



# Monitoring of Pesticides in New Zealand groundwater systems

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protecting people and their environment through science

# Outline

- **Monitoring of pesticides**
- **Temporal variability**
- **Point sources**
- **Interpretation of results**

# Detection of pesticides in NZ groundwater

- **Three main types of monitoring**
  - drinking water supplies
  - targeted “at risk” areas
  - general groundwater resource
- **Each type show different results**
- **Drinking water supplies**
  - one well with dieldrin at >50% MAV
  - 4 out of 483 with very low levels

# National surveys

- **Surveys in 1990, 1994, 1998 & 2002**
- **1990 to assess if there was a problem; limited to 6 areas**
- **1994 more widespread**
- **1998 every region, looked at ELISA kits & metabolites**
- **2002 every region - used ELISA kits to screen samples**
- **Surveys analysed for acid herbicides & semi-volatile organics  
- range of organochlorine, organophosphorus &  
organonitrogen pesticides**
  - ◆ **1990 & 1994 : DL around 0.1 ppb**
  - ◆ **1998 & 2002 : DL around 0.01 ppb**

# Pesticides in NZ Groundwater

- If a DL of 0.1 ppb is used for comparison, then
  - 1990 : 82 wells; 7% with detectable pesticides
  - 1994 : 116 wells; 14% with detectable pesticides
  - 1998 : 95 wells; 11% with detectable pesticides
  - 2002 : 133 wells; 9% with detectable pesticides
- For a DL of 0.01 ppb, then
  - 1998 : 95 wells; 35% with detectable pesticides
  - 2002 : 133 wells; 21% with detectable pesticides

# Detailed results from 1998/98 survey

- ◆ 33 wells with pesticides detected (35%)
- ◆ 18 wells had two or more pesticides detected (19%)
- ◆ 20 different pesticides were detected
- ◆ 76% of pesticides detected were triazines (74% < 0.1 ppb)
- ◆ Only one well with pesticides > MAV; known point source
- ◆ 11 out of the 15 regions had one or more wells with pesticides present

## Individual Pesticides Detected

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Pesticide	Number	Range (ppb)
2,4-D	1	0.9
Alachlor	2	0.02 – 0.25
Atrazine	7	0.01 – 0.08
Cyanazine	1	1
Diazinon	4	0.01 – 0.03
Hexazinone	2	0.12 – 0.23
MCPA	1	61
MCPB	1	2.1
Mecoprop	1	420
Metolachlor	1	0.21

## Individual Pesticides Detected

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<b>Pesticide</b>	<b>Number</b>	<b>Range (ppb)</b>
<b>Metribuzin</b>	<b>2</b>	<b>0.14 – 1.2</b>
<b>Pendimethalin</b>	<b>1</b>	<b>0.03</b>
<b>Picloram</b>	<b>1</b>	<b>0.3</b>
<b>Pirimiphos methyl</b>	<b>1</b>	<b>0.01</b>
<b>Procymidone</b>	<b>1</b>	<b>0.17</b>
<b>Propazine</b>	<b>4</b>	<b>0.01 – 2.5</b>
<b>Simazine</b>	<b>18</b>	<b>0.01 – 0.32</b>
<b>Terbuthylazine</b>	<b>10</b>	<b>0.01 – 3.5</b>
<b>Triclopyr</b>	<b>2</b>	<b>0.14 – 0.3</b>
<b>Trifluralin</b>	<b>1</b>	<b>0.02</b>



# Summary for 2002 survey

- 133 wells were sampled throughout New Zealand
- 28 wells (21%) with one or more pesticides detected
- 19 different pesticides detected plus 2 metabolites, most detections were triazines
- Most pesticides were < 0.1 ppb
- Only 3 detections were above 1 ppb

# Summary for 2002 survey

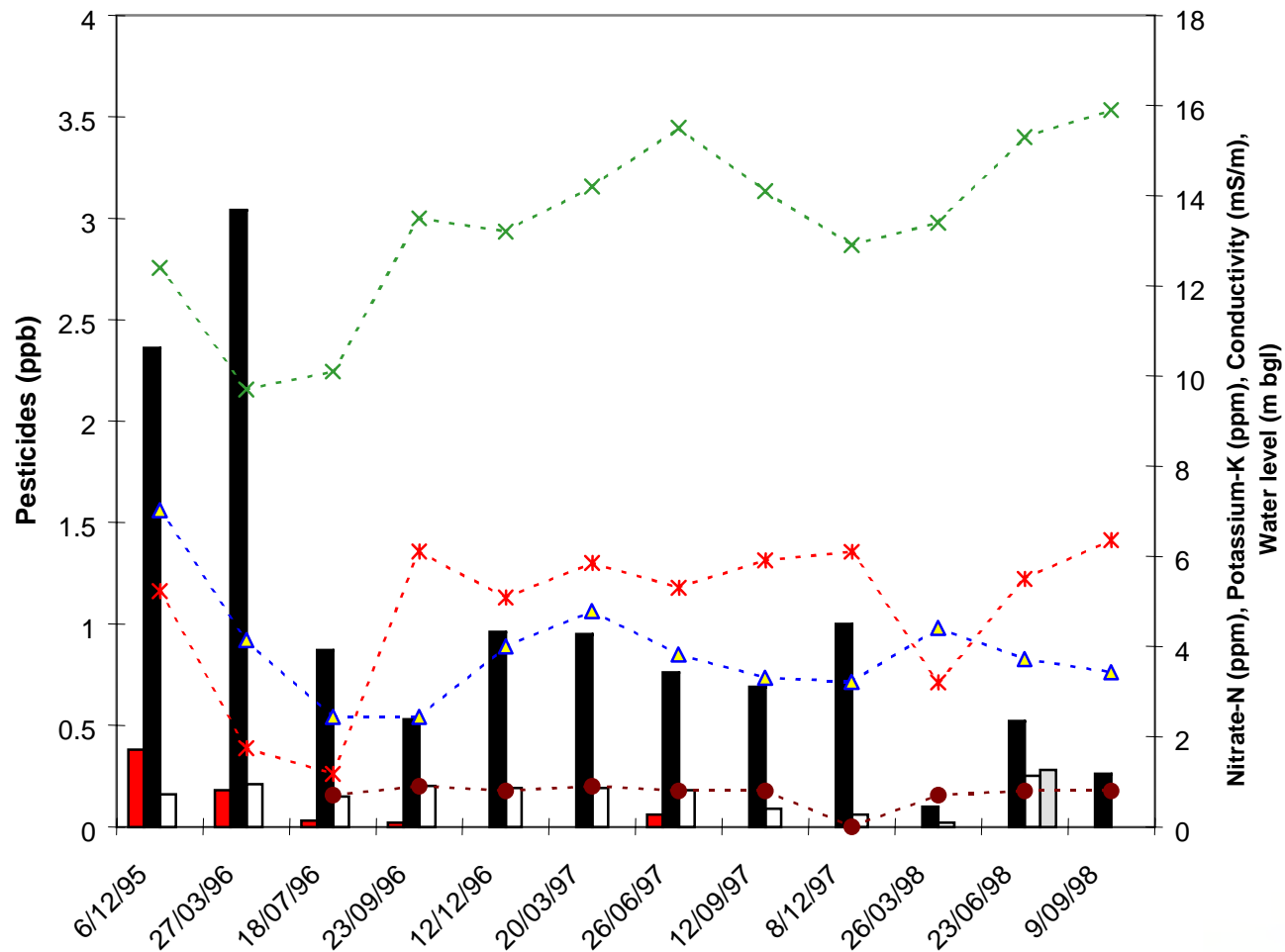
- **Contamination more in unconfined compared with confined aquifers**
- **More pesticide detections with :**
  - shallower wells screened near the water table
  - lower temperatures
  - higher nitrate levels

# Regional Council surveys

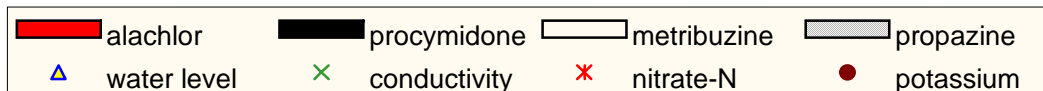
- More intensive regional surveys have been undertaken by several councils
- Mixture of targeted high risk & general resource surveys
- Wide range of results
- Little contamination in areas like Taranaki
- More contamination in areas like Waikato and Canterbury (targeted high risk)
- A general resource survey in Canterbury found 12-14%, only 1 > MAV (dieldrin)

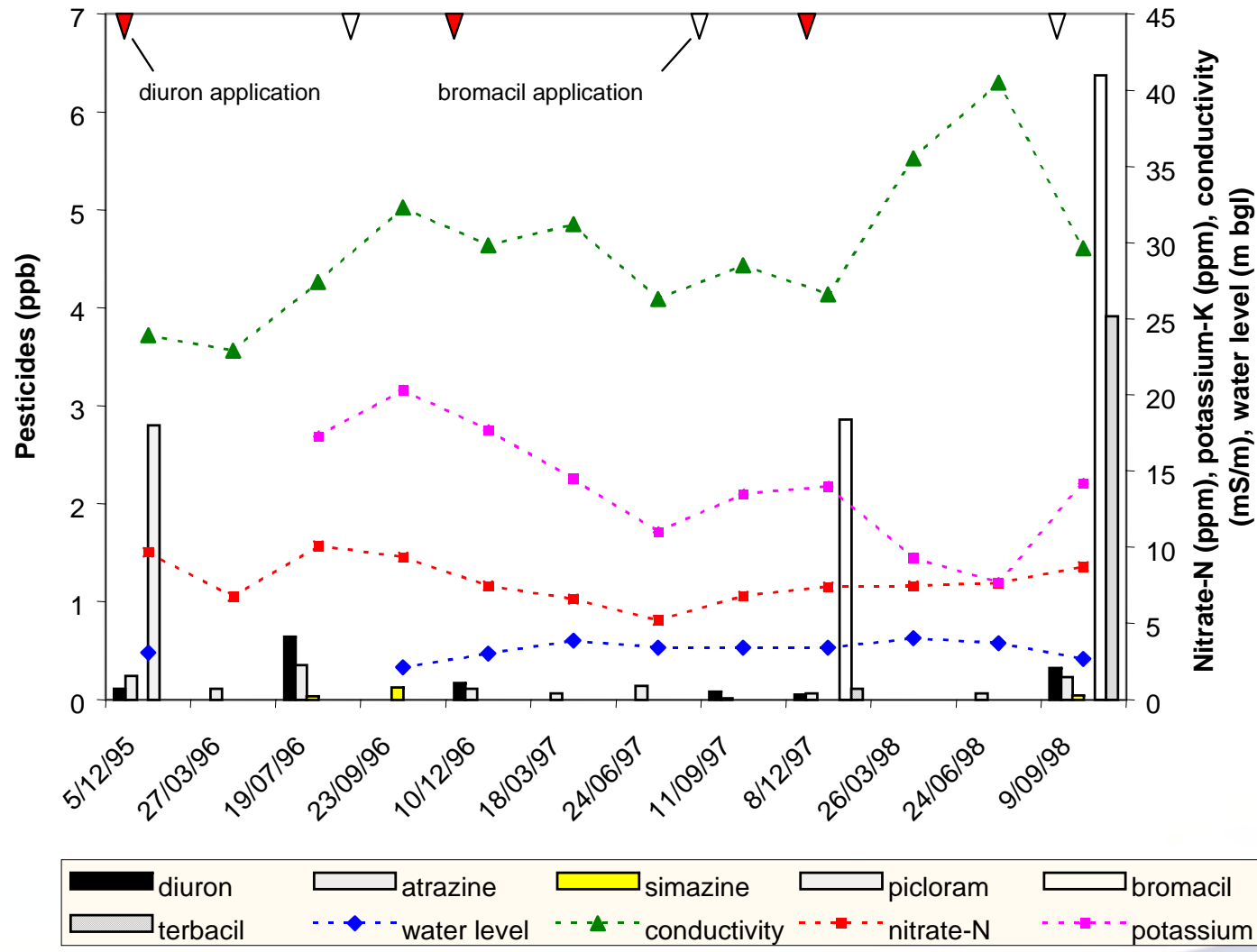
# Temporal variation of pesticides

- **Temporal monitoring carried out by Environments Waikato & Canterbury**
- **Variation in temporal patterns**
  - some sites pesticide levels consistent
  - some sites sporadic detections
- **Some relationship with other parameters such as nitrate & conductivity at some sites but not others**



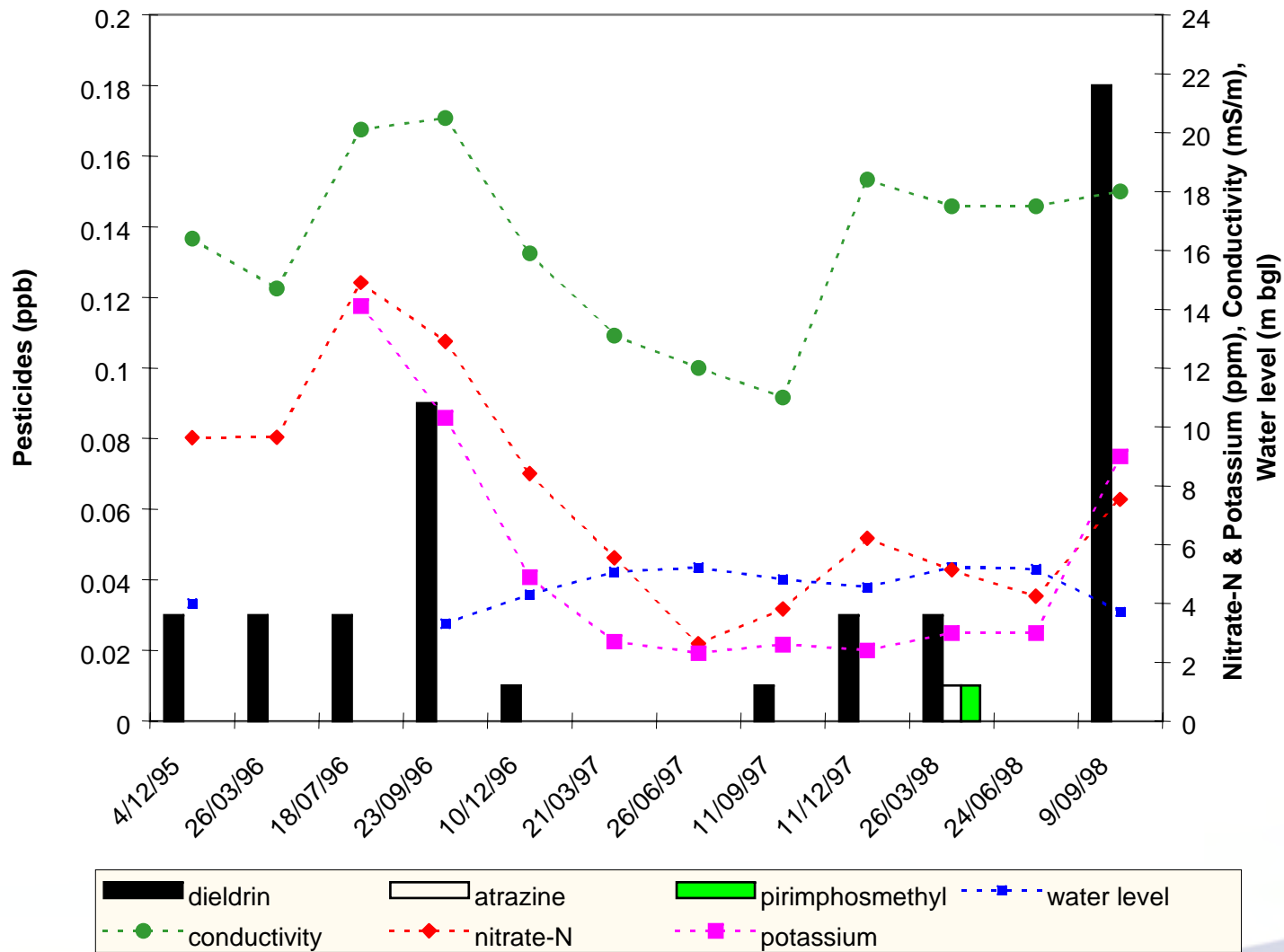
# Site 61.113 Waikato (Hadfield & Smith, 1999)





# Site 61.357 Waikato (Hadfield & Smith, 1999)





# Site 70.69 Waikato (Hadfield & Smith, 1999)

# Temporal variation of pesticides

- **Variability affected by many factors:**
  - recharge patterns - timing wrt pesticide application
  - amounts & timing of pesticide application
  - crop rotations
  - different pesticide characteristics
- **Example of atrazine monitoring in Iowa**
  - increased for 4 years
  - fluctuated for next 10 years
- **Assessment of long-term trends is difficult**



# Point Sources - Landfills or dumps

- **Landfills or dumps**
  - unused pesticides can be dumped in formulation strength
  - containers can be punctured or corrode
  - pesticides may not have to travel through soil
- **Landfill near Blenheim**
  - mecoprop on 2 occasions @ 2.4 & 3.2  $\mu\text{g/L}$
  - would not normally expect this pesticide in groundwater
- **South Canterbury point source - 1998 survey**
  - mecoprop, MCPA, MCPB @ 420, 61 and 2.1  $\mu\text{g/L}$

# Point Sources - Mapua site

- **Fruitgrowers Chemical Site, Mapua, Nelson**
  - Chemicals manufactured between 1955 - 88
  - Organochlorines still persist in soil at medium - high levels
  - DDT, DDE, DDD, aldrin, lindane
  - detected in the groundwater at variable levels
- **Options considered include thermal desorption, bioremediation and sealing in a permanent landfill**
- **Orphan site - TDC working with government**

# Point sources - Sheep dip sites

- Arsenic used from mid 1800's to 1950's, then lindane
- Dieldrin (organochlorine) used 1950's - 1966
- Hadfield & Smith have looked at sheep dips in Waikato
  - estimated 10,000 old dip sites in Waikato region
- Investigated one site in detail
  - groundwater plume extending 40 m from site - levels up to 2.2  $\mu\text{g/L}$  - MAV = 0.03  $\mu\text{g/L}$
  - significant levels still in soil - problem for many years

# Interpretation of results

- **Check against Drinking Water Standards**
- **Look up likely leaching properties of pesticide detected**
  - good site = <http://waffle.nal.usda.gov/agdb/arsppdb.html>
- **Check for local uses of the pesticide**
  - talk to farmer & neighbours
  - look up Novachem manual or similar
- **Talk to an “expert”**
- **Resample well to confirm result**

# Interpretation of results

- **Be aware of temporal variability issues**
- **Talk to landowner**
  - sometimes they will change pesticide use to avoid repeat contamination
- **Link results in with other studies**
- **Be aware of political issues**