air Pollution Prediction Index

## Event number:

WP pressure above 1020hPa (1 point for every hPa)

GS pressure above 1020hPa (1 point for every hPa)

WN pressure above 1020hPa (1 point for every hPa)

WP air temp at midnight (1 point every C &lt; 8C)

WP air temp at dawn (1 point every C &lt; 4C)

WP wind speed at surface (1 point every kt &lt; 5kt)

Sky Tower wind speed (1 point every kt &lt; 8kt)

Sky Tower wind direction (5 points 161-210, 10 points 090-160)

WP wind direction 1000ft (5 points 161-210, 10 points 090-160)

WP wind direction 2000ft (5 points 161-210, 10 points 090-160)

WP wind direction 3000ft (5 points 161-210, 10 points 090-160)

WP Temp at 1000hPa minus WP Temp at surface (1 point every C)

## Midnight Pollutant score:



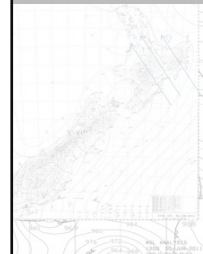
The ability to predict these events would.....

- Allow AC to inform the public of high air pollution events
- Targeted mitigation strategies can be implemented
- Inform DHB to allow for staffing preparation

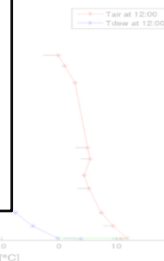
More young and older people are admitted to hospital for breathing complaints after these events

14/07/2014	15	95	21	95 (10)	206.1	99.9 (5)
28/07/2014	17	99	18	95 (9)	129.0	99.9 (5)
23/08/2014	7		22	99.9 (9)	97.9	

flow?



bility Essential



How to cite this paper: Dike, K.N., Singh, S., Taylor, S.P., Carroll, P., Palmer, J.A. (2017) A Statistical Analysis of the Relationship Between Brown Haze and Surface Air Pollution Levels on Respiratory Hospital Admissions in Auckland, New Zealand. *Journal of Environmental Protection*, 8, 1-11.

## Abstract

This paper reports hospital admissions for respiratory complaints over the summer of 2014/2015.

# What's so remarkable about Auckland's urban forest?

Craig Bishop





# Native biodiversity & Overall tree diversity



- Lots of native remnants
  - including unusual and highly threatened ecosystems
- High diversity in garden, park and street trees



# Main components of urban forest



1. Indigenous habitat remnants
2. Mixed habitat along natural features such as coastal cliffs and stream corridors
3. Street trees
4. Parks and other large sites (e.g. schools, hospitals, churches)
5. Habitat restoration plantings



# Benefits of urban forest

- Increases property values
- Cools the city by reducing the 'heat island effect'
- Absorbs carbon reducing our carbon footprint
- Cleans pollution from both air and water
- Improves our health and wellbeing – shown by numerous international studies
- Provides beauty and shelter
- Important contributor to the cultural health (Mauri) of the land
- Great places to play, walk, run cycle, amble and unwind
- Habitat for wildlife – filling the city with birds
- Conserves and maintains rare and unusual native biodiversity
- Provides resources (e.g. flax/harakeke) for weaving and other uses





# Research needs

- Understand the size-structure, ownership, protection status and **change in cover** in order to:
  - Monitor the impact of the removal of general tree protection
  - Inform better management of urban forest assets
  - Inform planting strategy (equity, focus effects)
  - Better \$ calculation for some of the benefits



## Six giant pohutukawa trees saved

By Mathew Dearnaley

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## 1800 Auckland trees join protection shortlist

5:39 AM Monday Nov 28, 2011

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## City's trees woefully protected, study finds

5:00 AM Thursday Jun 4, 2015

Auckland Council

Auckland Region

Environment

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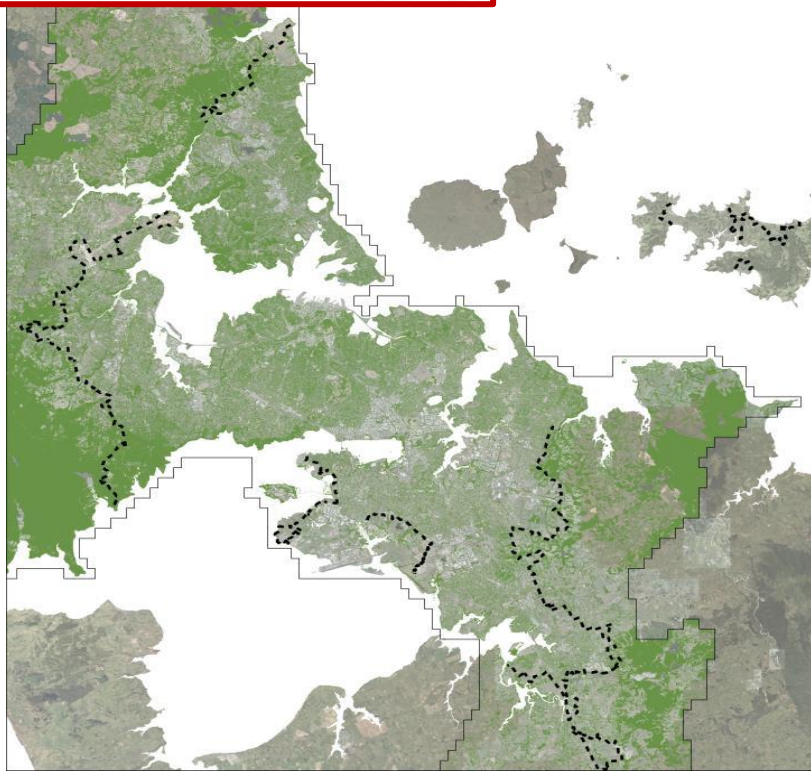
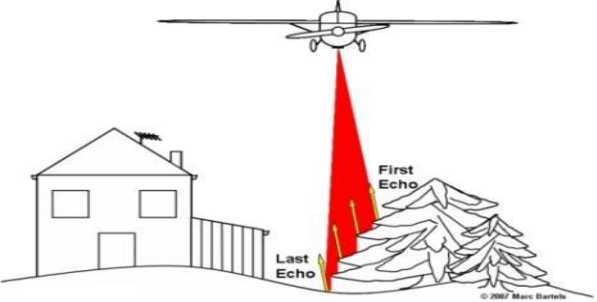
Google+

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Charmaine Wiapo of Ngati Whatua Orakei has helped plant 200,000 trees in 30ha at Bastion Point to link up with other tree corridors. Photo / Jason Oxenham

# LIDAR snapshot of urban forest in 2013

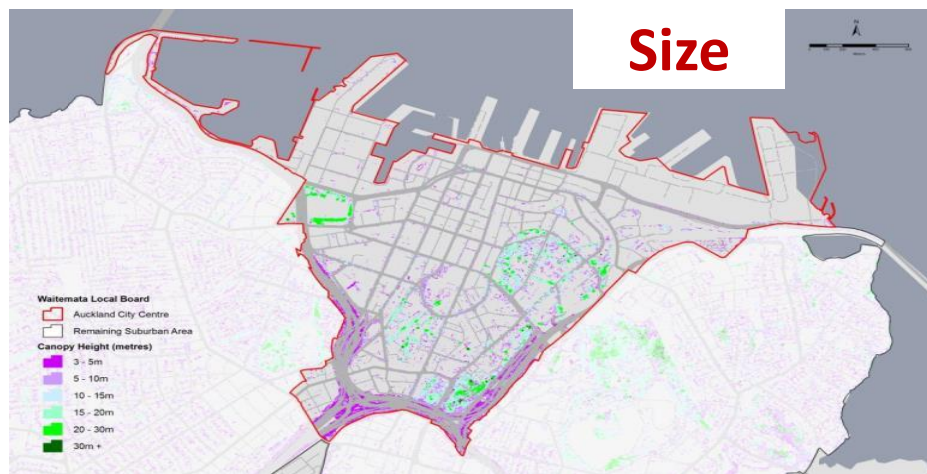




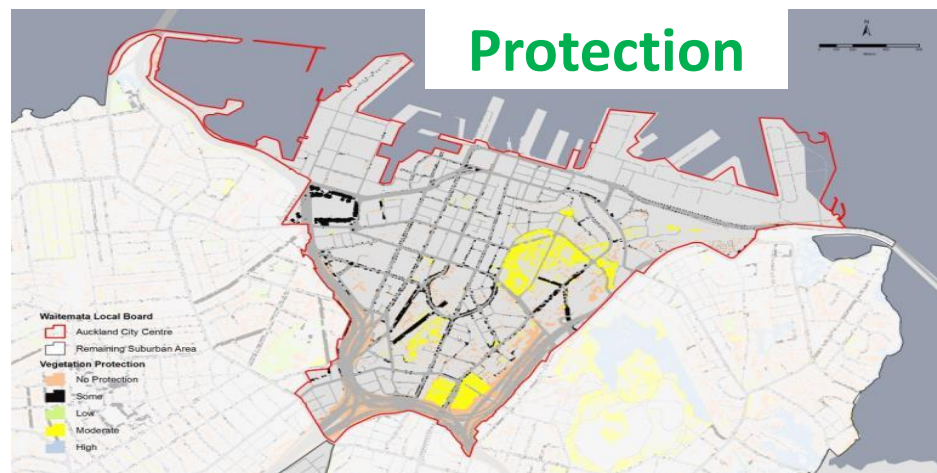
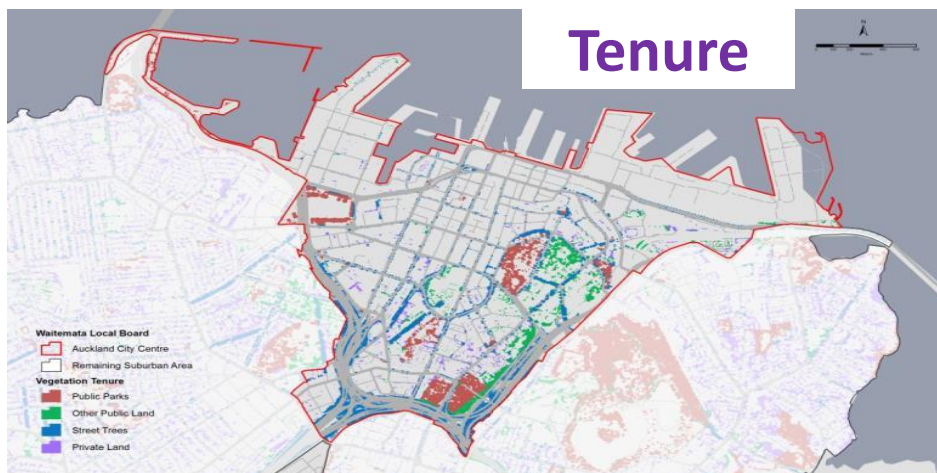
# Close-up of Waitemata Local Board LIDAR





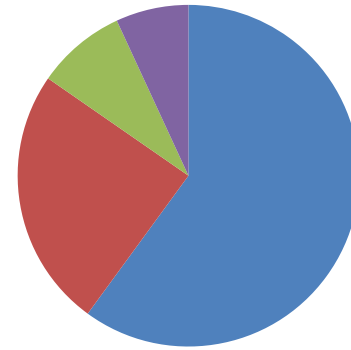


**Size, tenure & protection**  
info combined with  
**LIDAR data**

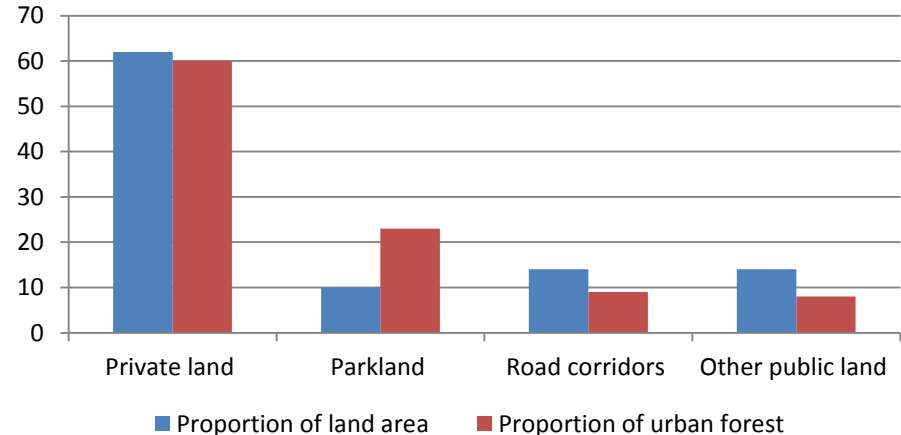


# Most (c.60%) urban forest is privately owned

- Auckland has c. 10,160 ha of urban forest canopy cover
- Overall % cover for the whole urban area is 18.1%
- But this varies dramatically by suburb (Stonefields 1% - Titirangi 68%)
- Parkland contains a disproportionately high % of urban forest

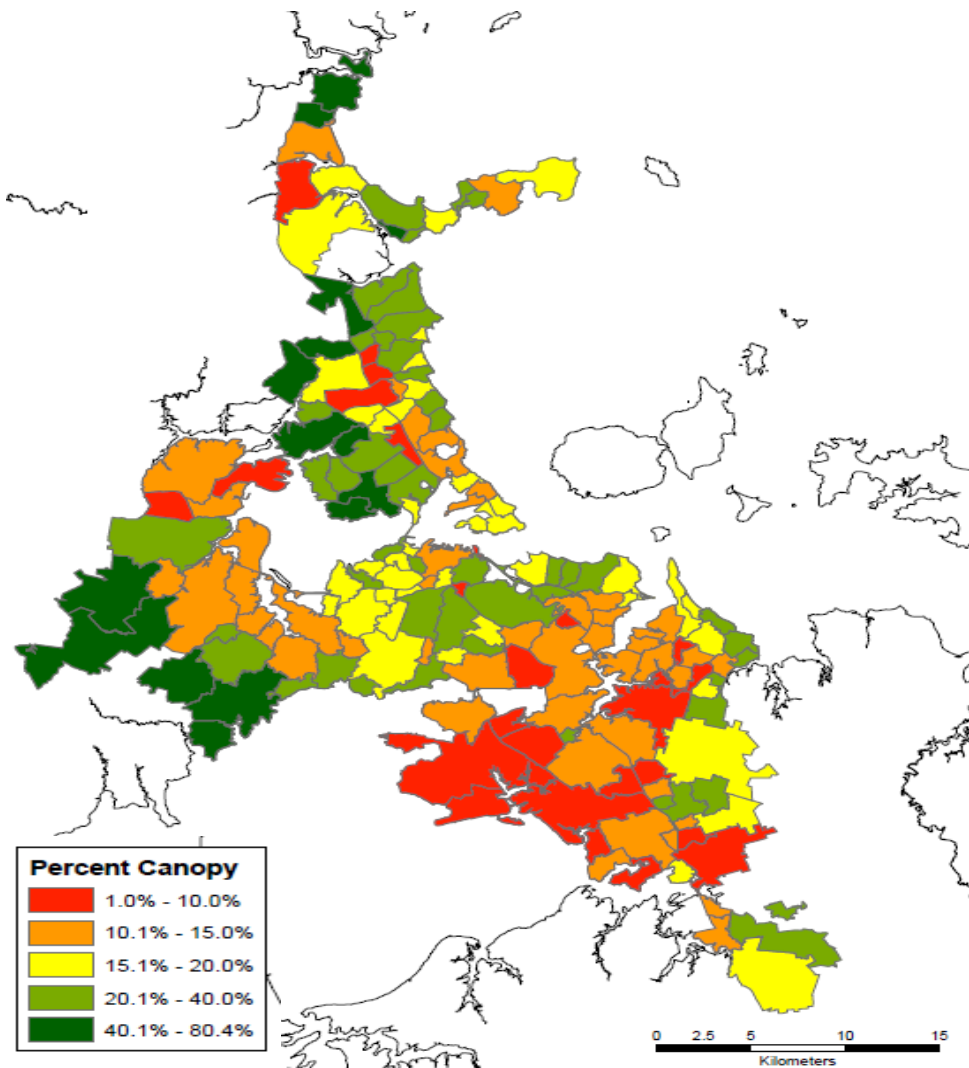


■ Private land (6,100 ha)    ■ Parkland (2,500 ha)  
■ Road corridors (860 ha)    ■ Other public land (700 ha)



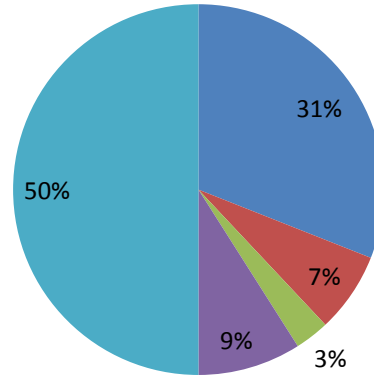
# There are wide variations in urban forest canopy cover

- Remnant indigenous forest patches provide most of the cover in western and (some) northern suburbs
- Street and private trees dominate in central and south





# Around half of Auckland's urban forest has no statutory protection



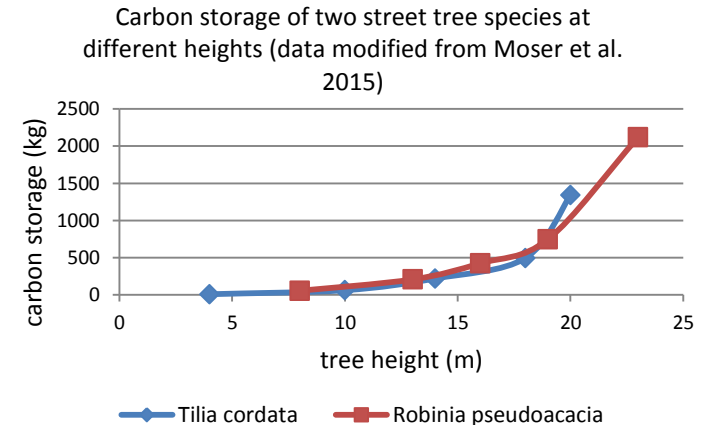
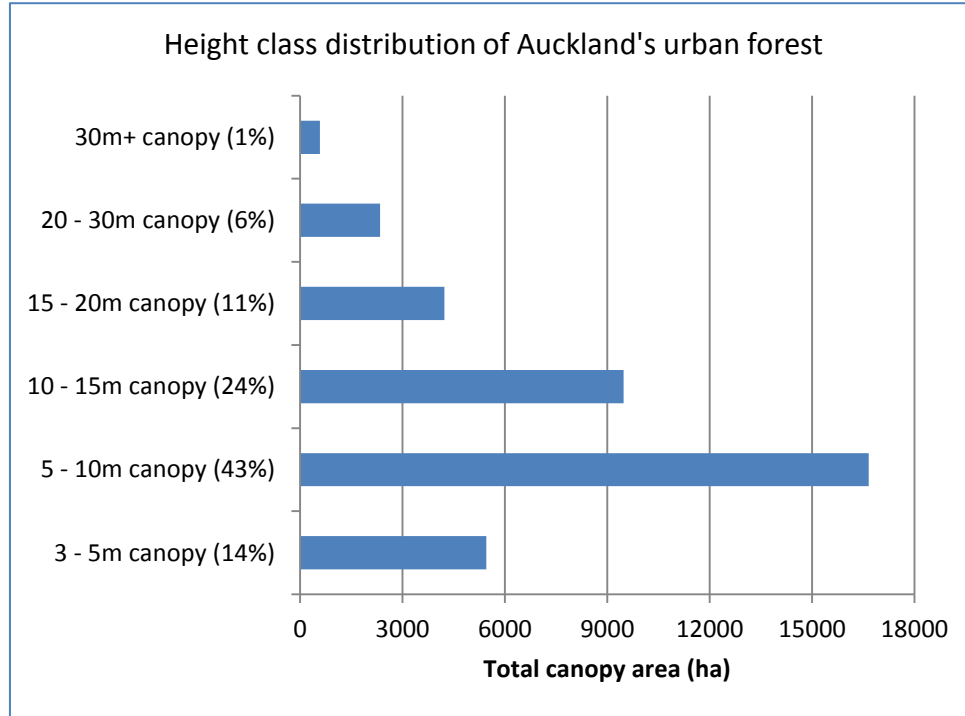
■ High protection: urban forest in significant ecological area

■ Moderate protection: urban forest in outstanding natural feature or landscape, open space conservation zone, coastal yard, riparian yard or lake protection zone

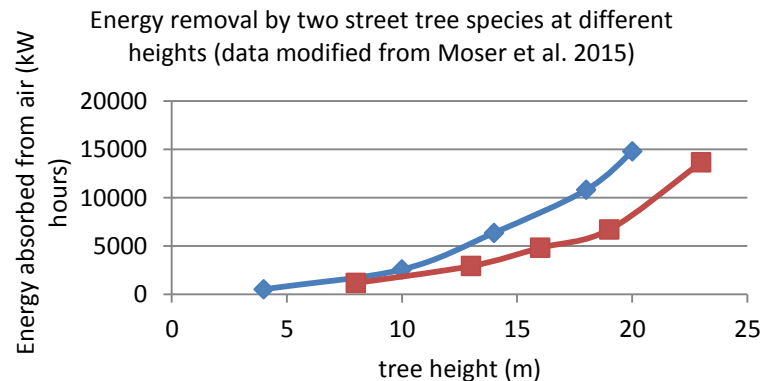
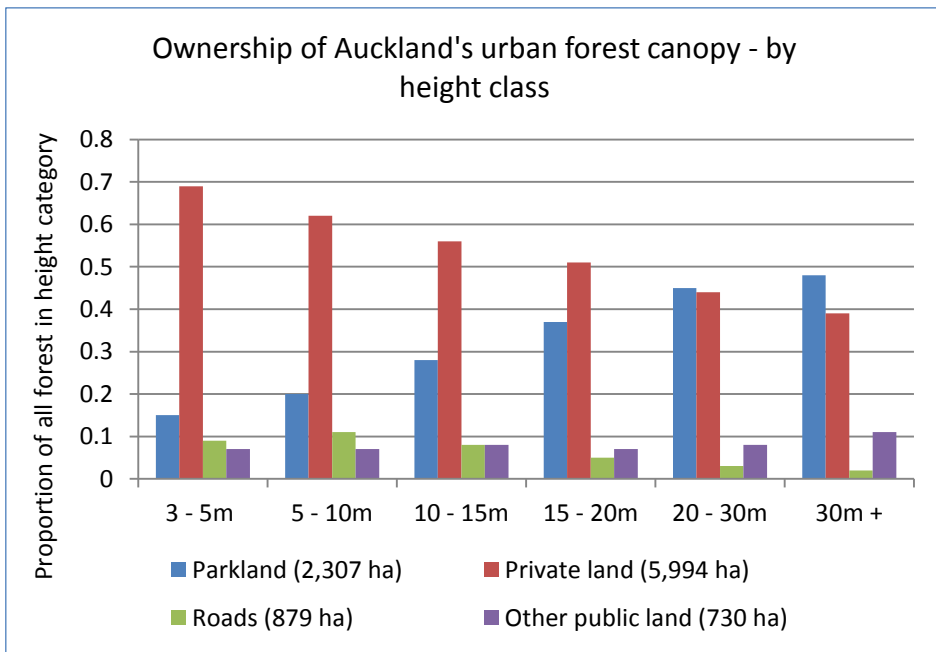
■ Some protection: urban forest in coastal natural character area or open space informal recreation zone

■ Low protection: urban forest in open space active recreation zone or road corridor

# More than 50% of Auckland's urban forest is <10m in height & 93% is <20m



# But fortunately, almost 50% of the bigger (>20m) trees are on public parkland





Thank you









**46 people**  
evacuated  
More rain was  
expected  
overnight



**RANGITIKEI**  
**29 people**  
evacuated from  
the isolated town  
of Koitiata  
**25 people**  
accommodated  
in the Civil  
Defence Centre  
overnight.



New Lynn floods: 'A lot of  
suffering going on in our  
community tonight'

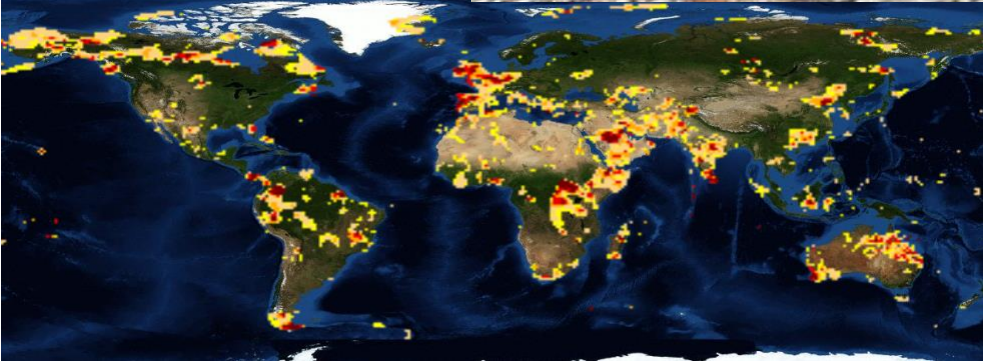




# North Island drought worst in history



## WATER RESTRICTIONS ESCALATED







# Summary

- Auckland has an amazing environment, that provides our point of difference and sustains us.
- Some environmental gains in recent decades
  - Improvements in air quality
  - Good progress where biodiversity is intensively managed
- But we have some significant environmental problems
  - Slow decline in freshwater and marine environments due to historical and current sediment and contaminant inputs
  - Slow decline in indigenous biodiversity where plant and animal pests are un-managed
  - Cumulative impacts - Interaction effects of multiple stresses and/ or 'Death by 1000 cuts'

