

Dr Hannah Ross

# Developing Source Water Risk Management Plans: National Case Studies



**water**  
NEW ZEALAND  
CONFERENCE & EXPO  
17-19 OCTOBER 2023  
Tākina, Te Whanganui-a-Tara Wellington

# Talk Outline

- Background
- Aims
- Methodology:
  - Create conceptual hydro(geo)logical model
  - Delineate Source Water Risk Management Areas (SWRMA)
  - Carry out a Catchment Risk Assessment
  - Prepare a Source Water Risk Management Plan (SWRMP)
- Summary

# Background - Source Water Risk Management Plans

- Havelock North 2016
- Water suppliers must prepare and implement a SWRMP to:

**Identify potential or emerging hazards**

**Assess risks associated with those hazards**

**Identify how risks will be managed**

- Water Services Act 2021 + Taumata Arowai

Version as at 4 October 2023



**Water Services Act 2021**

Public Act 2021 No 36  
Date of assent: 4 October 2021  
Commencement: see section 2

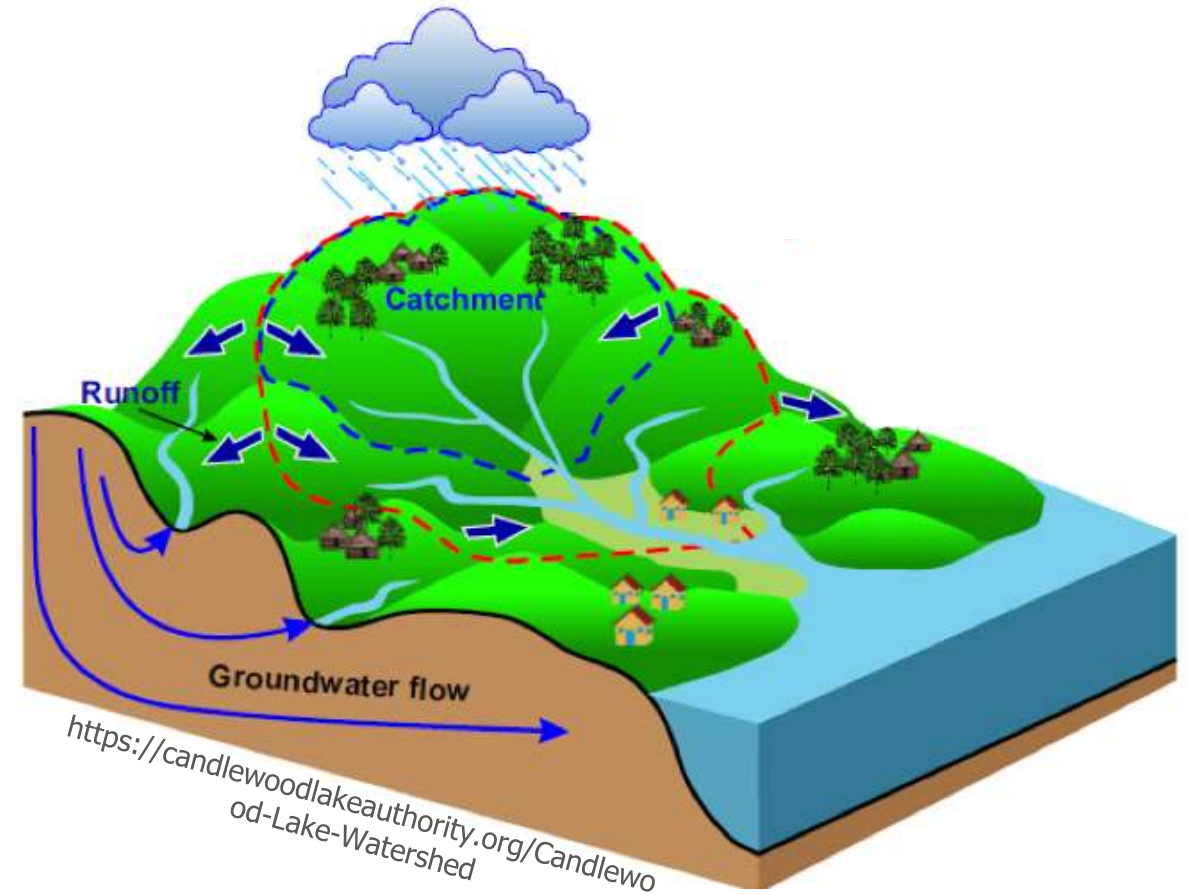


# Aims

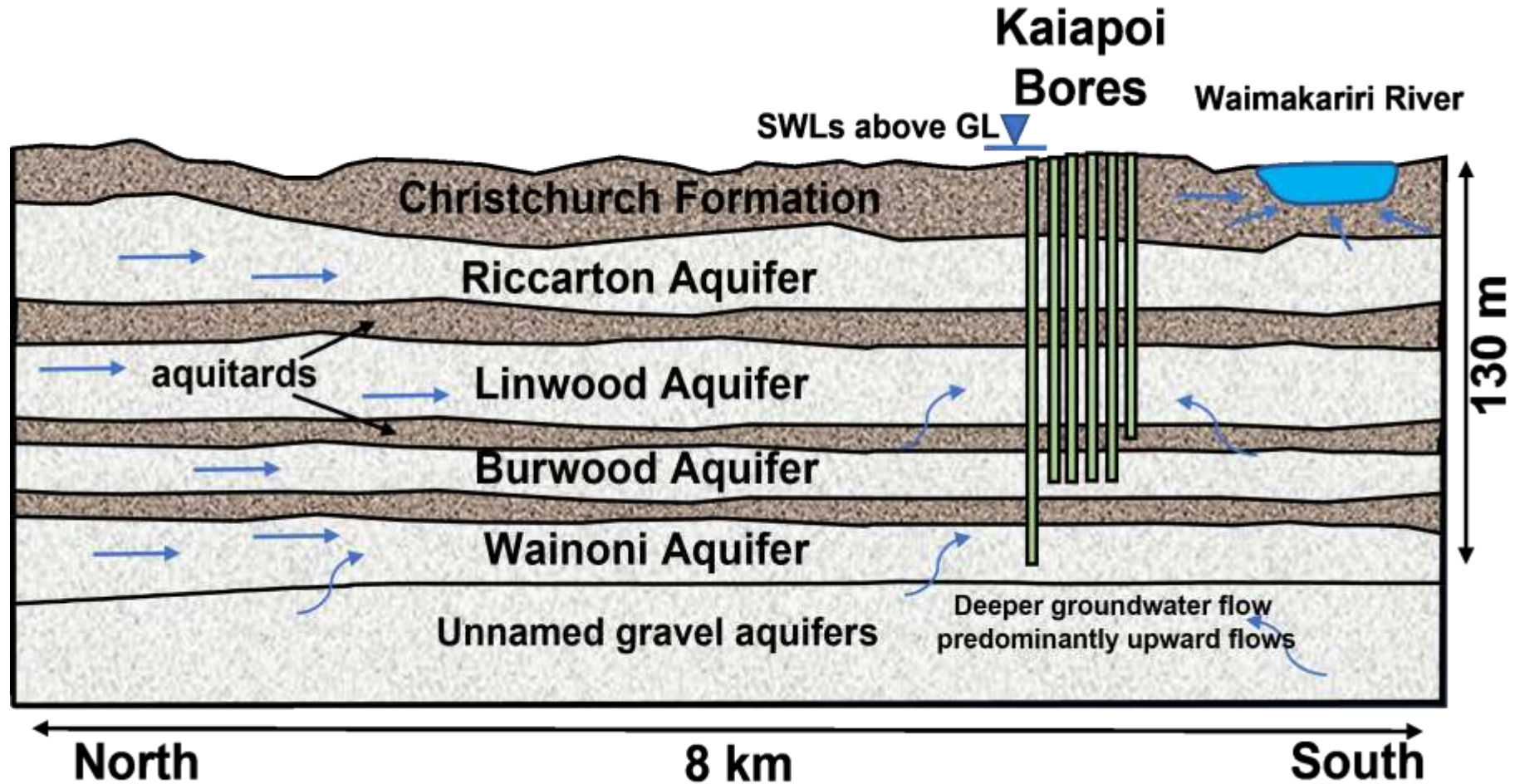
- Be part of supporting the multi-barrier approach to drinking water safety
- To develop a robust, defensible and scalable methodology for preparing SWRMPs

# 1. Conceptual Hydro(geo)logical Model

- First key step is creating a conceptual hydro(geo)logical model
- Collate and analyse data:
  - Geology, hydrogeology, raw water quality, flow direction, etc
- Think about potential pathways

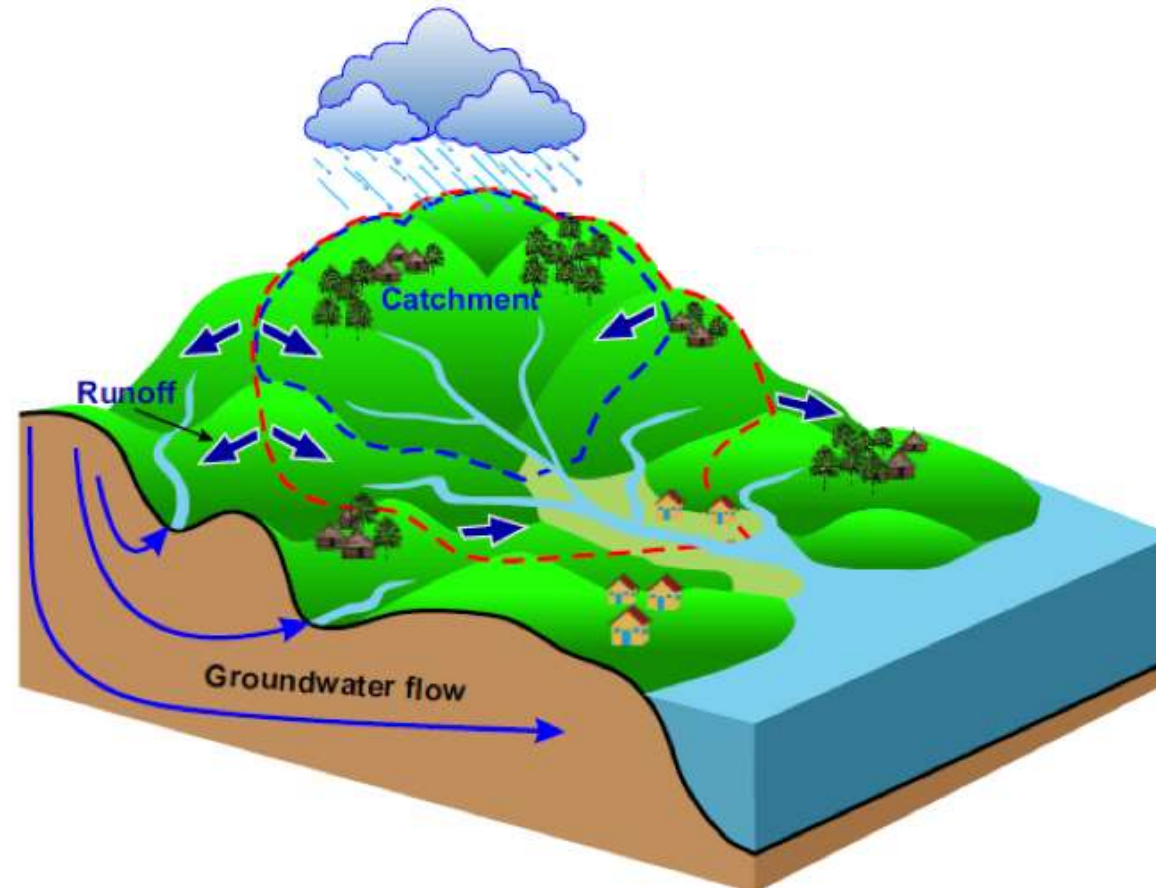


# 1. Conceptual Hydro(geo)logical Model

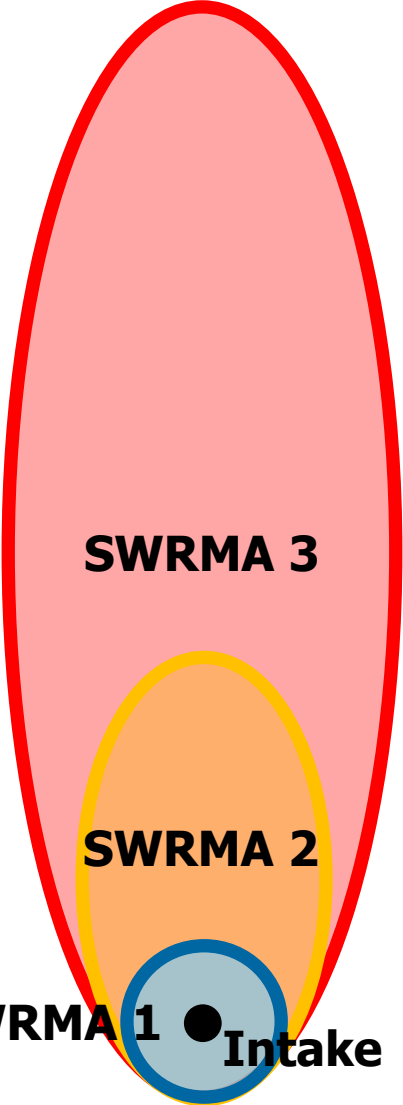


## 2. Source Water Risk Management Areas

- Delineate the source water catchment
- NZ guidelines (MfE) recommend three areas are delineated around each water supply intake point
  - Use generic or numerical modelling methods



# 2. Source Water Risk Management Areas

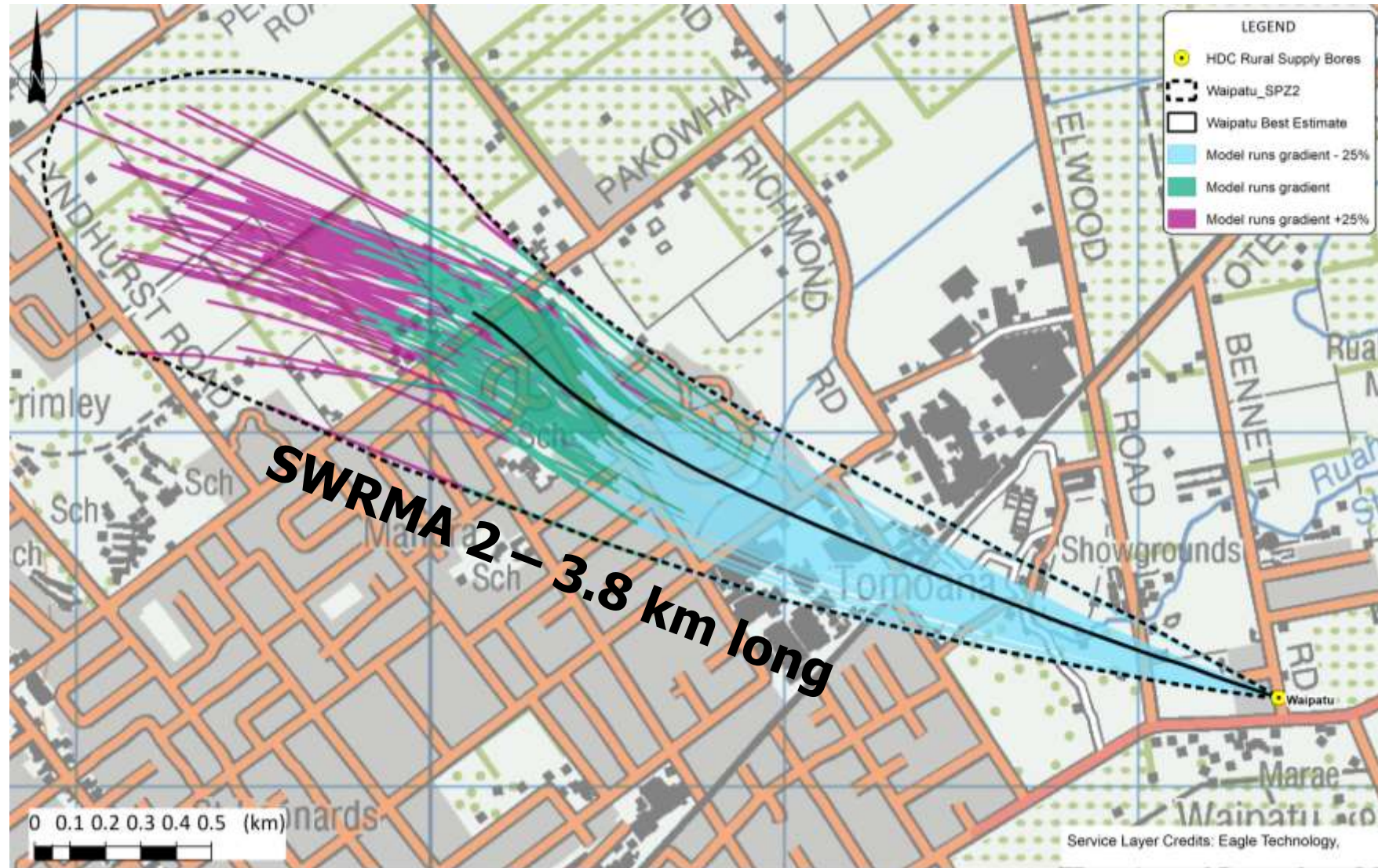


**water**  
NEW ZEALAND  
CONFERENCE & EXPO  
17-19 OCTOBER 2023  
Takina, Te Whanganui-a-Tara Wellington



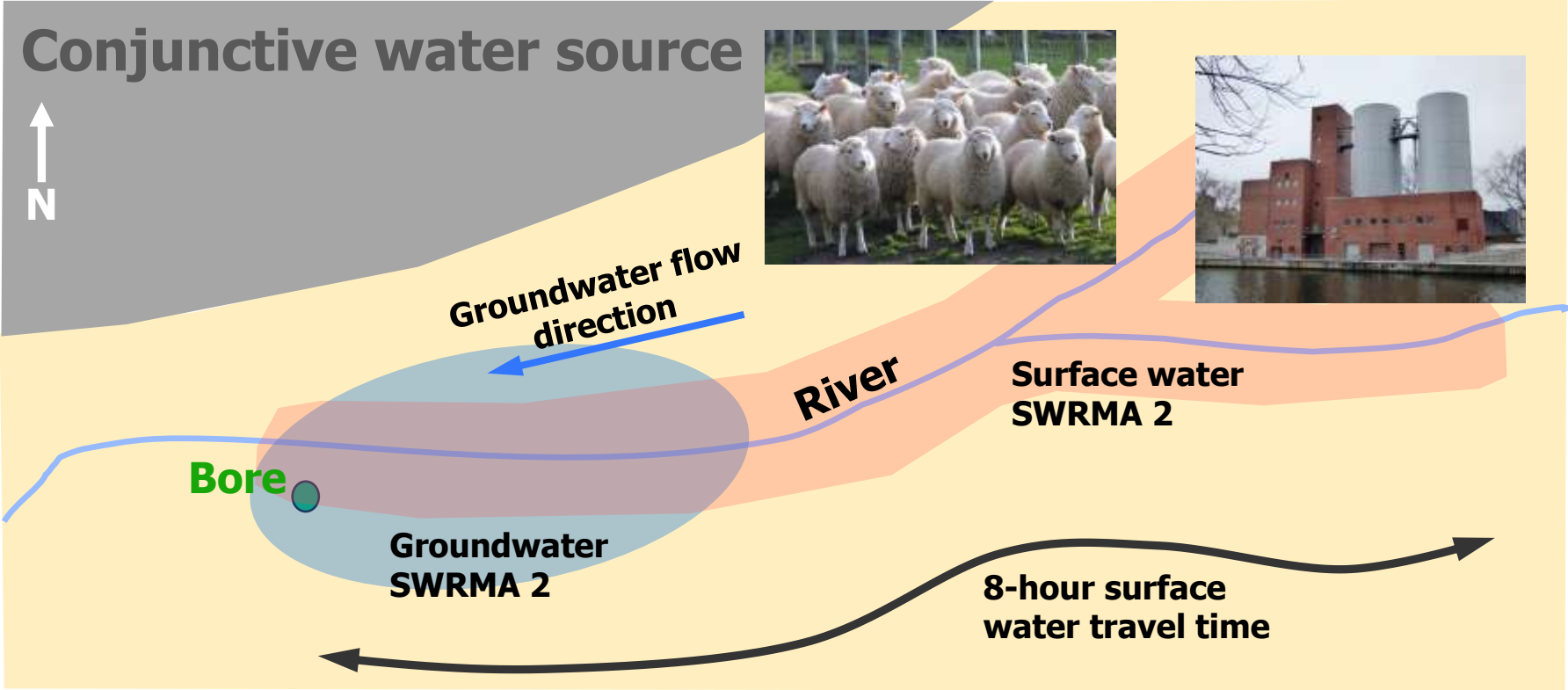
## 2. Source Water Risk Management Areas

- Waipatu drinking water supply, Hastings District Council
- Single bore abstracting groundwater from confined aquifer
- Uniform flow equation (Toews & Gusyev, 2013)



# 2. Source Water Risk Management Areas

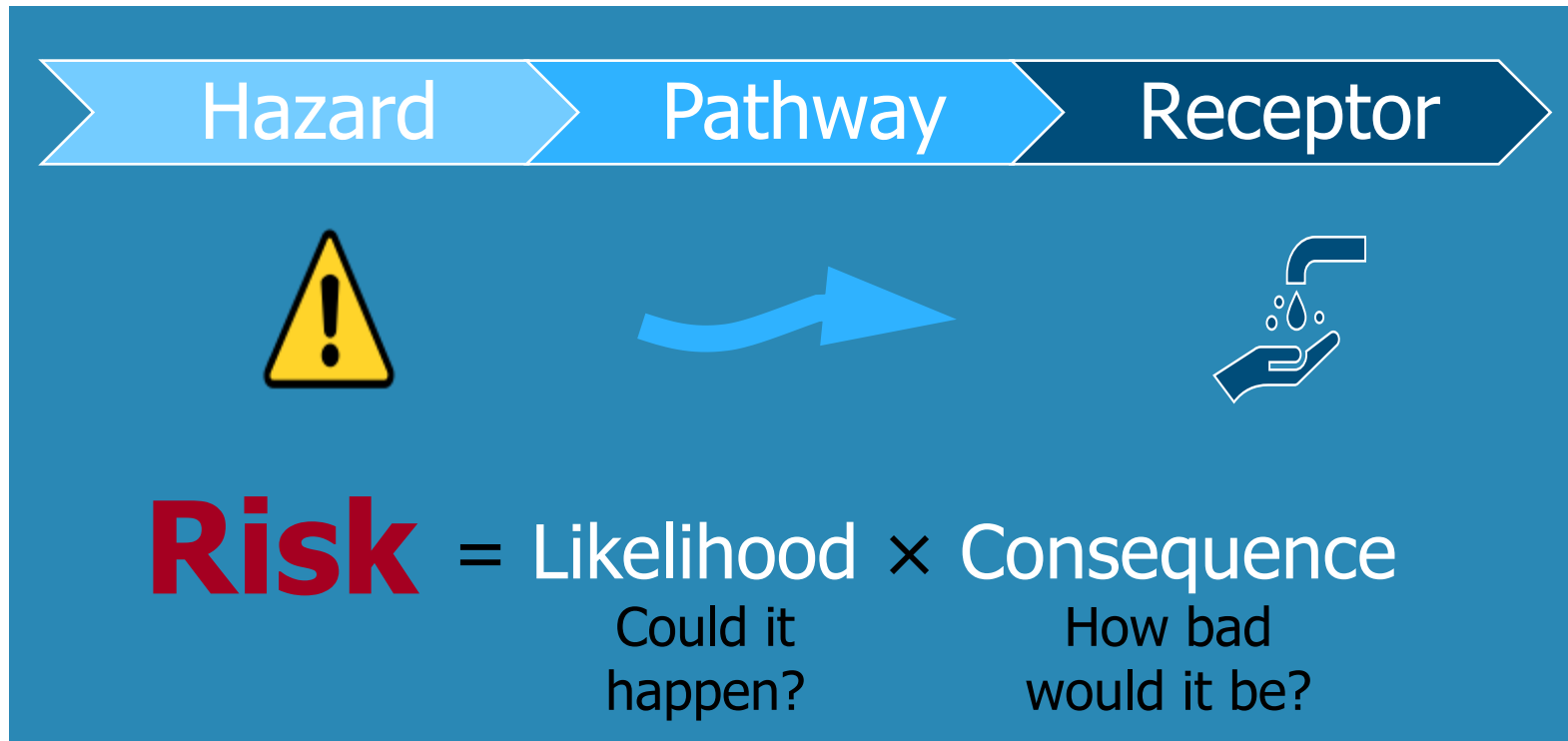
- Importance of conceptual model



-  Impermeable rock
-  Alluvium

# 3. Catchment Risk Assessment

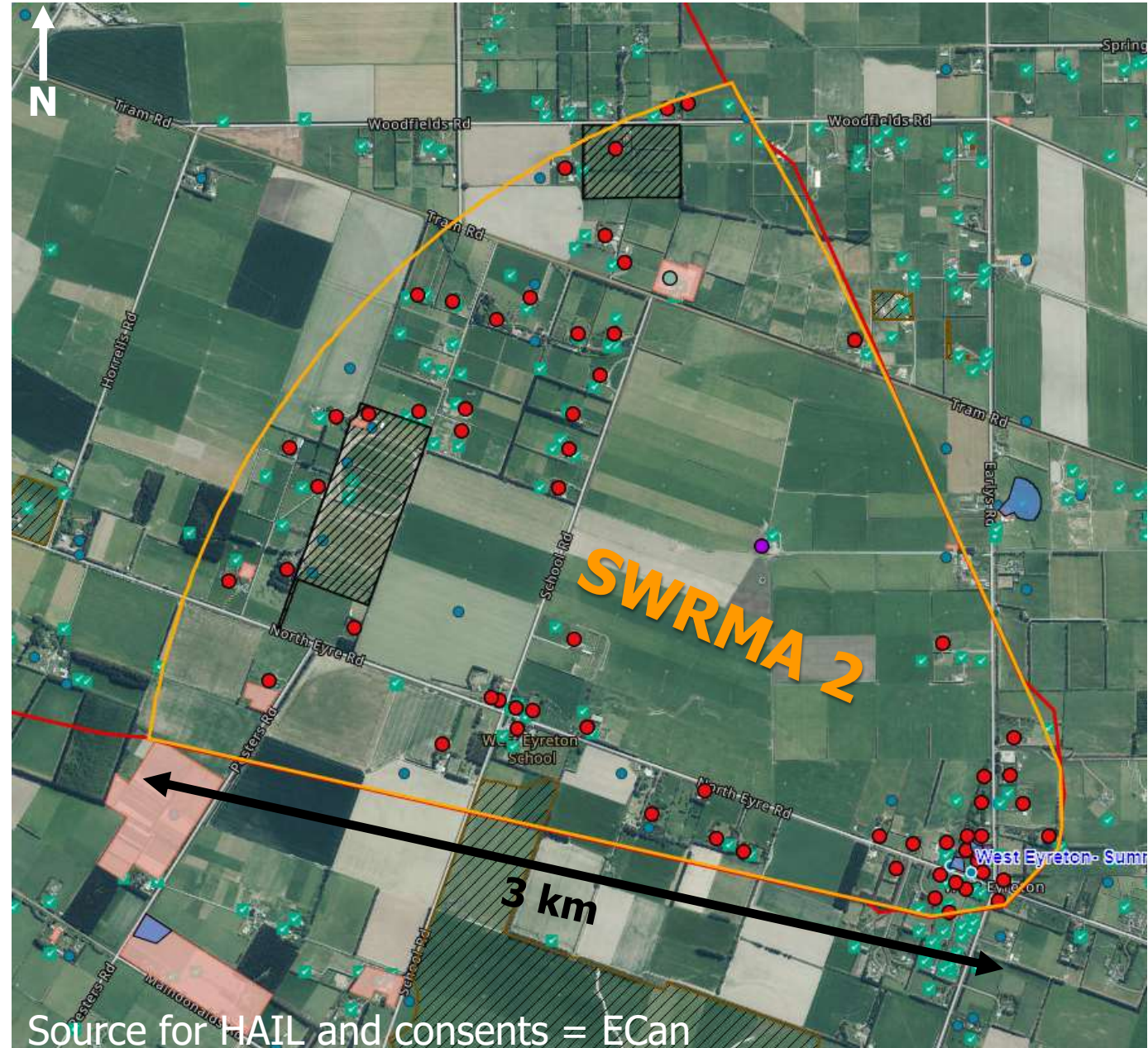
- Addresses Section 43 (2) of Water Services Act 2021:
  - a) Identify potential and emerging hazards
  - b) Assess the risks associated with those hazards



# 3. Catchment Risk Assessment

a) Identify hazards 

- Collate and review data in mapping software:
  - Regional councils
  - Drinking water suppliers
  - Site visits



# 3. Catchment Risk Assessment

## a) Identify hazards



### Hazardous activities

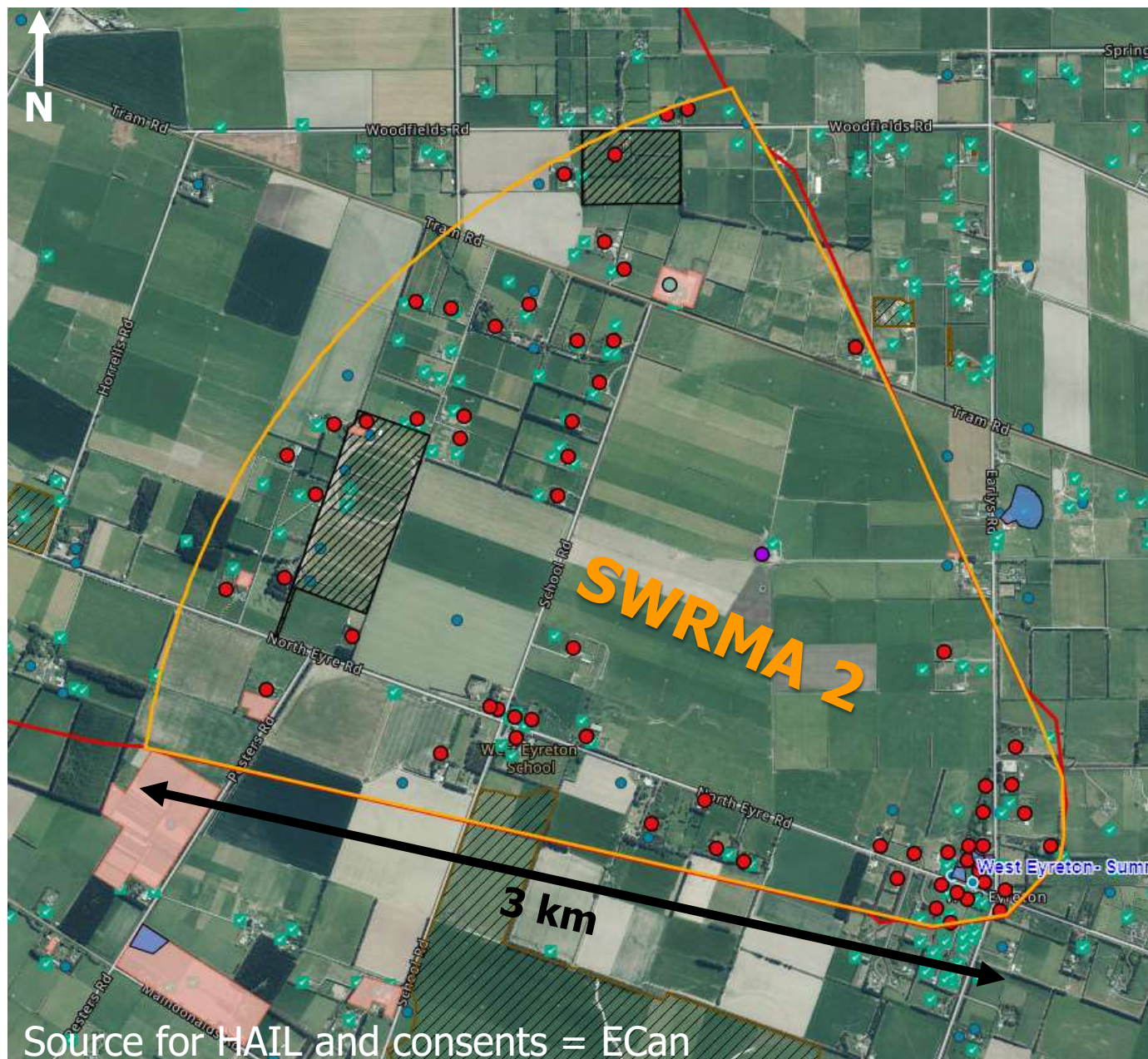
- Historic / ongoing
- Short-term / long-term contaminant source
- Volume of contaminant stored / used

### Potential contaminants

- Physico-chemical properties
- Toxicity / pathogenicity
- Acute / chronic health effects

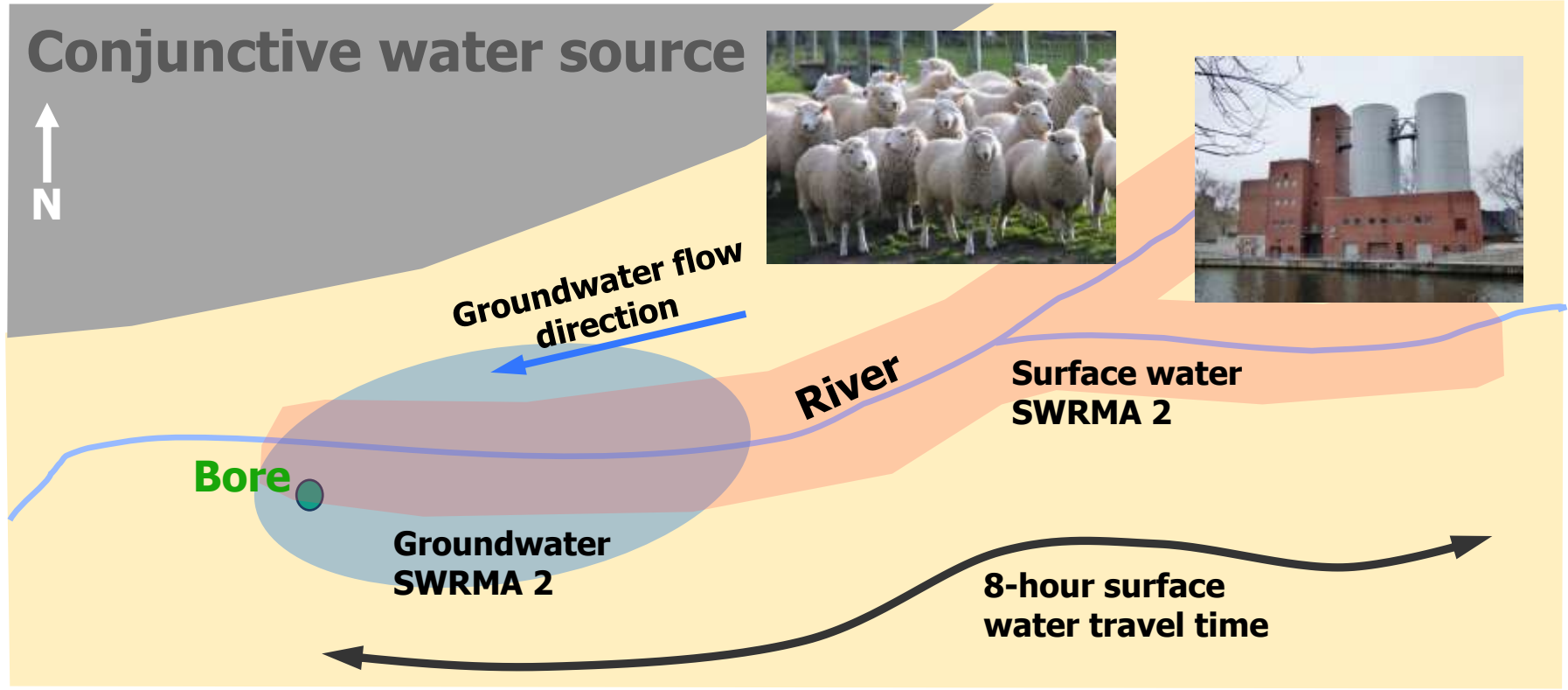
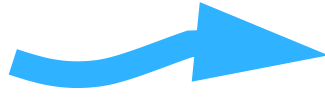
### Other environmental hazards

- Saline intrusion
- Cyanobacteria



# 3. Catchment Risk Assessment

a) Identify pathways



-  Impermeable rock
-  Alluvium

# 3. Catchment Risk Assessment

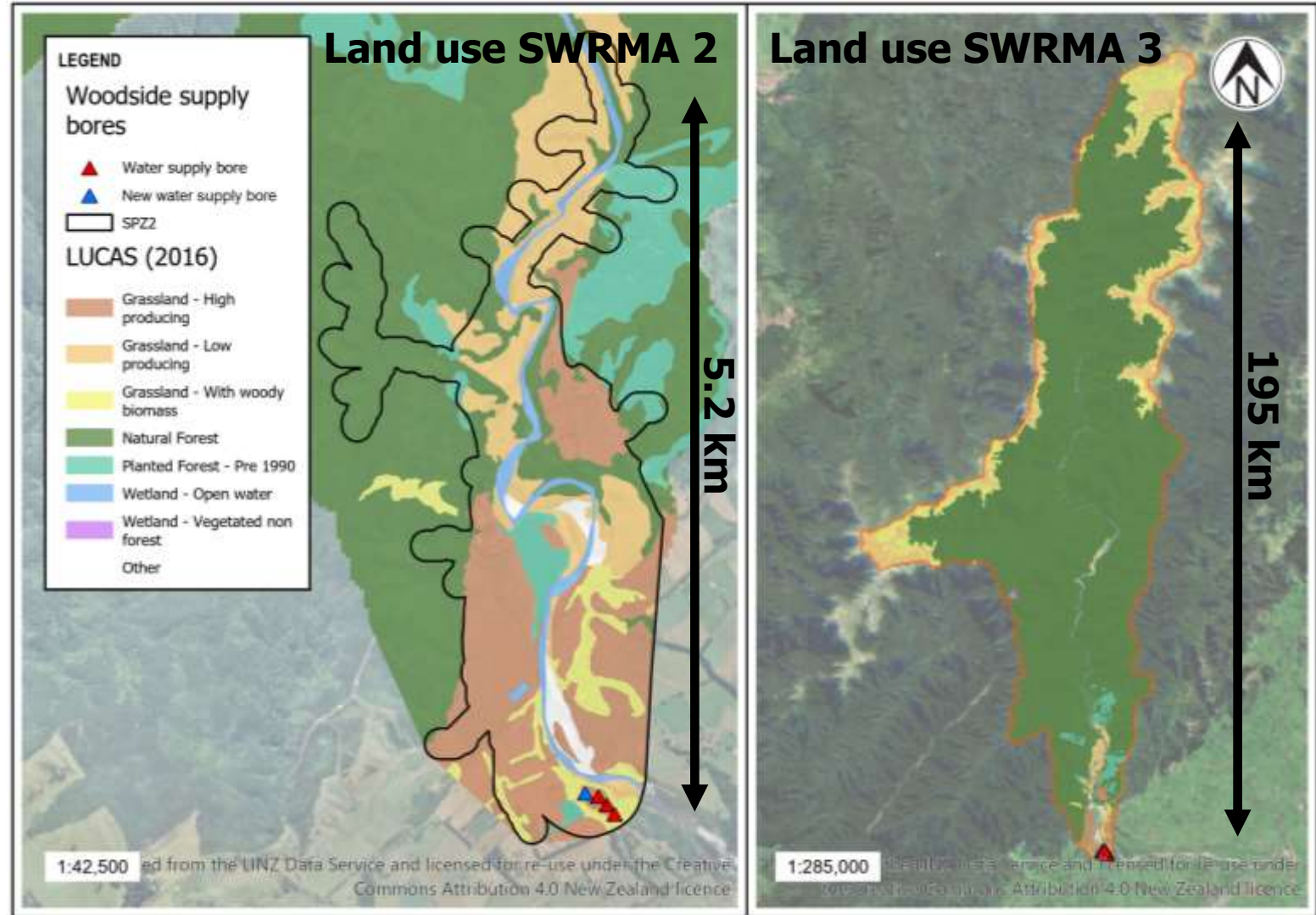
- Featherston and Greytown water supply from Woodside bores



- Potential hazards



- Potential pathways



# 3. Catchment Risk Assessment

## b) Risk assessment

**Risk** = Likelihood × Consequence

Ranking	Description
Rare	May occur only in exceptional circumstances
Unlikely	Could occur
Possible	Might occur at some time
Likely	Will probably occur
Almost certain	Is expected to occur in most circumstances

Ranking	Description
Insignificant	Insignificant
Minor	Minor impact for small population
Moderate	Minor impact for large population
Major	Major impact on a sub-population
Severe	Major impact on most population

		Consequence				
		Insignificant	Minor	Significant	Major	Severe
Likelihood	Almost certain	Medium	High	Very high	Extreme	Extreme
	Likely	Medium	Medium	High	Very high	Extreme
	Possible	Low	Medium	Medium	High	Very high
	Unlikely	Very low	Low	Medium	Medium	High
	Rare	Very low	Very low	Low	Medium	Medium



# 3. Catchment Risk Assessment

Activity category	A SWRMA	B Potential contaminant source	C Examples of potential contaminants	D Hazard					E Contaminant pathway	Unmitigated Risks			
				Protozoa	Bacterial/virus	Chemical/Aesthetic	Radiological	Disruption to		F Consequence of the hazardous event	G Likelihood of hazardous event occurring	H Maximum (unmitigated) risk (F×G)	I Uncertainty
In-ground water supply bore infrastructure	SWRMA1	Surface contaminant enters bore directly due to damage/aging to in-ground water supply bore infrastructure	Fertilisers, pesticides, fuel/hydrocarbons, heavy metals, pathogens	X	X	X	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer.	Major	Rare	Medium	Estimate	
Rural	SWRMA1	Fertilizer (potentially stored in sheds adjacent to M35/2589)	Nitrate, cadmium, uranium, perchlorate			X	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Moderate	Rare	Low	Estimate	
	SWRMA1	Agricultural/horticulture chemicals (potentially stored in sheds adjacent to M35/2589)	Insecticides, herbicides and fungicides			X	N/A		Moderate	Rare	Low	Estimate	
	SWRMA1	Farm equipment (cleaning, fuelling and maintenance) (potentially stored in sheds adjacent to M35/2589)	PAHs, BTEX, Nickel, Chlorate			X	N/A		Moderate	Rare	Low	Estimate	
	SWRMA1	Stock grazing (stock can graze up to the stock exclusion zone fencing)	Pathogens, nitrate, veterinary medicines	X	X	X	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Major	Rare	Medium	Estimate	

# 4. Source Water Risk Management Plans

- Source-specific management solutions (controls)
- Focus on the prioritized risks identified in the CRAs
- Categorise the management solutions into two groups:
  - **Operational solutions**
  - **Non-operational solutions**



## Maintaining your wastewater system

As a property owner, you are responsible for maintaining your onsite wastewater system and know how it works.

All onsite wastewater systems need to dispose of the water used in your home. In most cases, this is done in a field. This is the area where the treated water from your septic tank is distributed. It may be lawn area. This area should not be used by vehicles or stock.

If the area is boggy, smelly, or overgrown, there might be a leak that needs to be repaired.



Tips for maintaining your septic tank

PDF download 3.5 MB



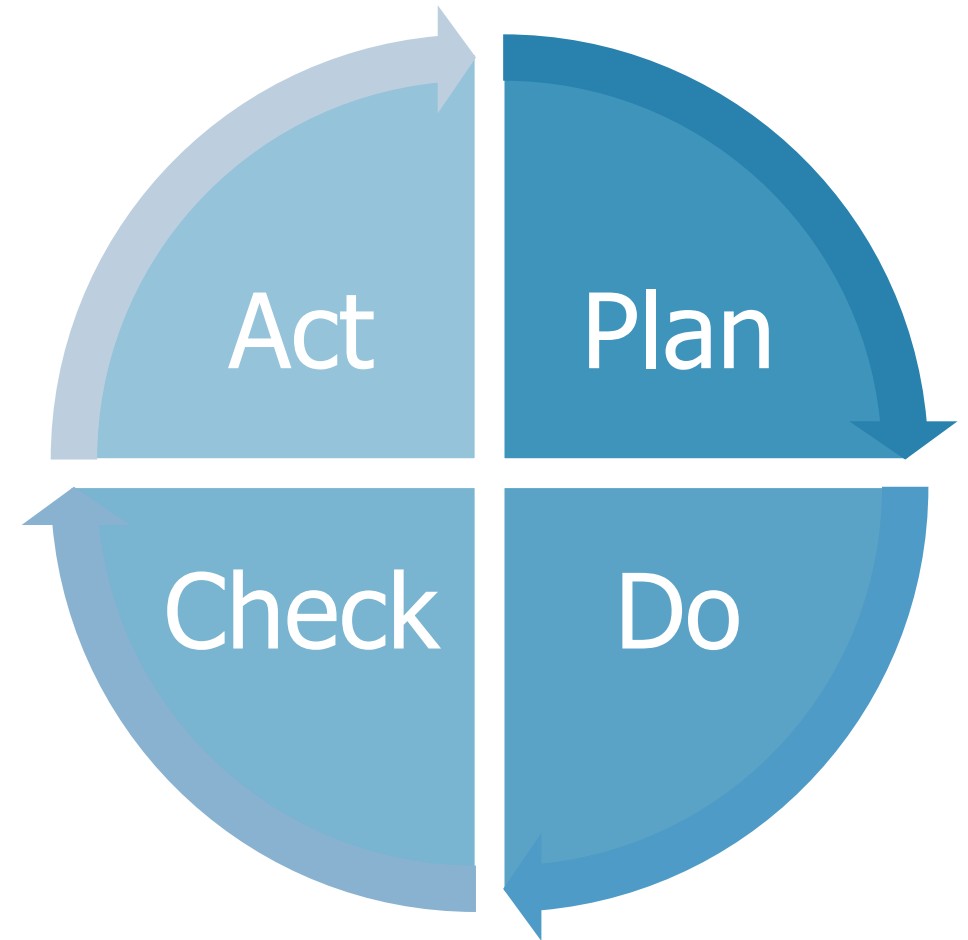
# 4. Source Water Risk Management Plans

- Confined aquifer with 'leaky' aquitard – wastewater network risk rated **Extreme**

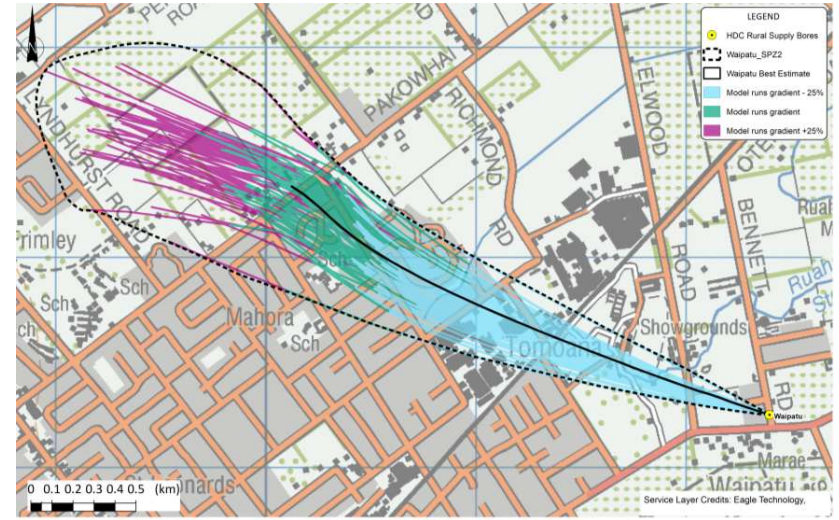
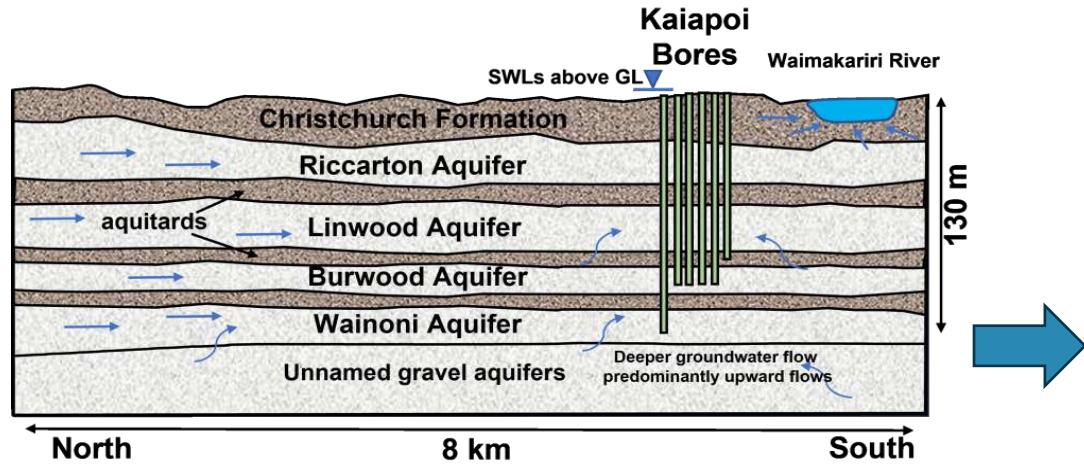
Potential Operational Solutions	Potential Non-Operational Solutions
<ul style="list-style-type: none"><li>• Prioritise wastewater infrastructure condition assessment (within SWRMA 1).</li><li>• Carryout upgrades based on findings above.</li></ul>	<p><i>Research / review</i></p> <ul style="list-style-type: none"><li>• Quantitative assessment of potential cumulative impact of numerous leaking wastewater connections within SWRMA1 using an available hydrogeological numerical model.</li></ul> <p><i>Regulatory / policy and engagement</i></p> <ul style="list-style-type: none"><li>• Pending results from the hydrogeological numerical model assessment above, explore options for increased regulation of wastewater connections with local council.</li></ul>

# 4. Source Water Risk Management Plans

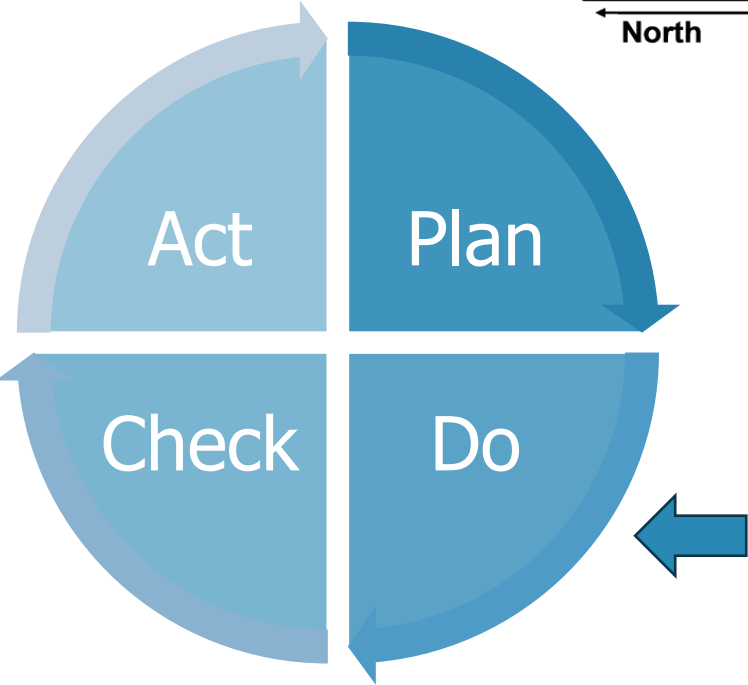
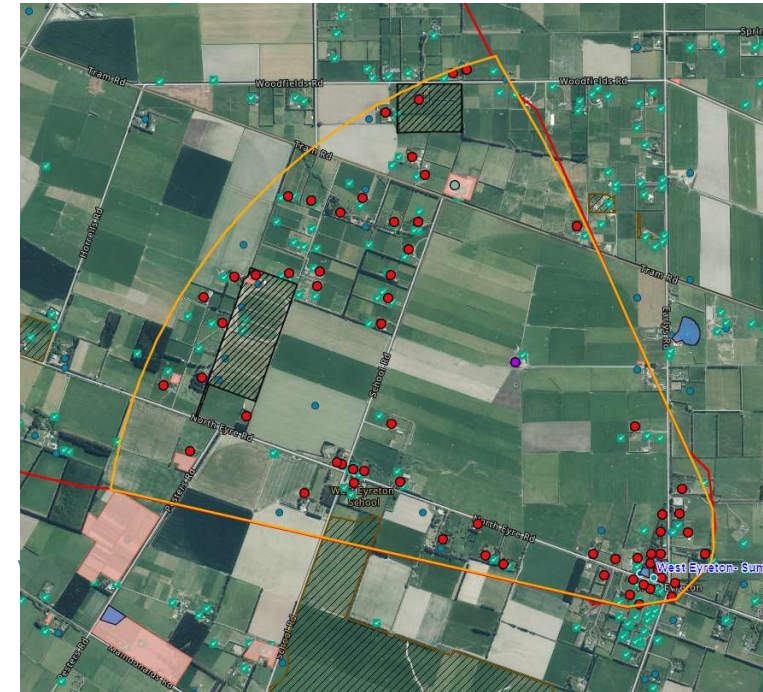
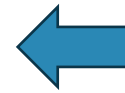
- Living documents to be continually updated:
  - Accessible
  - Reproducible and transparent workflows
  - Consultation
  - Changes in source water catchment
  - Changes in legislation
  - Continually assess effectiveness



# Summary



Activity category	A	B	C	D			E	Unmitigated Risks			
				Hazard	Contaminant pathway	Consequence of the hazardous event		Likelihood of hazardous event occurring	Maximum (unmitigated) risk (FixG)	Uncertainty	
In-ground water supply bore infrastructure	SWFRMA1	Surface contaminant enters bore directly due to damage/aging to in-ground water supply bore infrastructure	Fertilisers, pesticides, fuel/hydrocarbons, heavy metals, pathogens	X	X	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer.	Major	Rare	Medium	Estimate
Rural	SWFRMA1	Fertilizer (potentially stored in sheds adjacent to M35/2589)	Nitrate, cadmium, uranium, perchlorate	X	N/A	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Moderate	Rare	Low	Estimate
	SWFRMA1	Agricultural/horticulture chemicals (potentially stored in sheds adjacent to M35/2589)	Insecticides, herbicides and fungicides	X	N/A	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Moderate	Rare	Low	Estimate
	SWFRMA1	Farm equipment (cleaning, fuelling and maintenance) (potentially stored in sheds adjacent to M35/2589)	PAHs, BTEX, Nickel, Chlorate	X	N/A	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Moderate	Rare	Low	Estimate
	SWFRMA1	Stock grazing (stock can graze up to the stock exclusion zone fencing)	Pathogens, nitrate, veterinary medicines	X	X	N/A	Direct: Contamination of the wellhead. Flooding of the wellhead providing a pathway to the deep source aquifer. Indirect: Leaching of chemicals and pathogens to soil and migration through unsaturated/saturated zone.	Major	Rare	Medium	Estimate



# Acknowledgements

- We would like to acknowledge the support of Waimakariri District Council, Hastings District Council and Wellington Water, who have agreed to share information on their water supplies in this talk
- The T+T team helping drinking water suppliers provide safe drinking water to communities