

Southland Regional Council (Environment Southland) Proposed Southland Water and Land Plan

Comments by:

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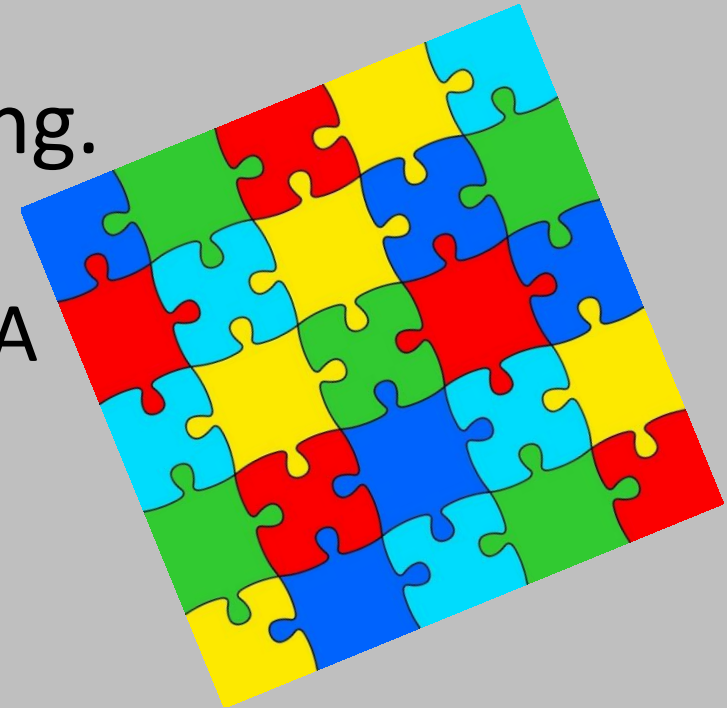
Dragun Corporation

Farmington Hills, Michigan, USA

On behalf of

Wilkins Farming Company

Southland, NZ





- Discuss Wendonside Groundwater Zone
- Discuss existing groundwater data
- Are there enough data to build a robust Conceptual Site Model

Why me, a Canadian working in the US?

1. 40+ years of using site-specific data to learn how watersheds work.



Biggest lesson learned:
How do you know when
you have enough data to
make conclusions.

Why me, a Canadian working in the US?

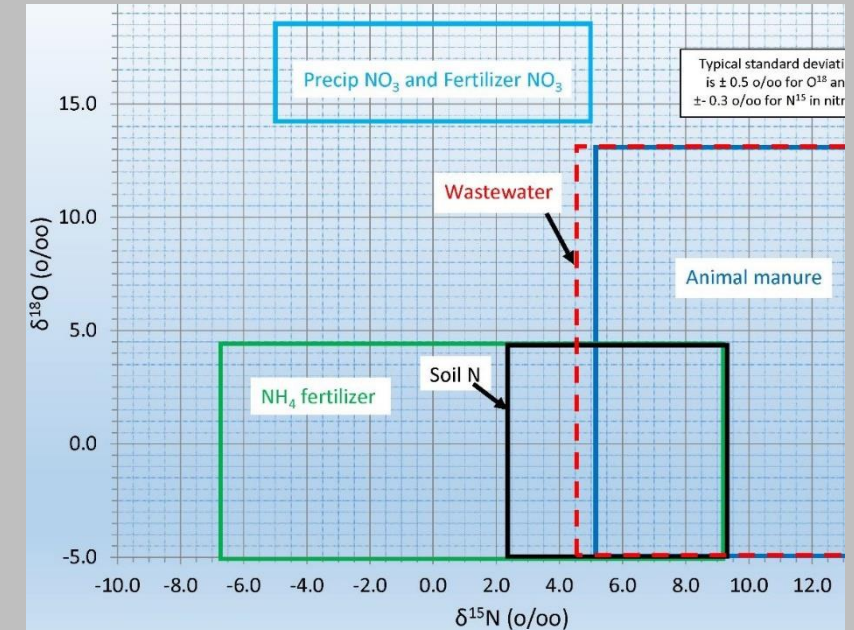
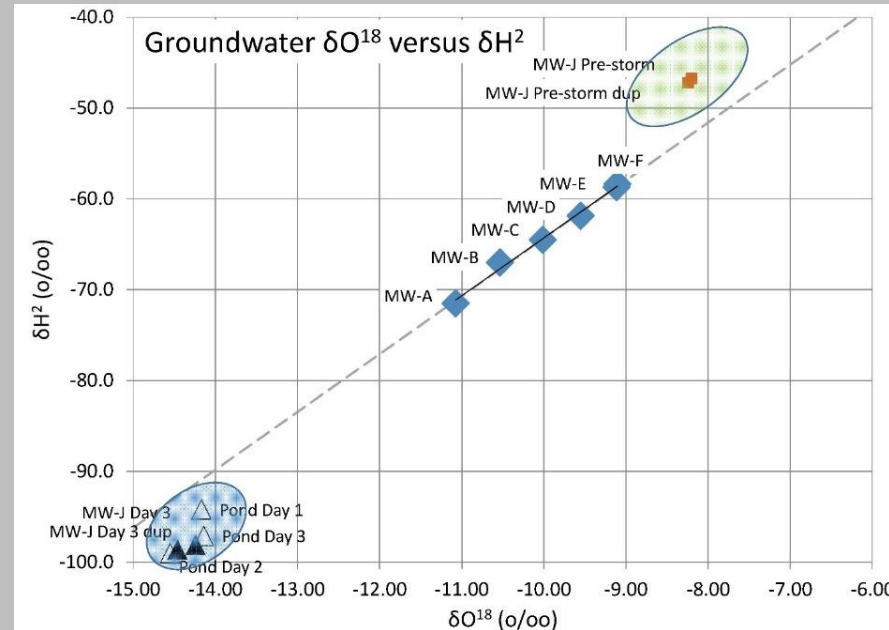
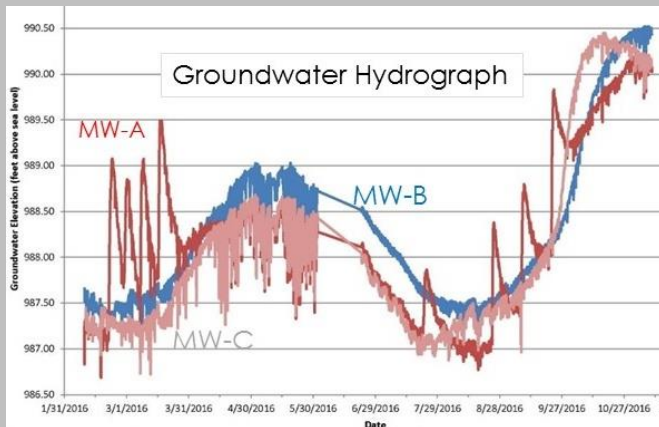
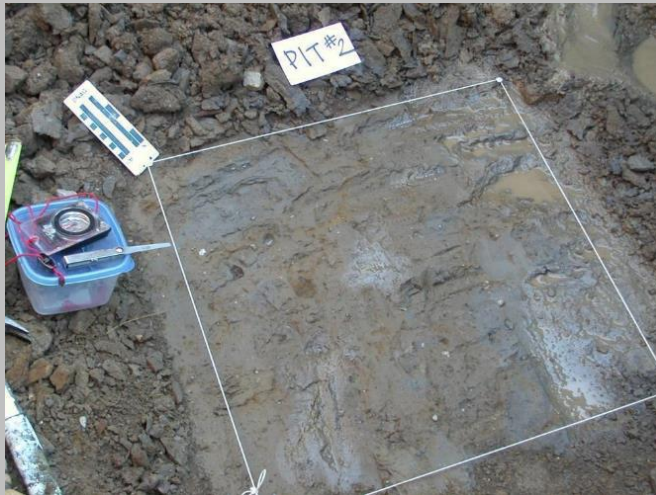
2. New Zealand experience: 1983 Maimai Catchment investigation with NZ Forestry Service and INS



Biggest lesson learned:
What you see is not
necessarily what you get.

Why me, a Canadian working in the US?

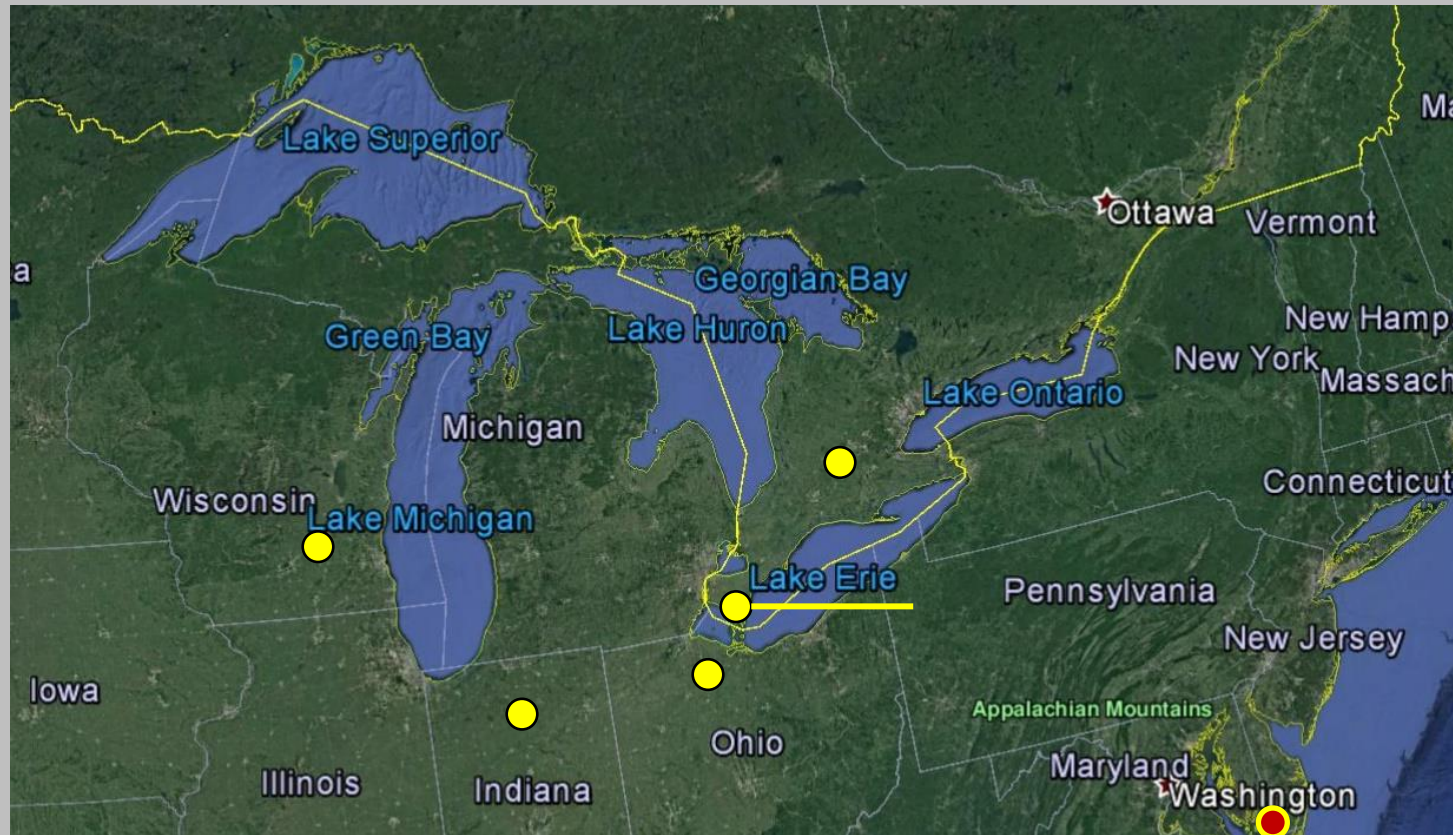
3. Dairy industry experience using multiple tools



Biggest lesson learned:
Again, what you see is not necessarily
what you get.

Why me, a Canadian working in the US?

4. Nutrients in groundwater is a world wide problem. First nitrate research I did was PLUARG in 1976.

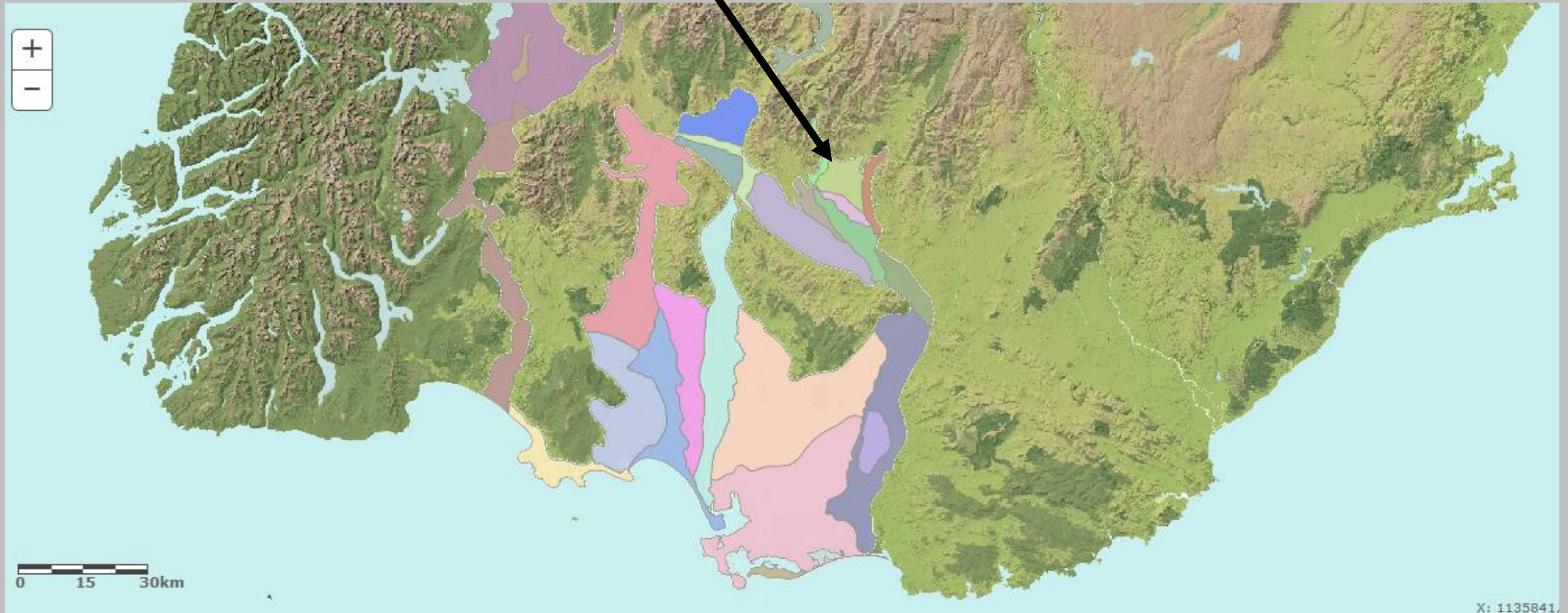


Biggest lesson learned: Many sites have legacy issues

Objectives of My Analysis of Nitrate in Groundwater in the Wendonside Groundwater Zone

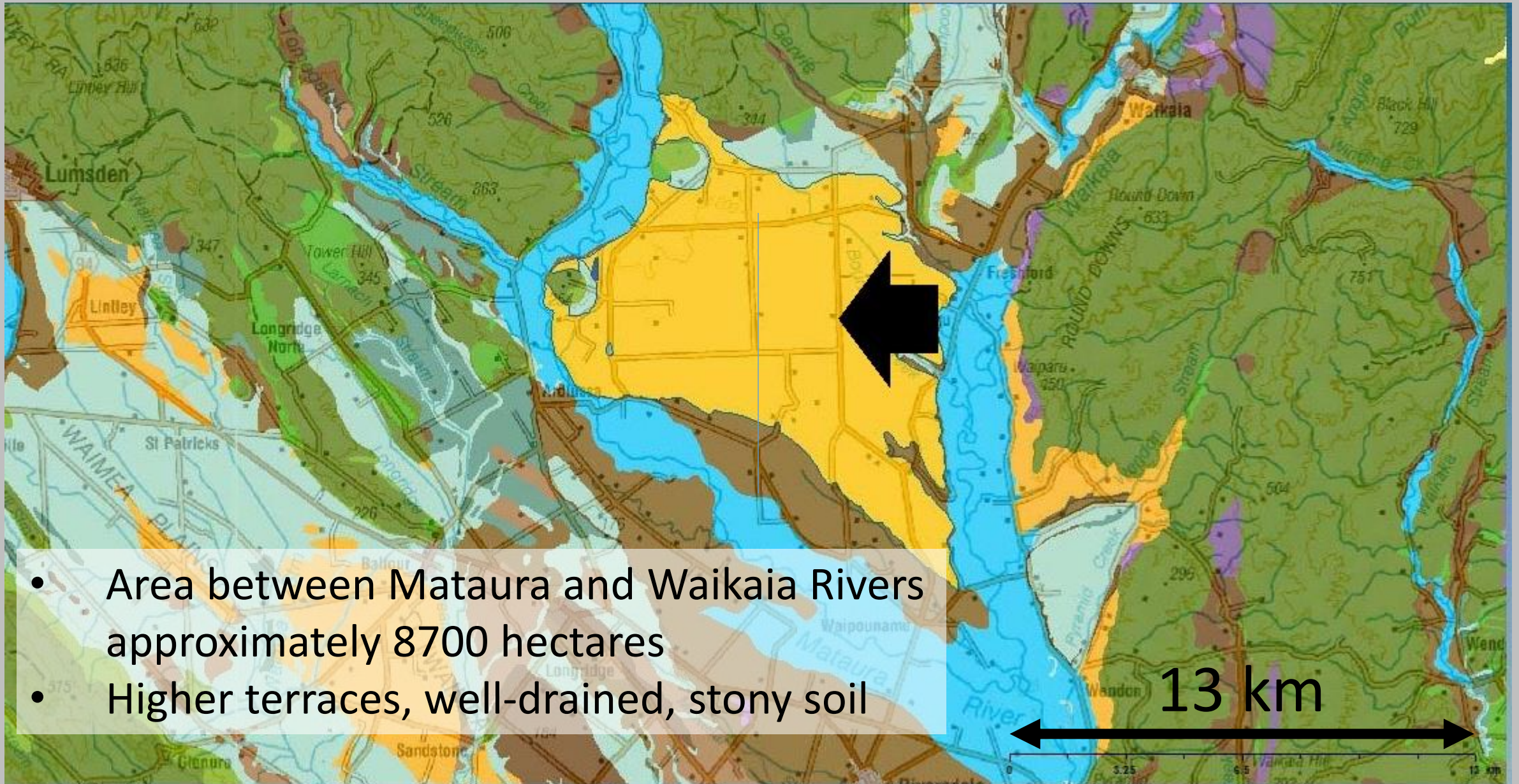
1. Are there enough data to characterize nitrate in groundwater in the Wendonside Groundwater Zone?
2. Do current groundwater nitrate concentrations in the Wendonside Groundwater Zone reflect current or historical agricultural activities?
3. Discuss proposed conceptual work plan.

Nitrate in Groundwater in the Wendonside Groundwater Zone

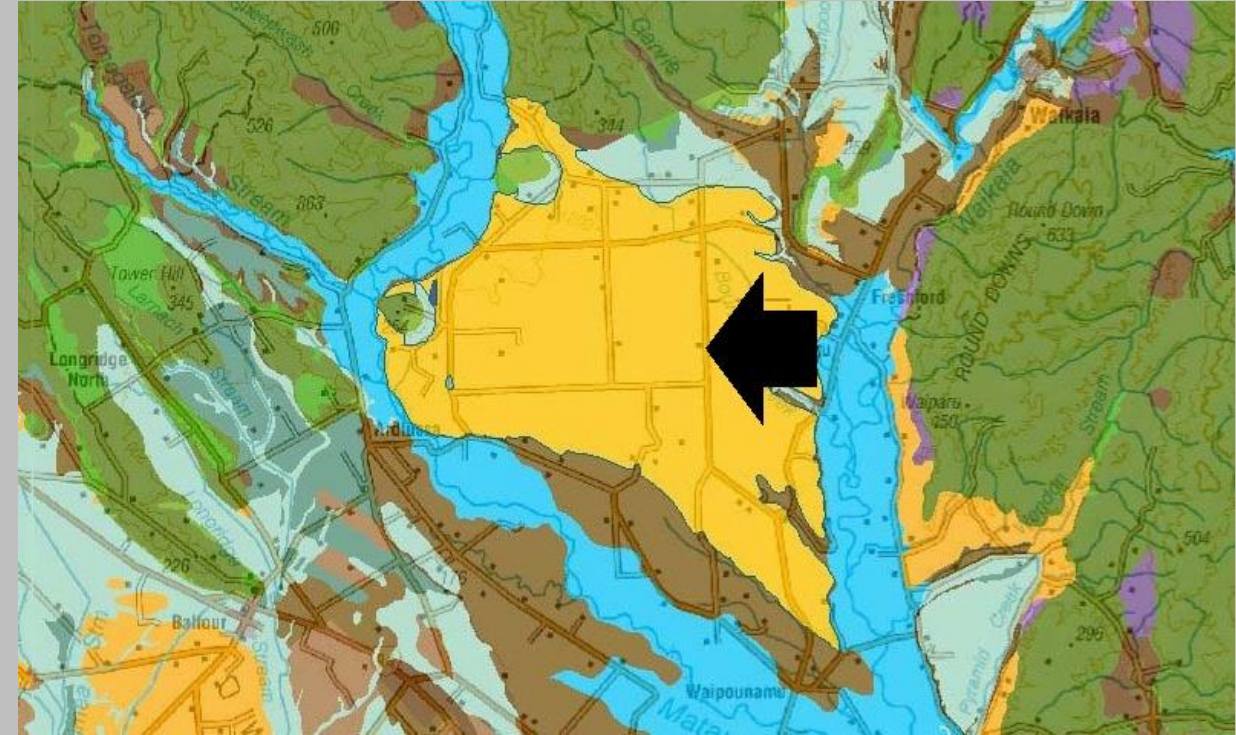


Note: The maps, sketches, and data are largely from Environment Southland publications

Wendonside Groundwater Zone

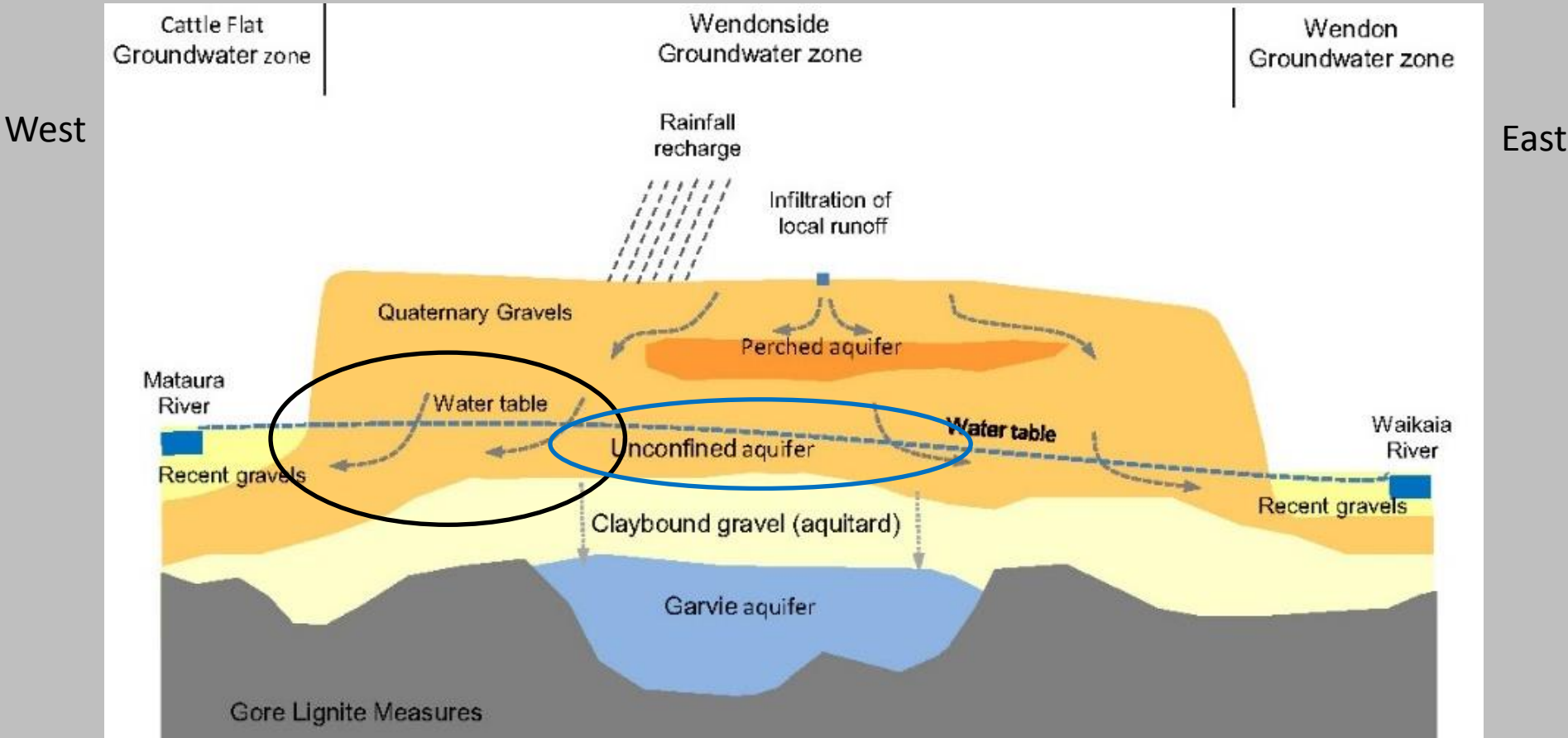


Most of reports on groundwater refer to the Wendonside Groundwater Zone (WGZ)



Wendonside Groundwater Zone (left) coincides with the Old Matura Physiographic Zone (right)

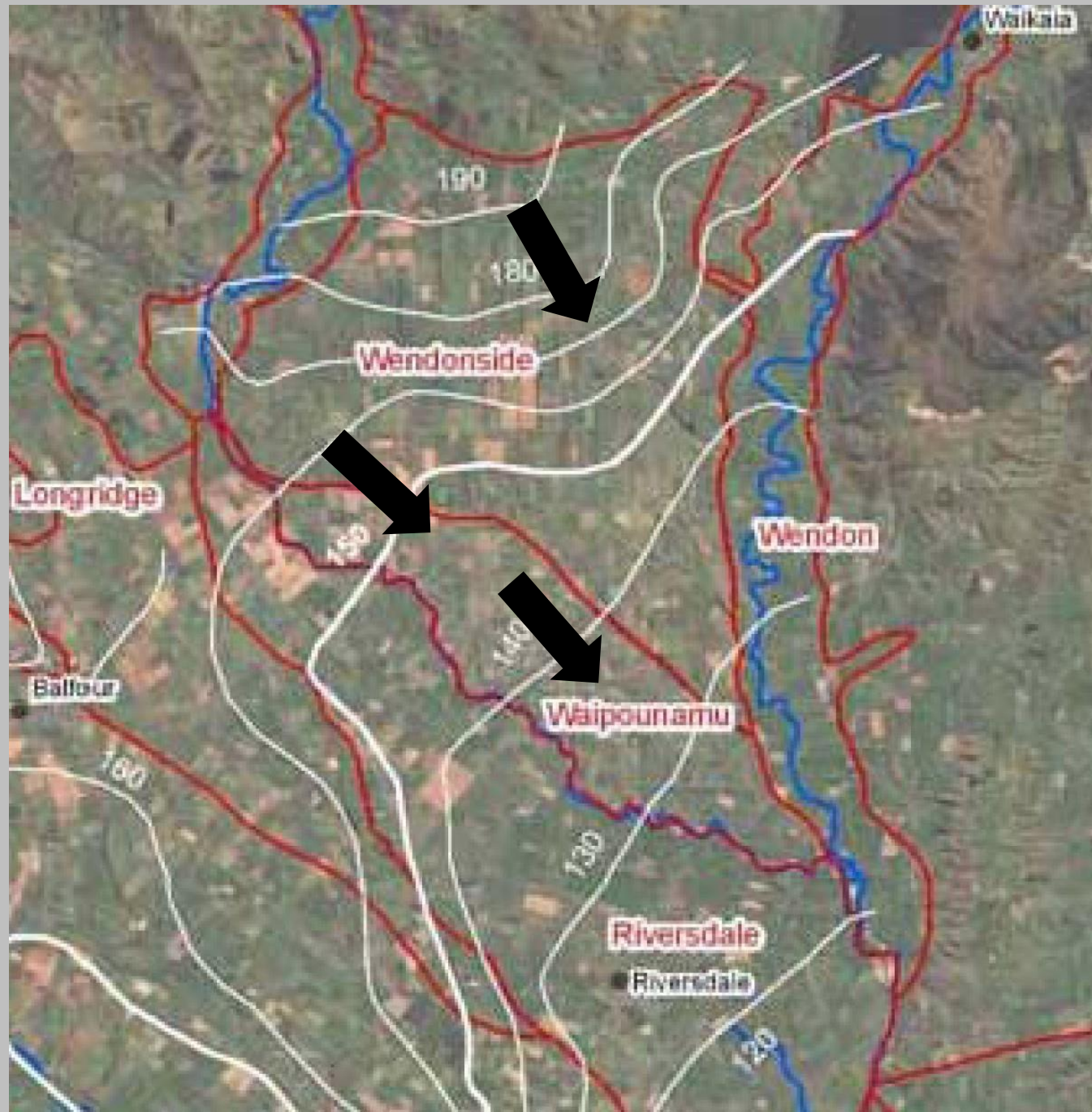
Schematic Cross-section of Wendonside Groundwater Zone



<i>Hydrostratigraphic Unit</i>	<i>Confined or Unconfined</i>	<i>Other</i>
Perched Zone	Unconfined	Shallow, thin, areally discontinuous
Wendonside Aquifer	Unconfined	Areally continuous, water levels vary seasonally
Garvie Aquifer	Confined	Areally limited, water levels do not vary seasonally

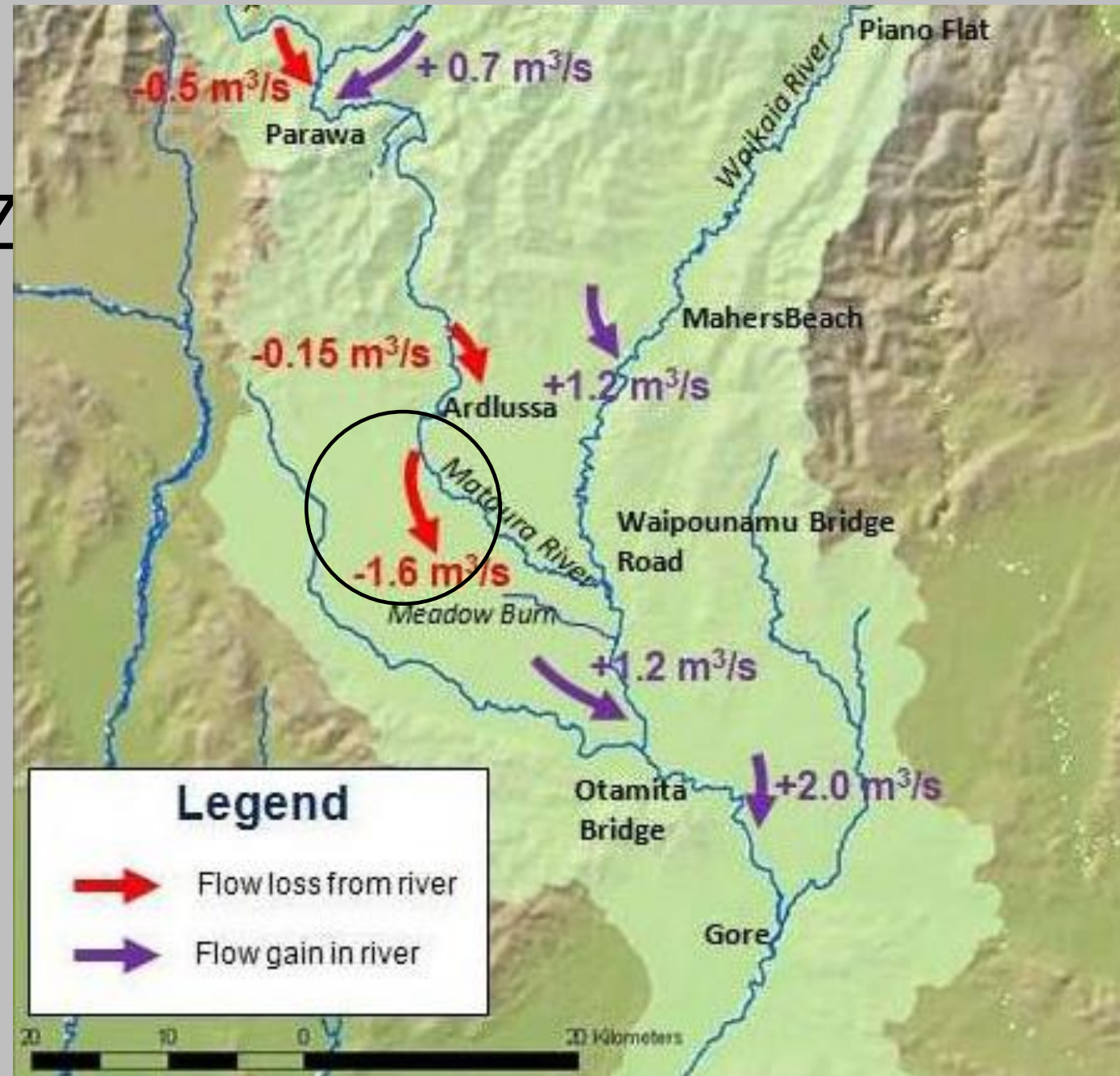
Groundwater Flow Map for the WGZ (Wilson et al., 2008)

- Groundwater contours indicate that WGZ groundwater does not discharge into the Mataura River

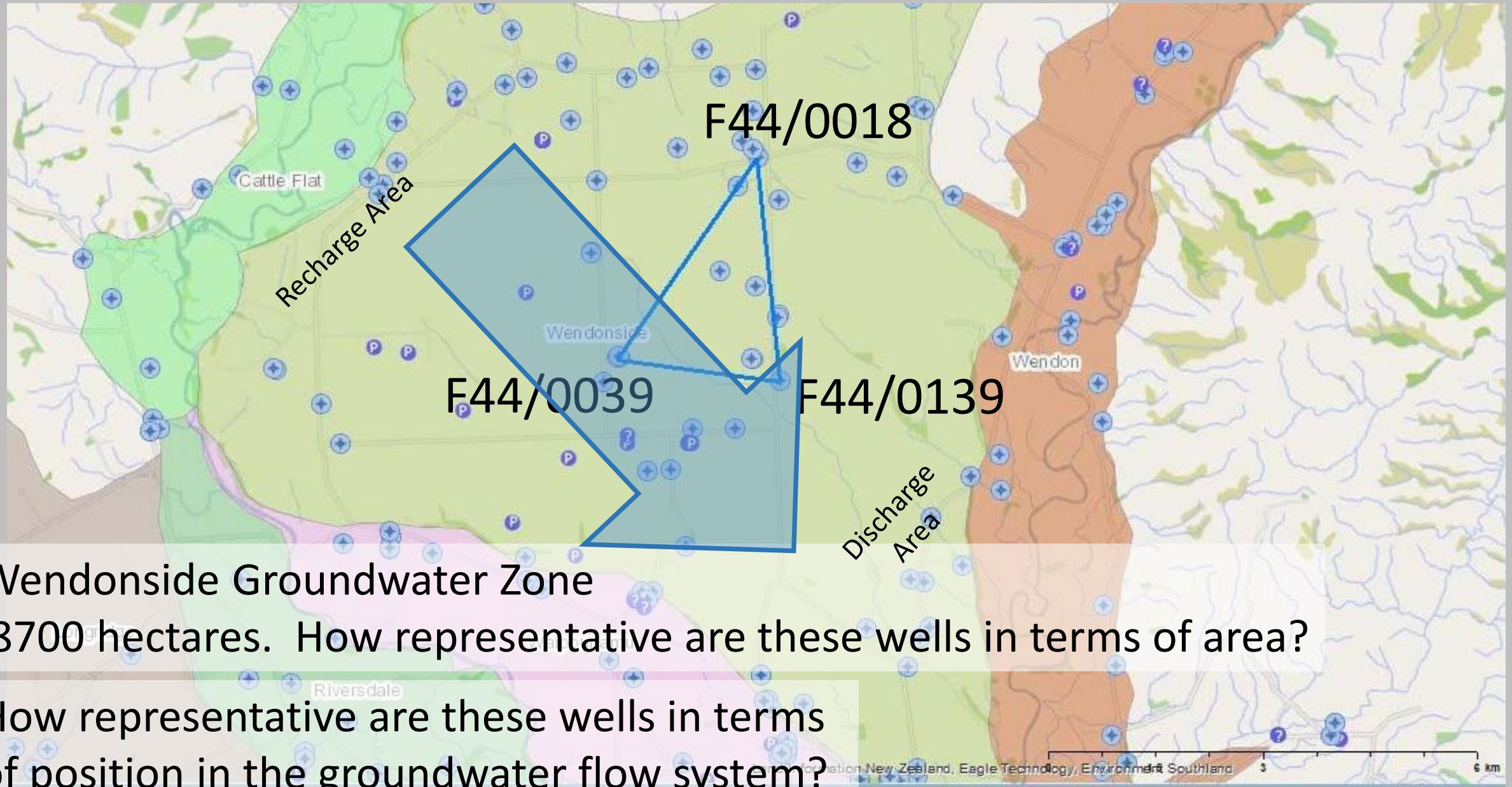


Stream Gauging near WGZ (Hughes et al., 2011)

- Indicates WGZ groundwater does not discharge into the Mataura River

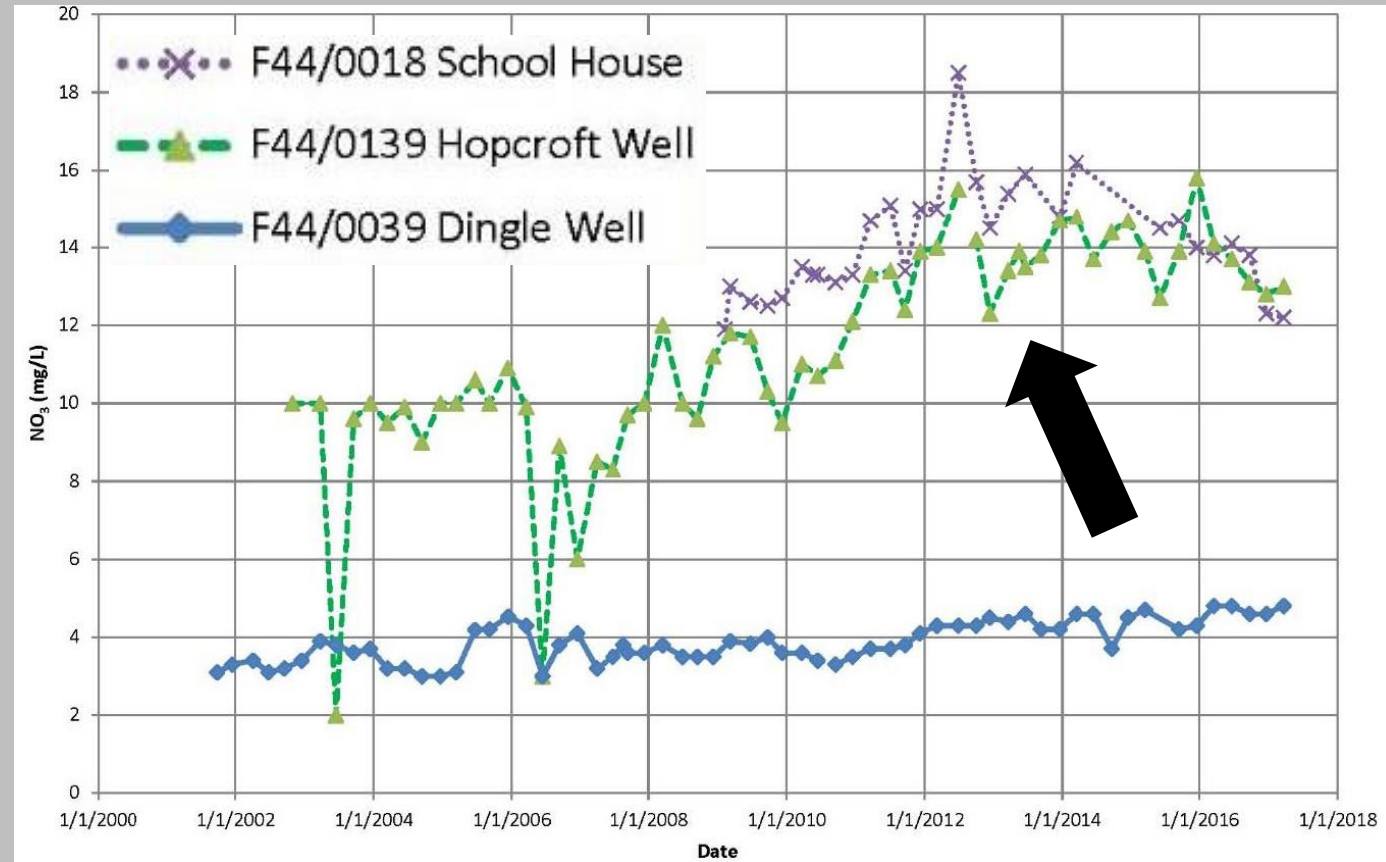


Active State of Environment Long-term Wells



Nitrate Trends, State of Environment Wells

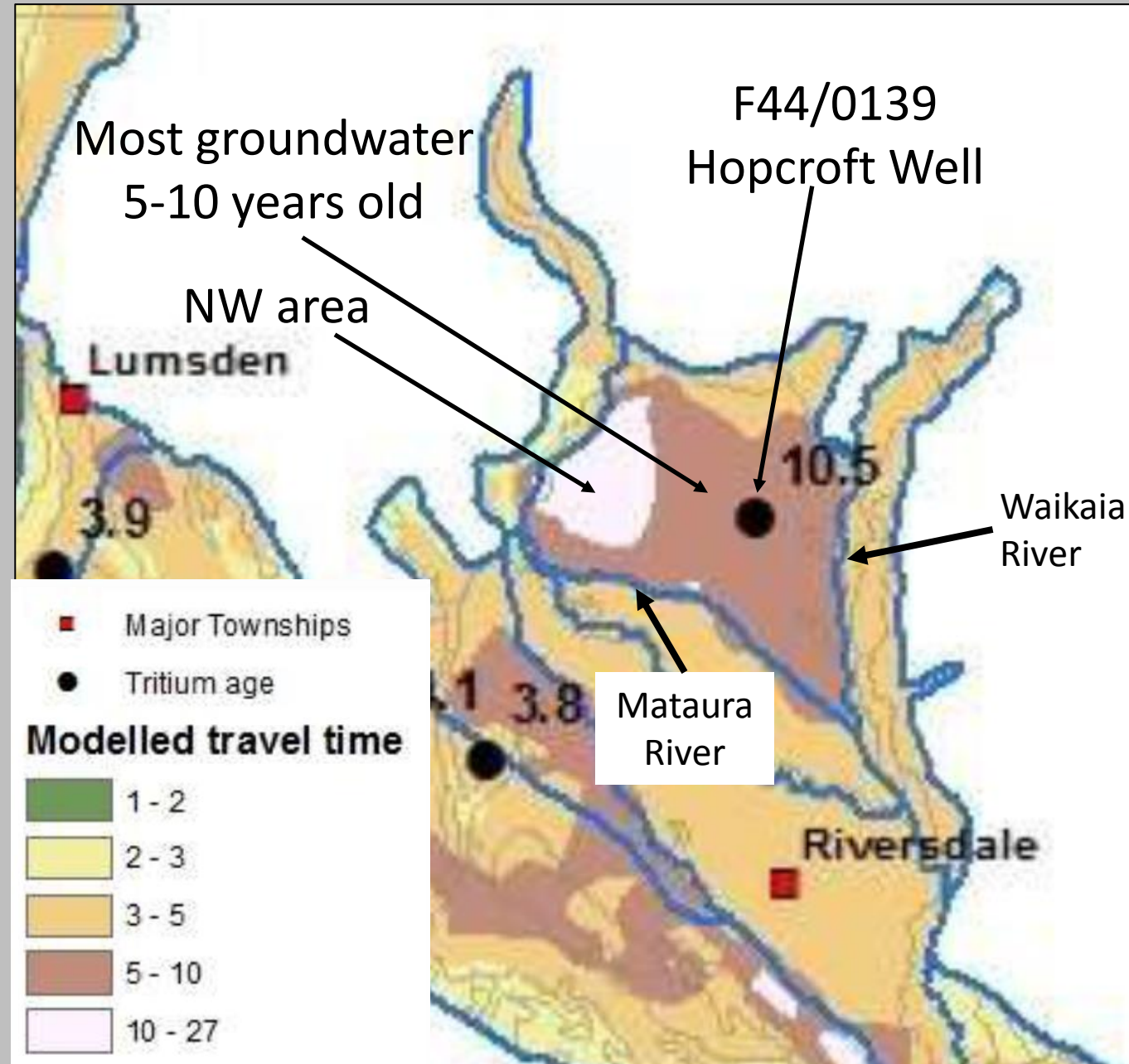
- Few long-term monitoring wells per aquifer
- Why did the trends change directions in ~2013?



<i>Well</i>	<i>Boring Depth (m)</i>	<i>Initial Depth to Groundwater (m)</i>	<i>Likely Aquifer</i>	<i>Groundwater Age (years)</i>
F44/0018 School House	10	4.17	Perched Zone	No data
F44/0139 Hopcroft	27	23.53	Wendonside Aquifer	10.5
F44/0039 Dingle	35	No data	Wendonside Aquifer	No data

Groundwater Residence Times in WGZ (Wilson et al., 2014)

- How representative are nitrate data of current agricultural practices?
- Should same rules apply for different travel times?



Things to Consider

1. Are there enough data to characterize nitrate in groundwater in the Wendonside Groundwater Zone?
 - Only 3 time-trend wells to cover 8700 hectares
 - Few time-trend wells per aquifer
 - How do the number of wells compare to other studies?
 - What agricultural practices do these wells represent?
 - Are these wells representative of recharge areas?
 - Are these wells representative of discharge areas?
 - What is the quality trend of groundwater discharge to surface water?

Things to Consider

- Are these wells secure?

The School House Well

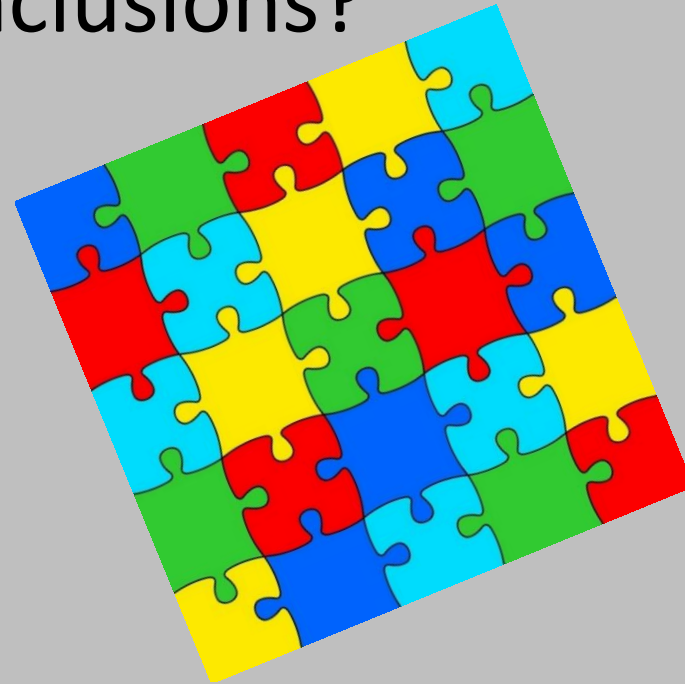


Things to Consider

2. Do current groundwater nitrate concentrations in the Wendonside Groundwater Zone reflect current or historical agricultural activities?
 - Tritium map indicates groundwater in northwest is 10-27 years old
 - Groundwater in the Hopcroft Well is ~10 years old
 - If tritium data are correct, nitrate data observed today do not necessarily reflect current agricultural activity.
 - What do changes in the nitrate time trends mean?

Are there enough data for a reliable
Conceptual Site Model (CSM)?

How do you know when there are enough data to make
reliable conclusions?



My opinion:

When you can reasonably predict the outcome of the next test.

Conceptual Work Plan to Make CSM More Robust

1. Evaluate groundwater nitrate in all aquifers in 3 transects from recharge to discharge area aligned in groundwater flow direction.
2. Also evaluate groundwater discharge at transect ends (river).
3. Use same transects to evaluate origin and timing of groundwater recharge by testing for environmental isotopes: O^{18} , H^2 , and H^3 .
4. Evaluate origin of nitrate along transects using nitrate isotopes and other advanced techniques.
5. Evaluate agricultural practices along transects (current and historical).

Thank you

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