How River Management Influences Groundwater

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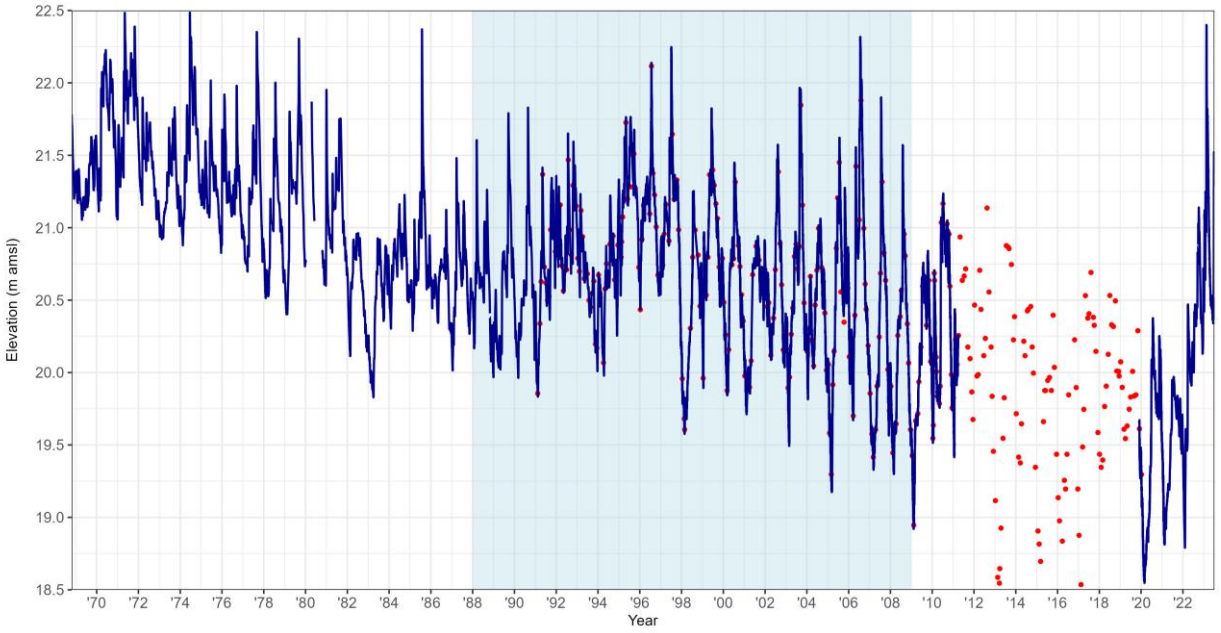
Motivation for the research

- Braided rivers are important sources of groundwater recharge
- We are seeing long term declines in regional aquifer levels in many regions

  Heretaunga aquifer water level decline ~ 2m over 54 years (36mm/yr)



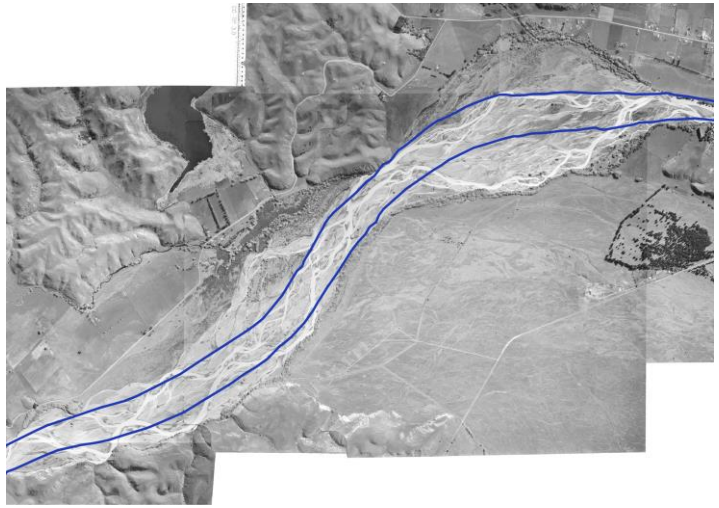
- We know this is not just climate driven
- It is not fully explained by water abstraction
- This is a concern with increasing extreme weather events (droughts)
  - Look out – incoming El Nino?

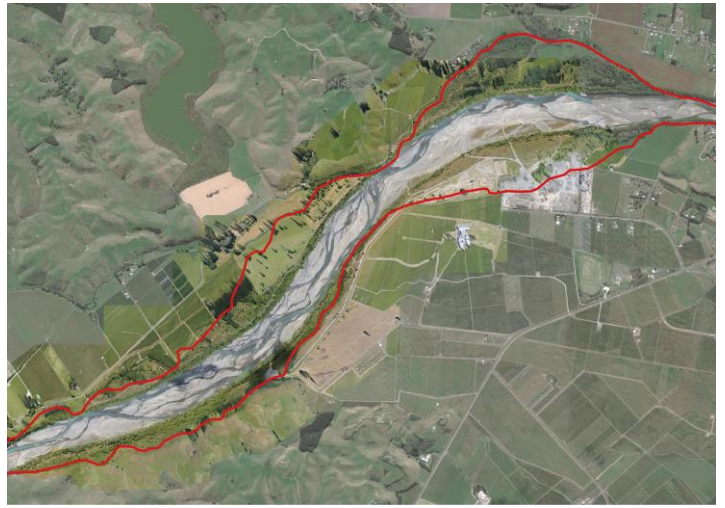
Historical context

- We typically don't think about how what is happening on the surface relates to groundwater recharge

- Historically, river management has been largely flood focused
  - Willow margins
  - Stop banks
  - Gravel extraction

- The result has been a narrowing of our rivers, particularly braided rivers

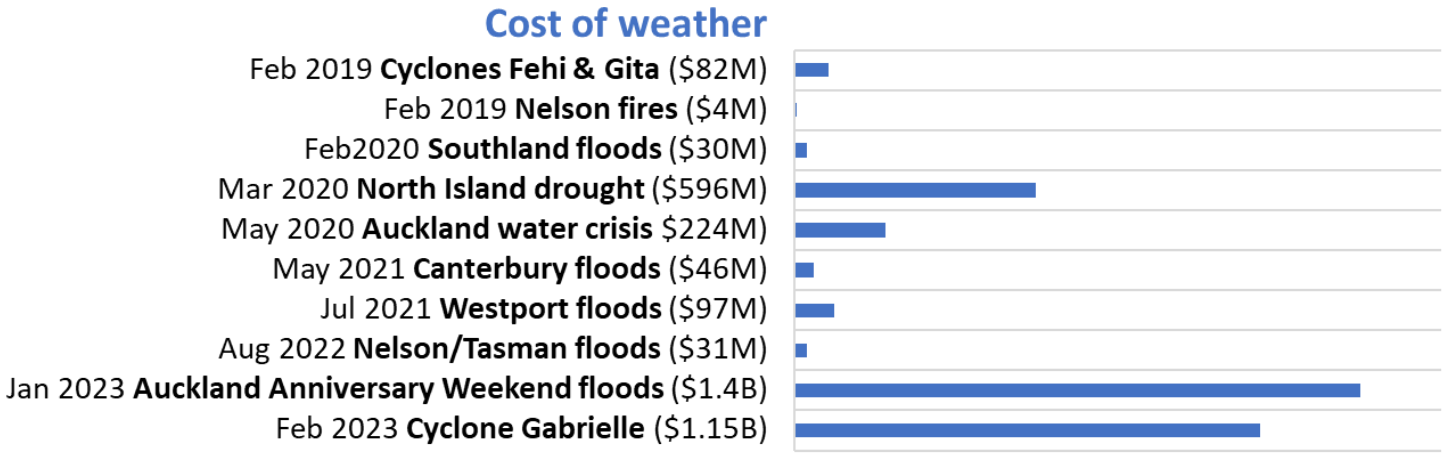




- This has happened over the same period that GW levels have dropped

Can we improve river management approaches?

- The river management focus on floods is not surprising - floods can do a lot of damage, particularly when flood defences fail



Droughts also come with a big cost

- What if the way we have been managing rivers for floods has actually impacted drought resilience?

- How can we better manage rivers to protect for floods and droughts and other values?

Specific Research Questions

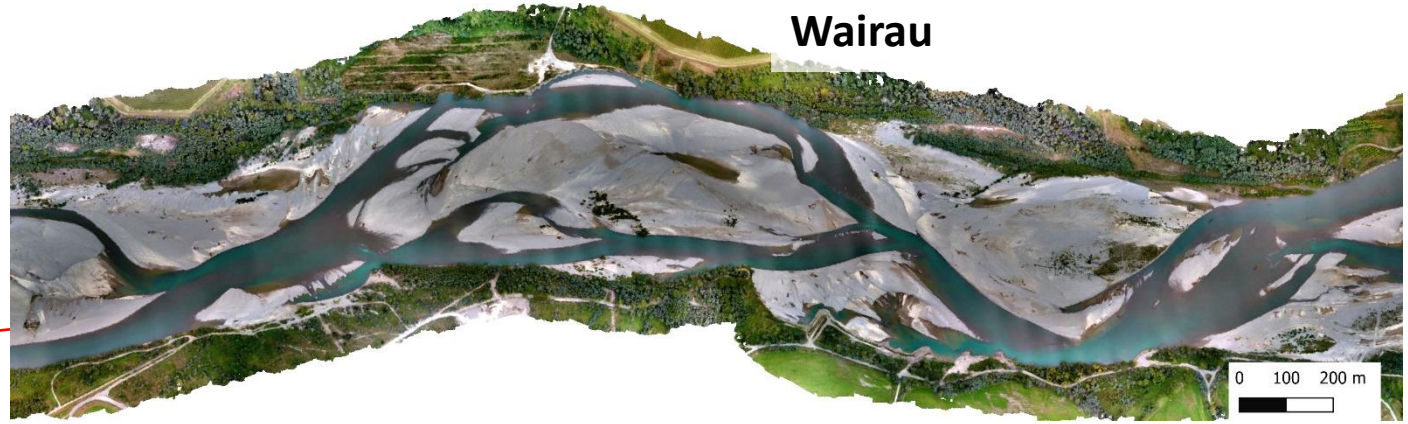
1. How do braided rivers actually work beneath the surface?
    - How can we simplify such complexity for catchment models?

2. How much water goes where?

3. How does management of the river influence the water balance?
    - Influence of channel shape and elevation


Ngaruroro
Wairau
Waikirikiri-Selwyn
0
100
200 km

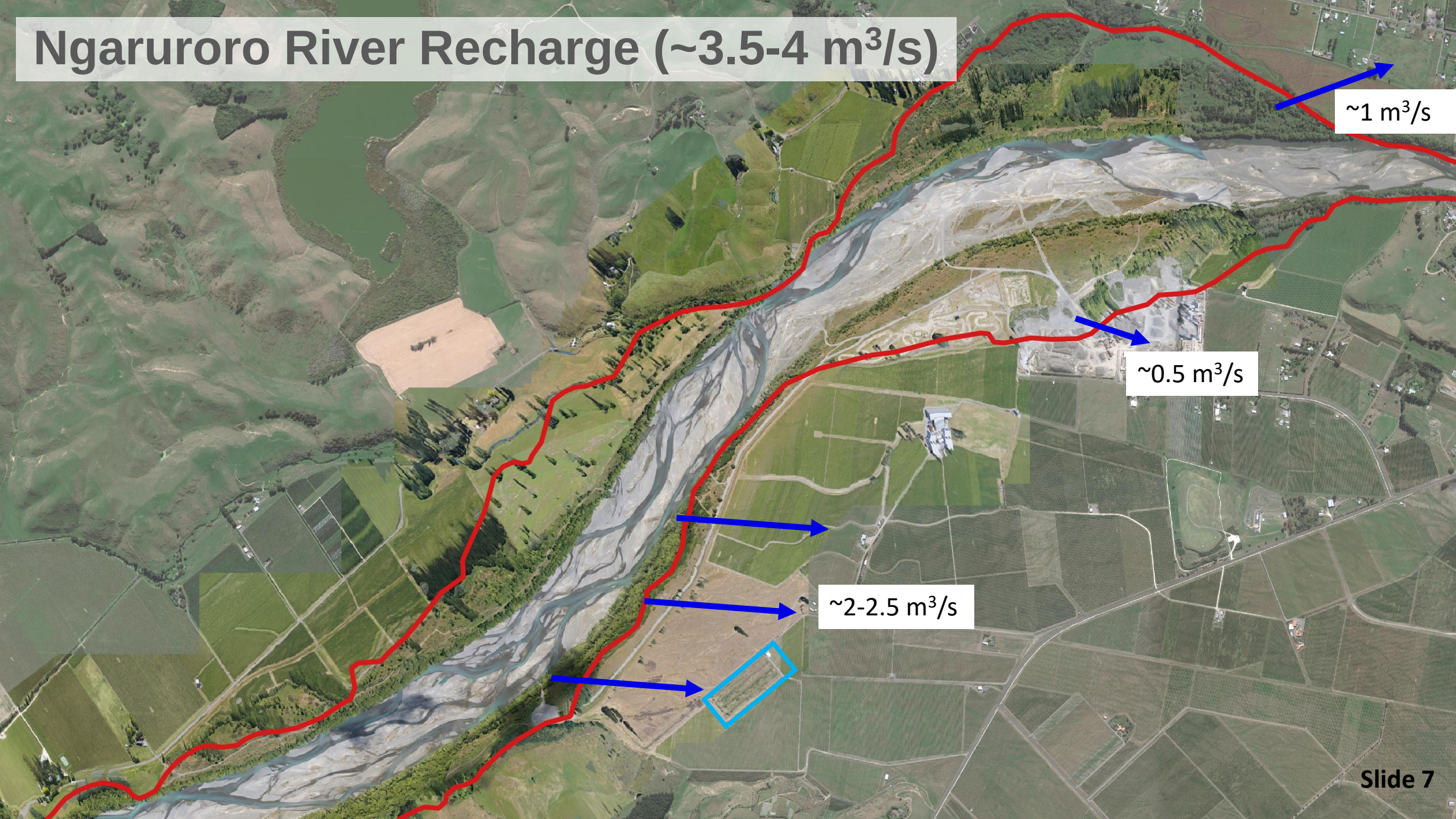

Ngaruroro
0
100
200 m


Wairau
0
100
200 m

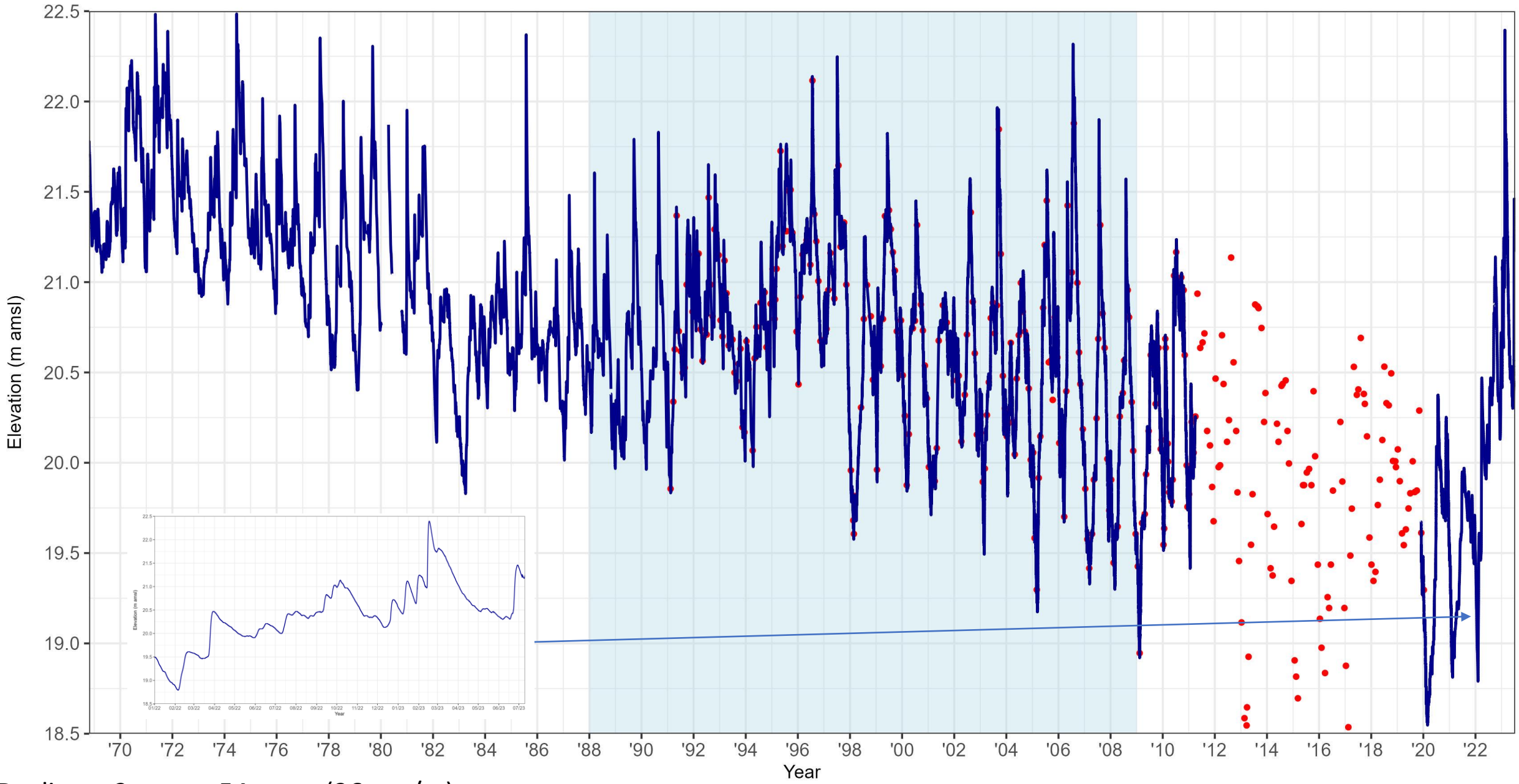

Selwyn/Waikirikiri
0
100
200 m

Slide 6

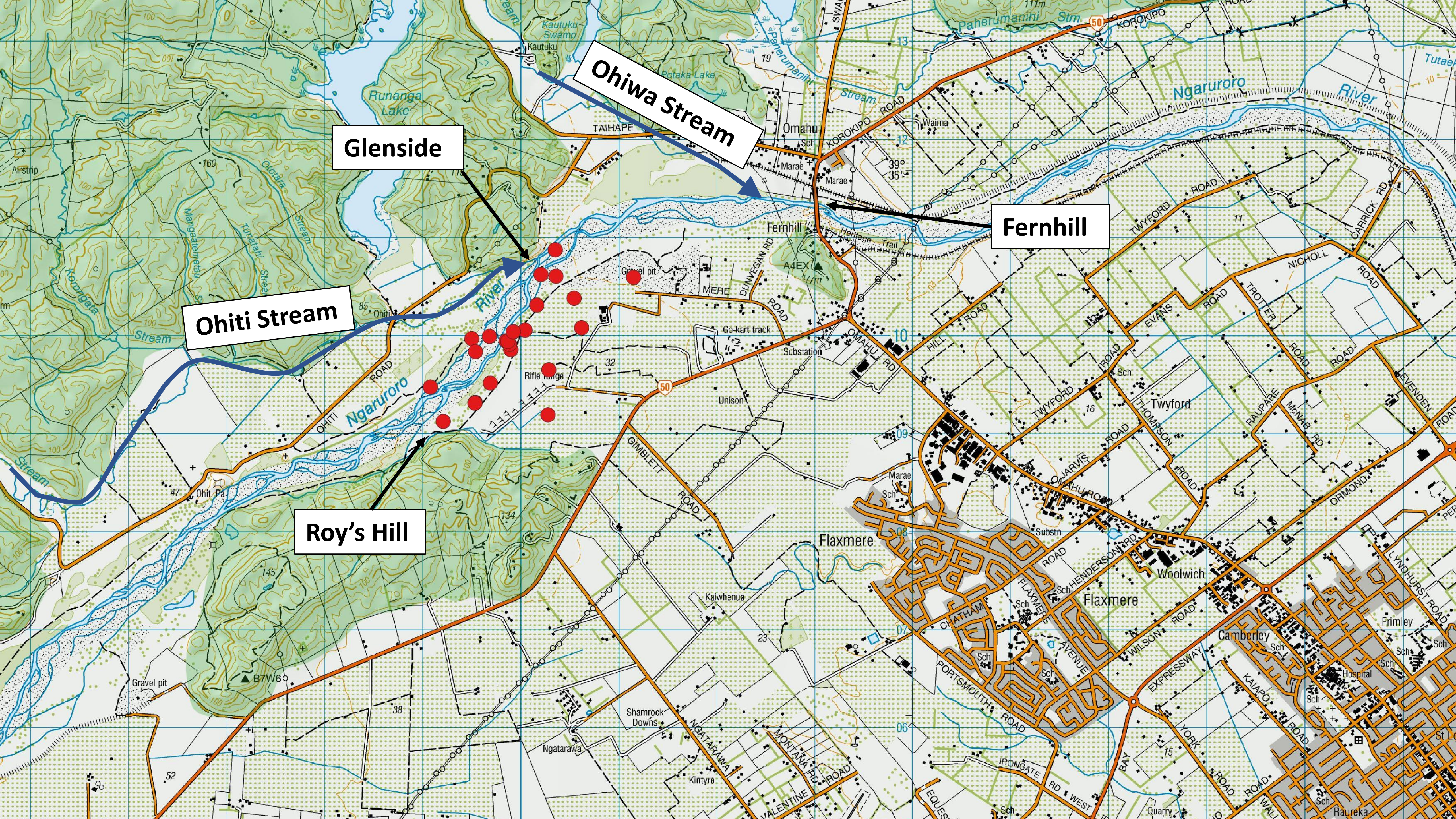
Ngaruroro River Recharge (~3.5-4 m^3/s)



Groundwater level at Substation

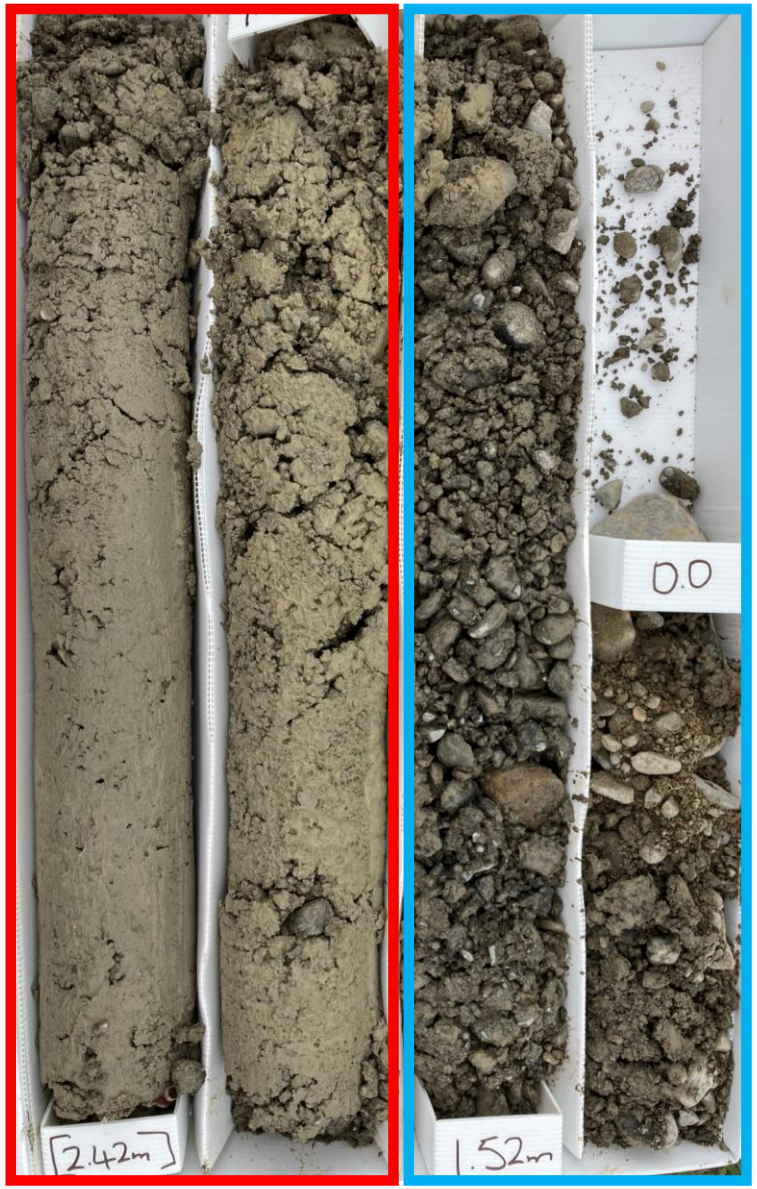


Decline ~ 2m over 54 years (36mm/yr)


Ohiwa Stream
Glenside
Fernhill
Ohiti Stream
Roy's Hill
Runanga Lake
Ngaruroro River
Omahu
Fernhill
Twyford
Flaxmere
Woolwich
Camberley
Frimley
Raureka
Ohiti Pa
Kaiwhenua
Shamrock Downs
Ngatarawa
Rifle range
Go-kart track
Gravel pit
Substation
Unison
Heritage Trail

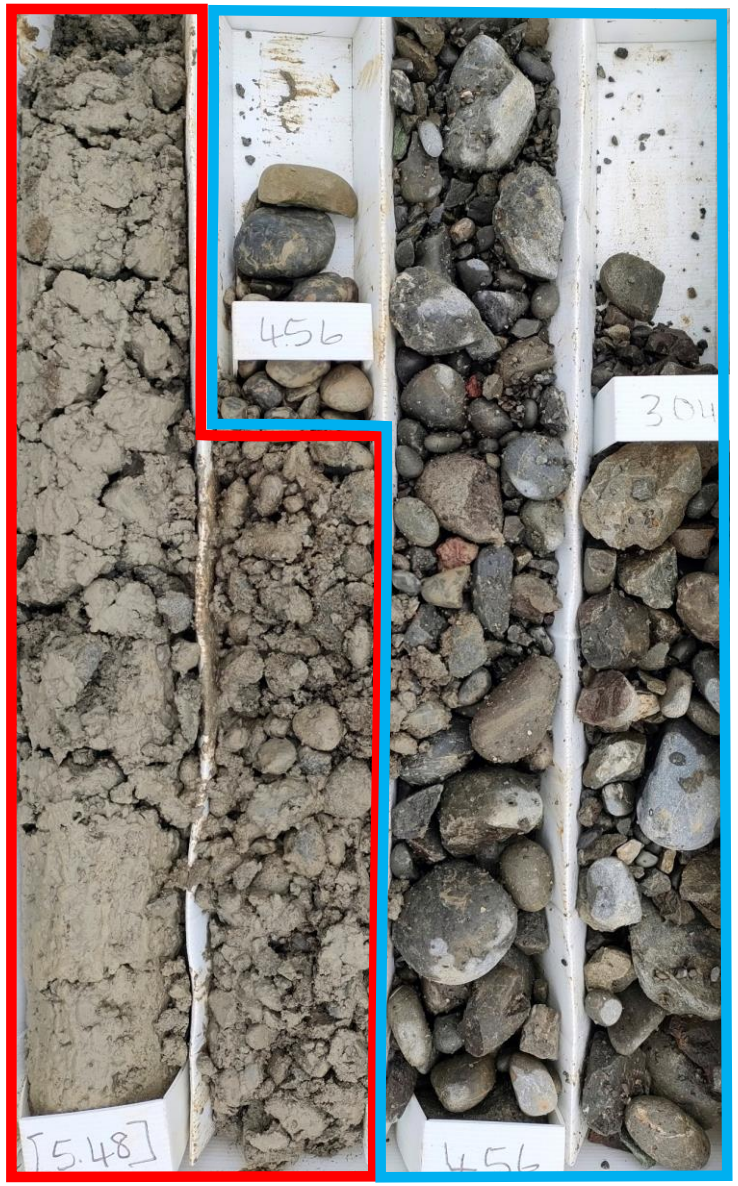
Ngaruroro

Unconformity ~1.5m depth



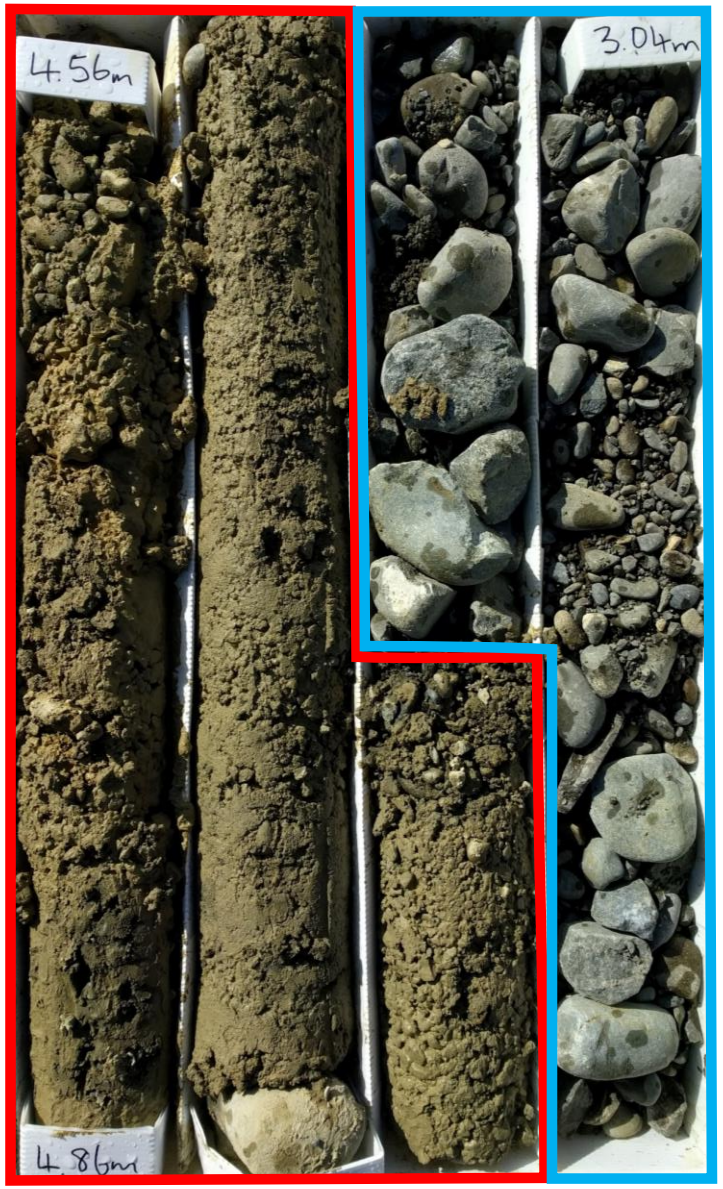
Wairau

Unconformity ~4.5m depth

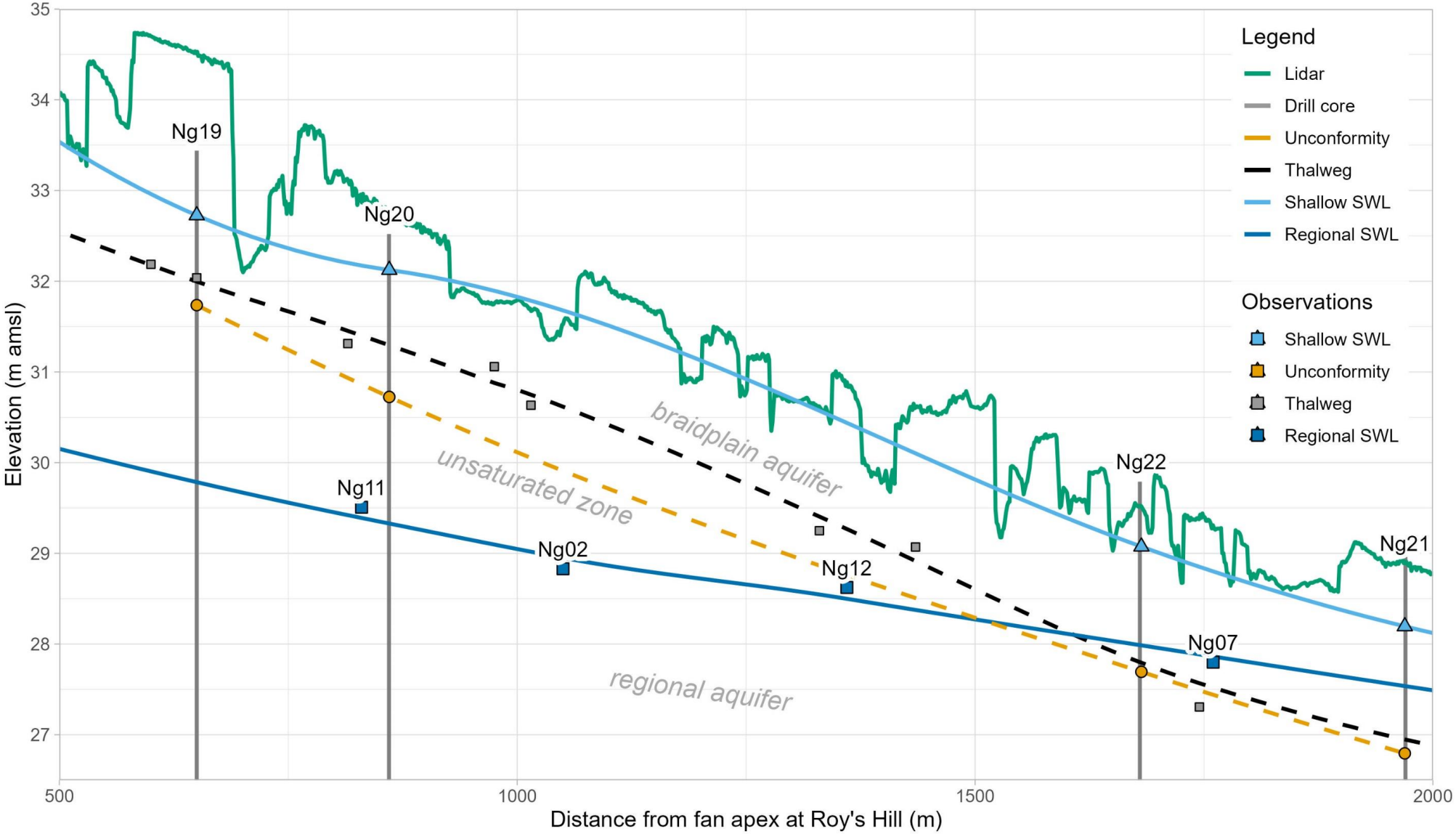


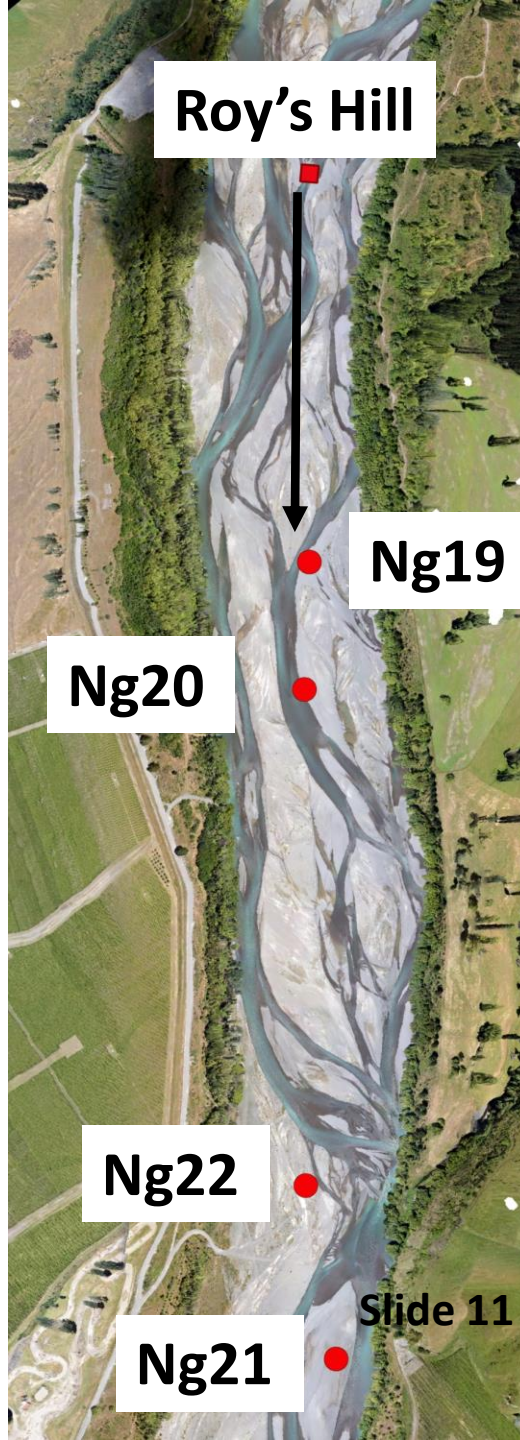
Selwyn

Unconformity ~3.5m depth

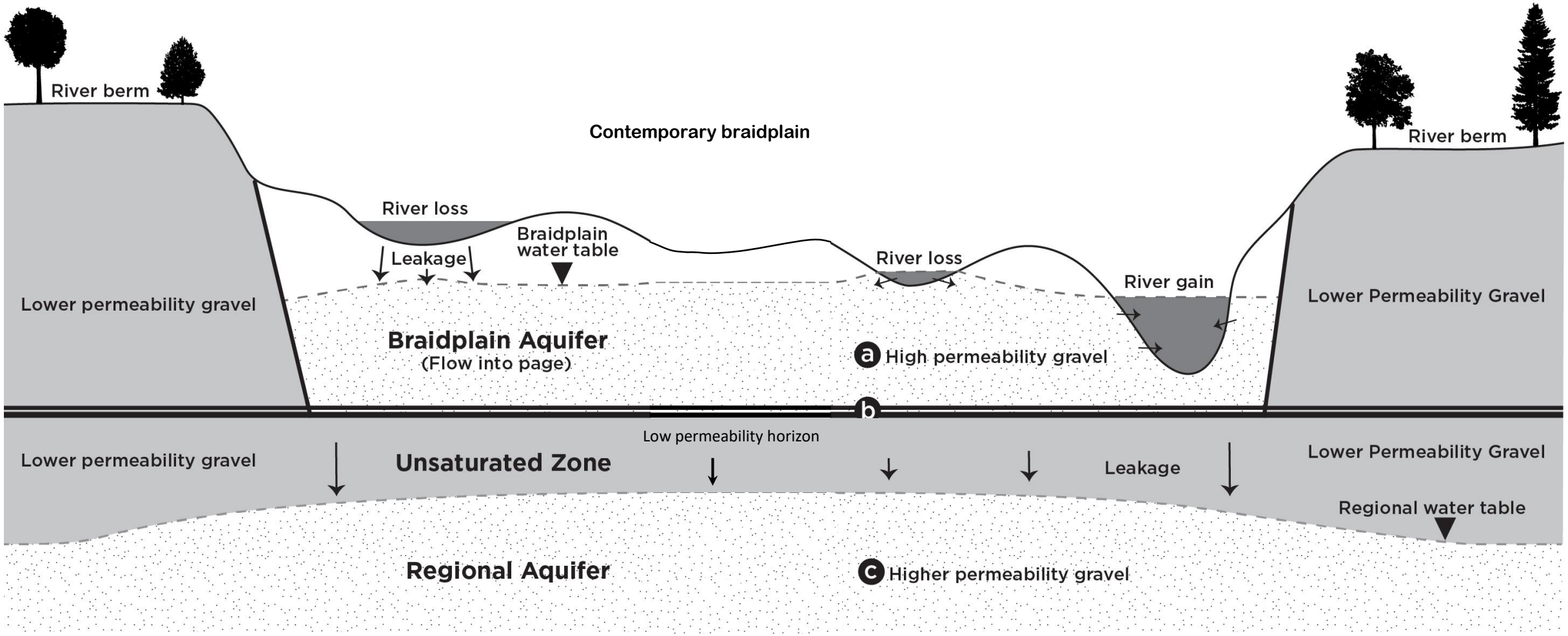


Ngaruroro River Long Section



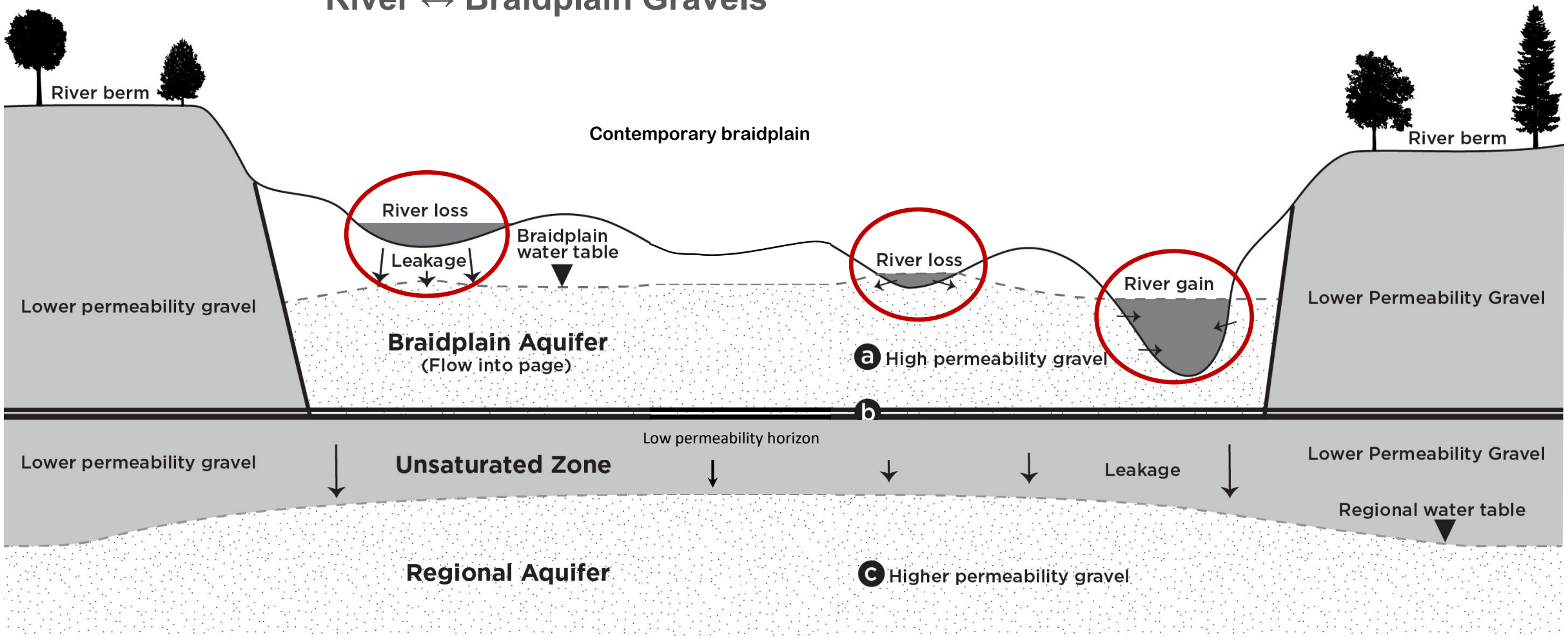


Exchange occurs at two scales



Exchange occurs at two scales

River ↔ Braidplain Gravels



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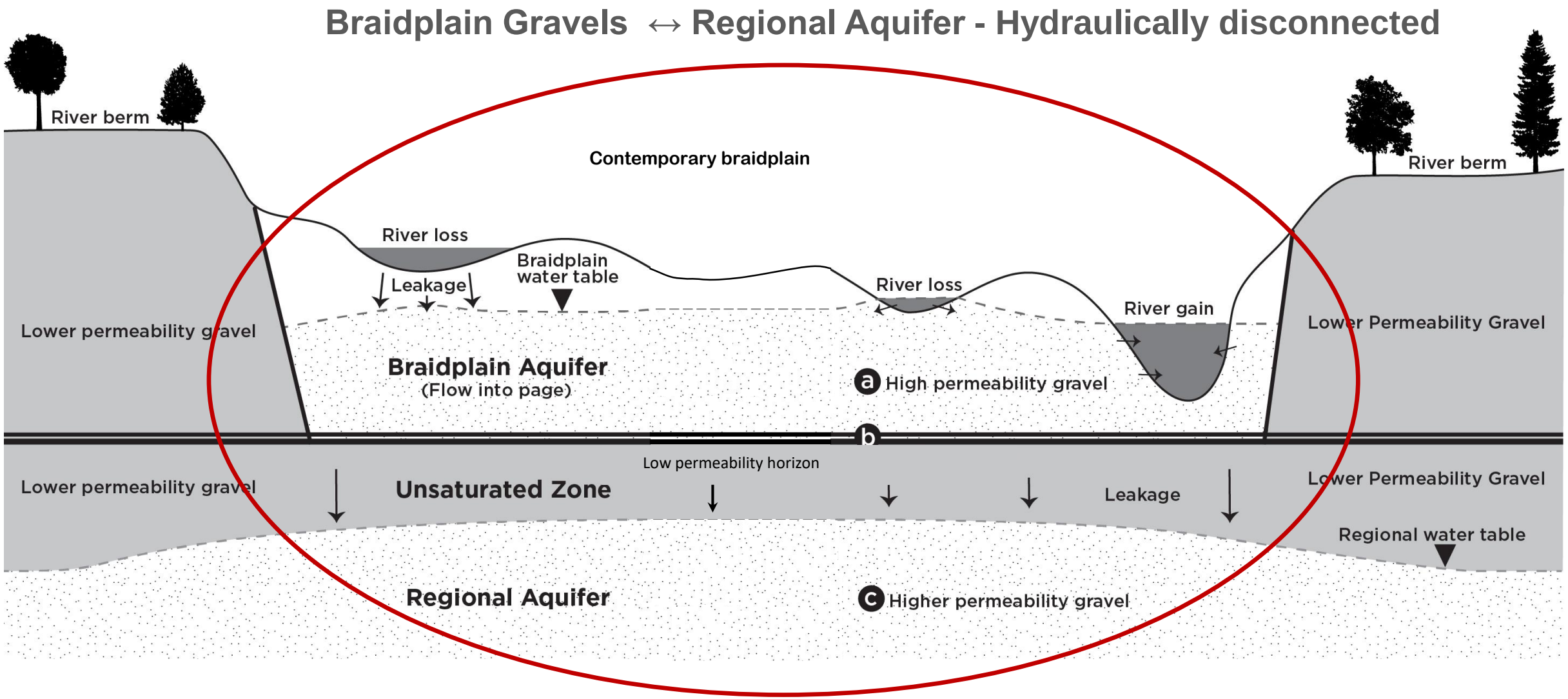
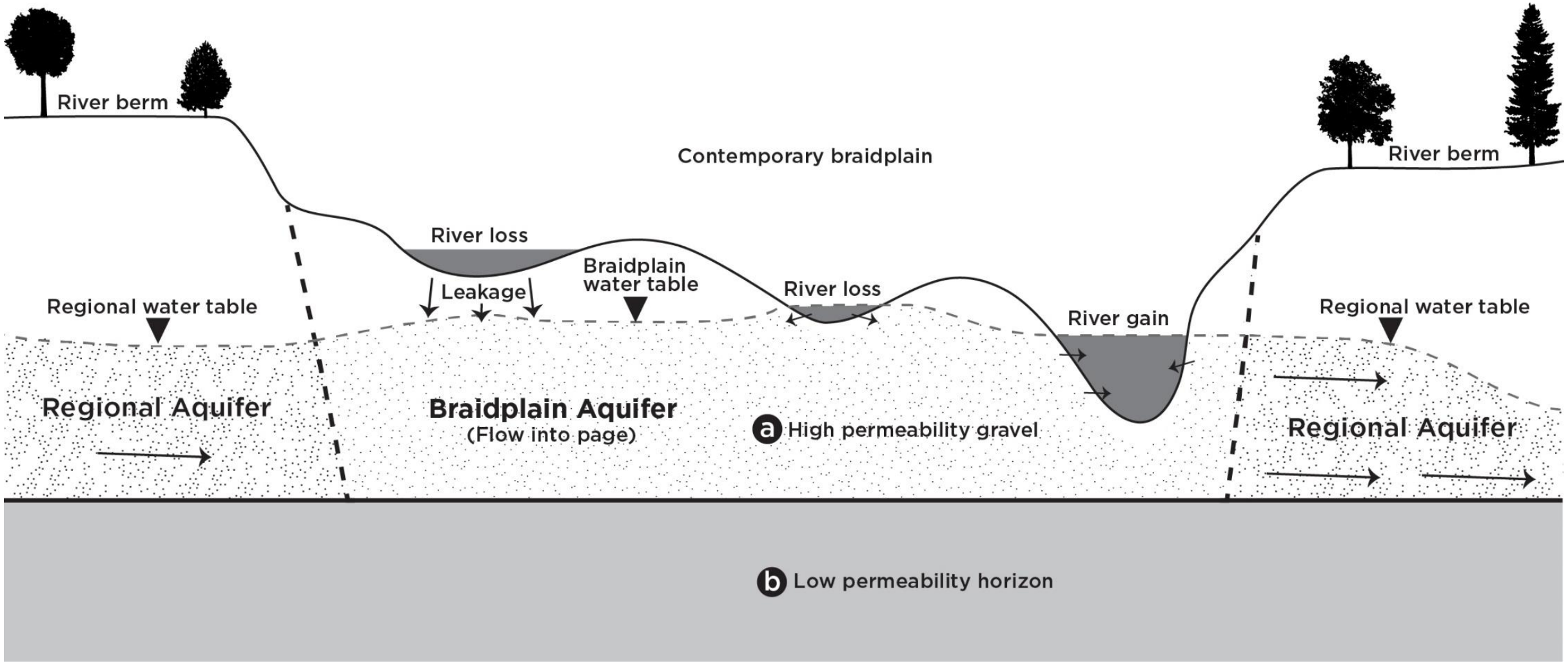
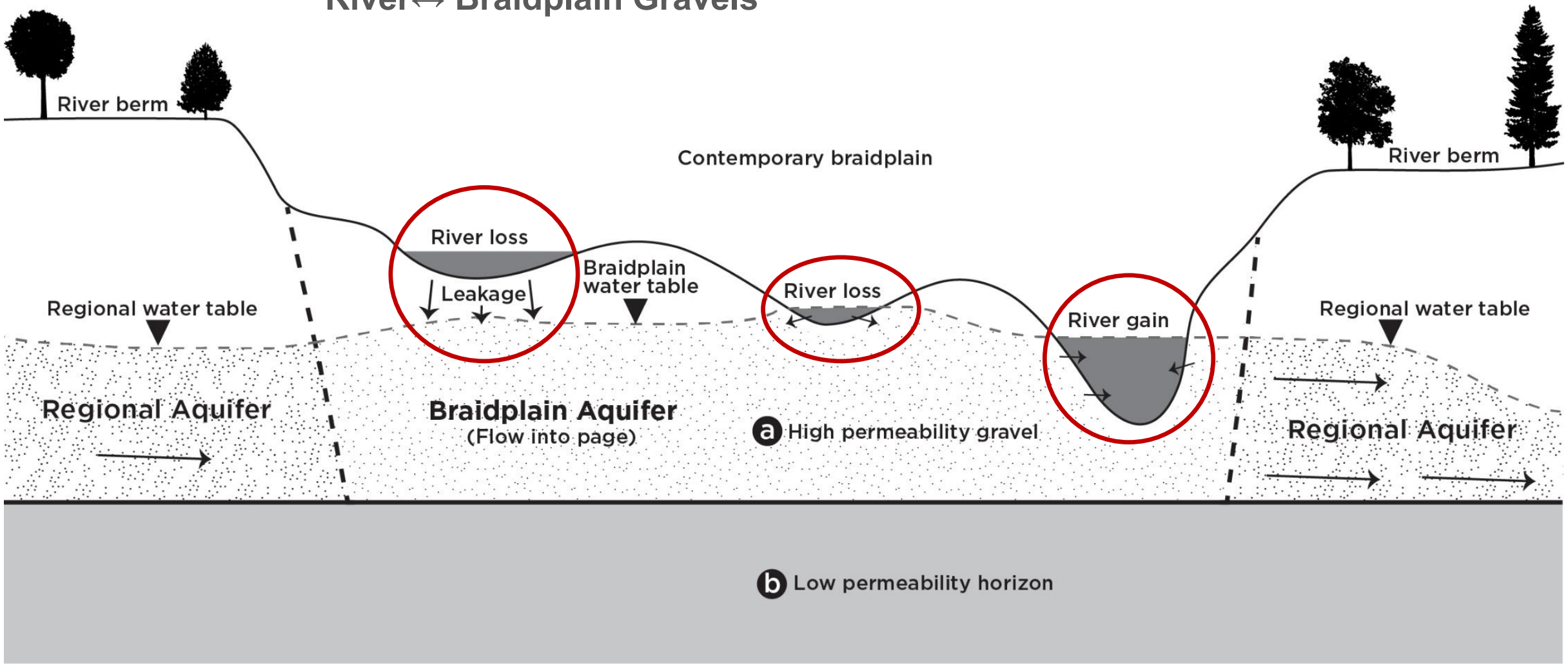


Exchange occurs at two scales



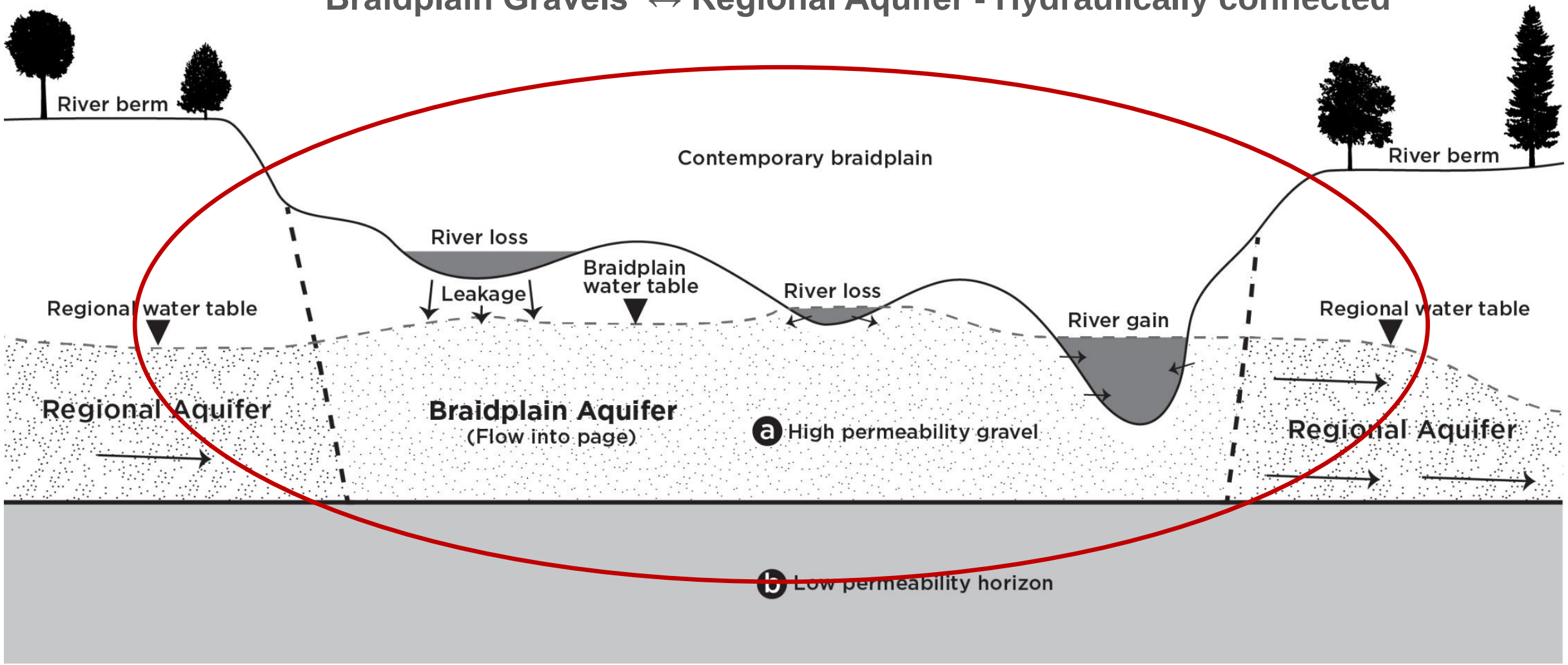
Exchange occurs at two scales

River↔ Braidplain Gravels



Exchange occurs at two scales

Braidplain Gravels ↔ Regional Aquifer - Hydraulically connected

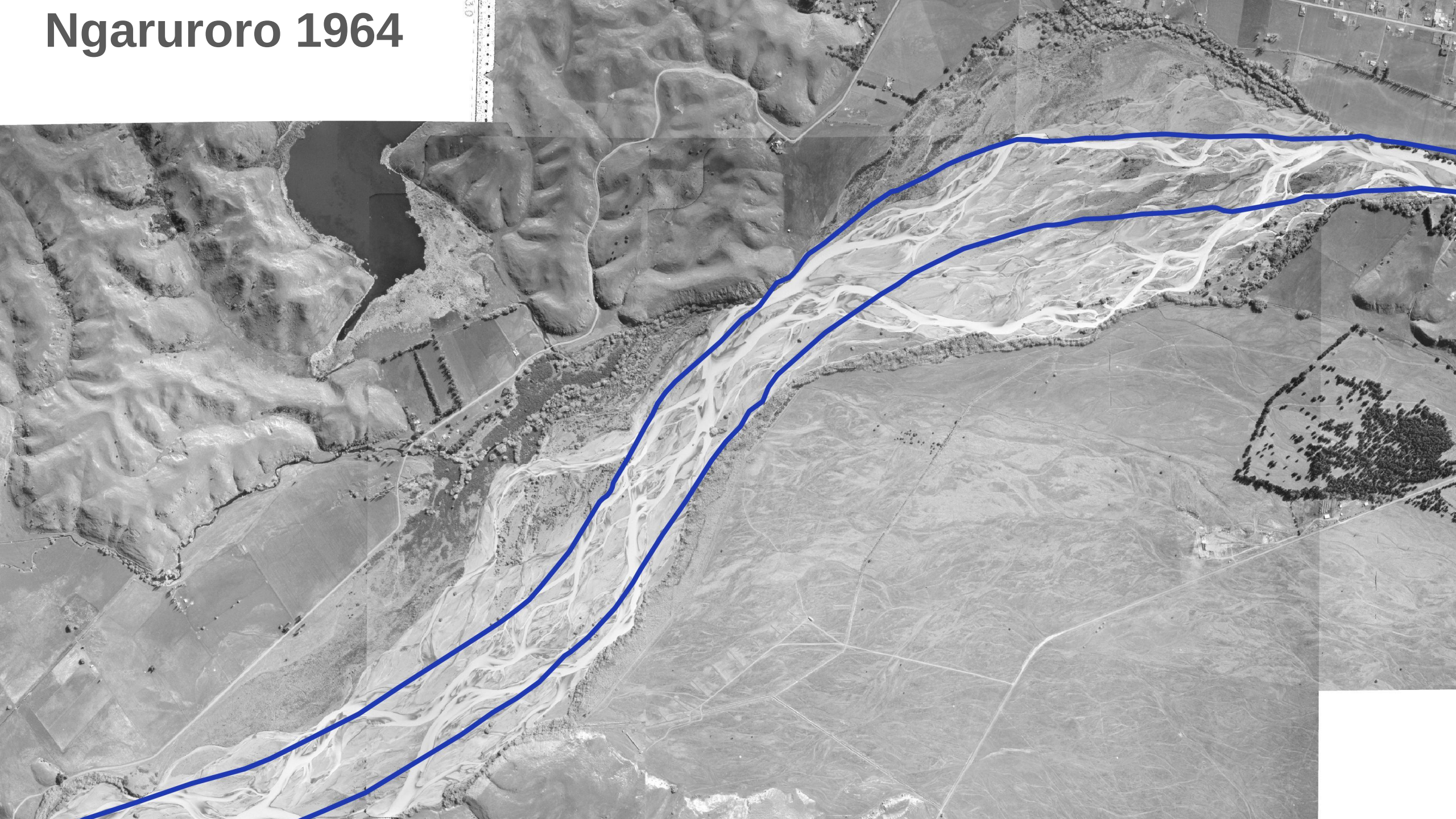


New Knowledge for River Management

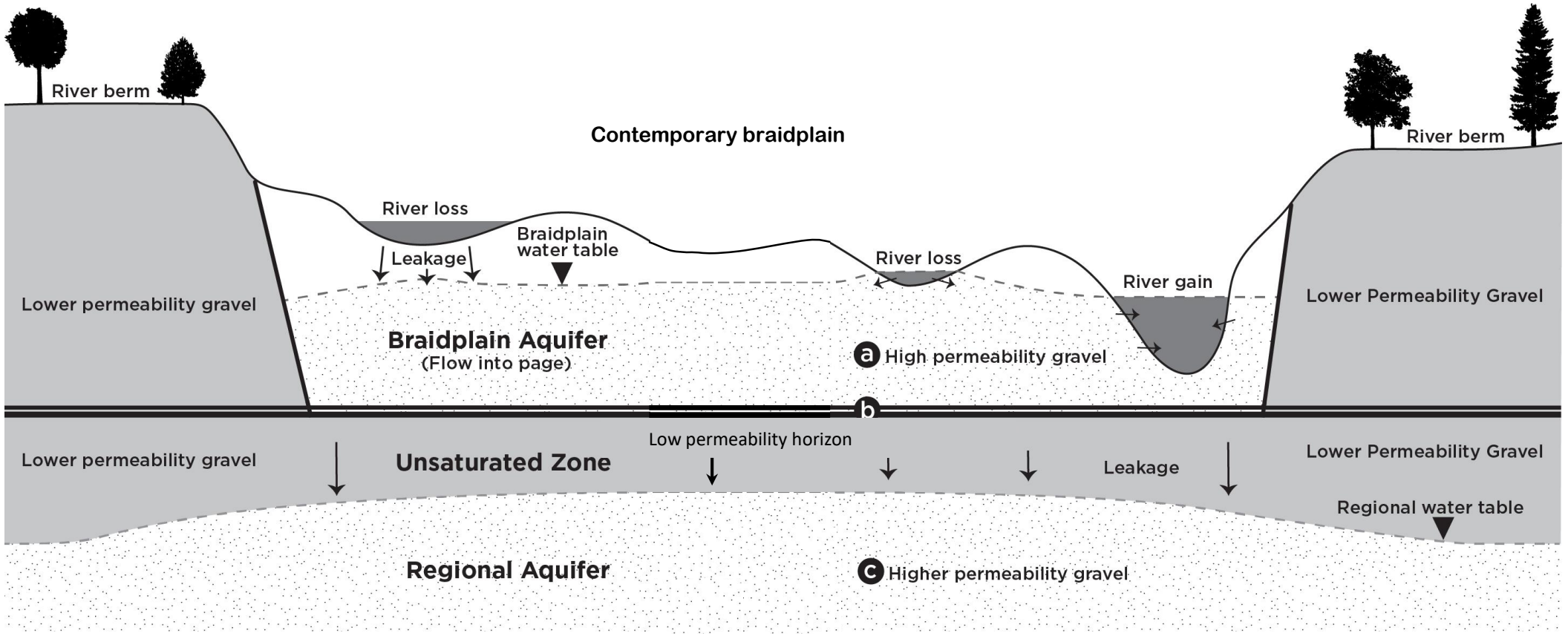
- The river system is much larger than its surface expression
- Braided rivers form their own aquifer system via bed mobility
- Braidplain Aquifer provides storage and mediates water exchange between the river & regional aquifer (and attenuates temperature)
- The effectiveness of the braidplain aquifer to function as a mediator is influenced by river management.
- There are opportunities to increase groundwater recharge by treating rivers as one component of a wider water & gravel balance (holistic view) - and managed with subsurface processes in mind (integrated management)

What are the implications for river management?

Ngaruroro 1964



Narrowing the river



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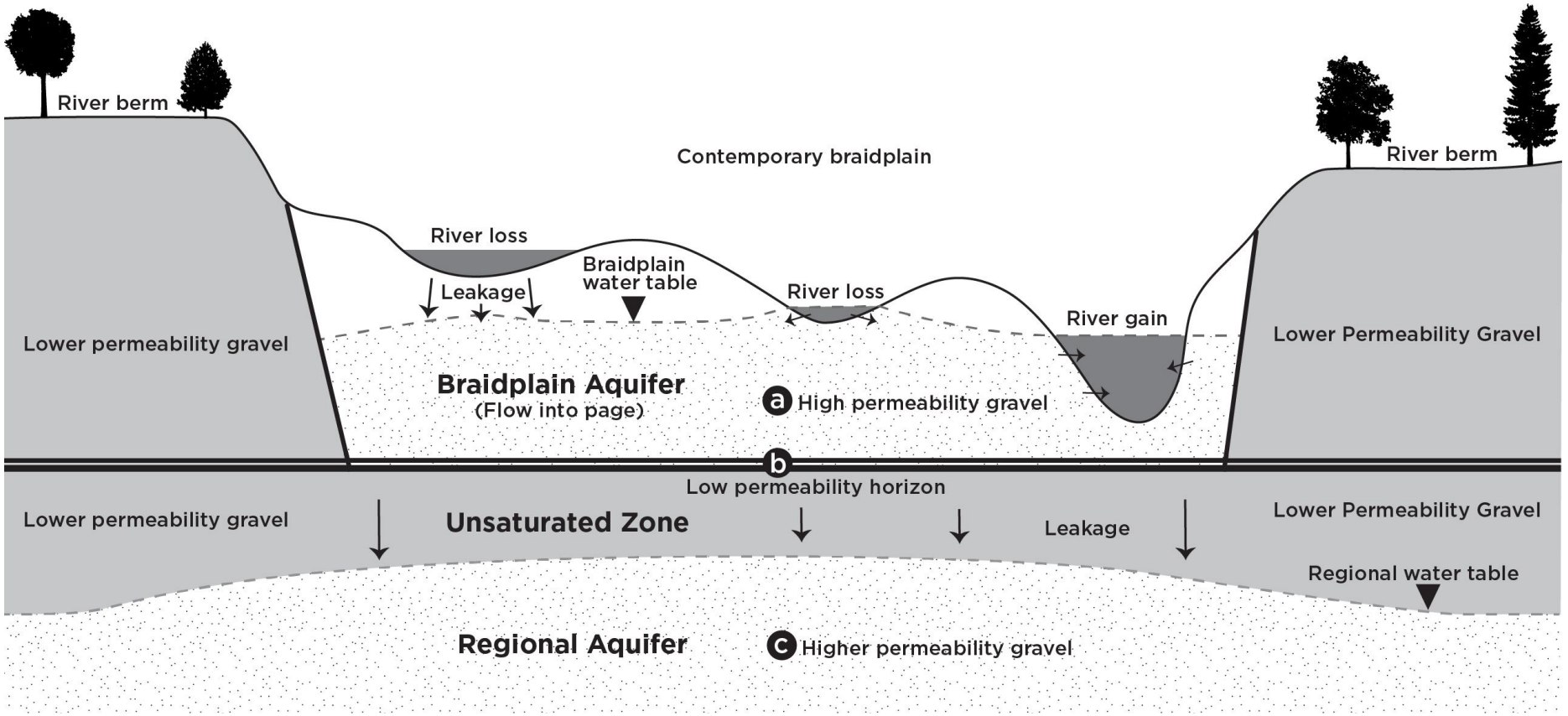
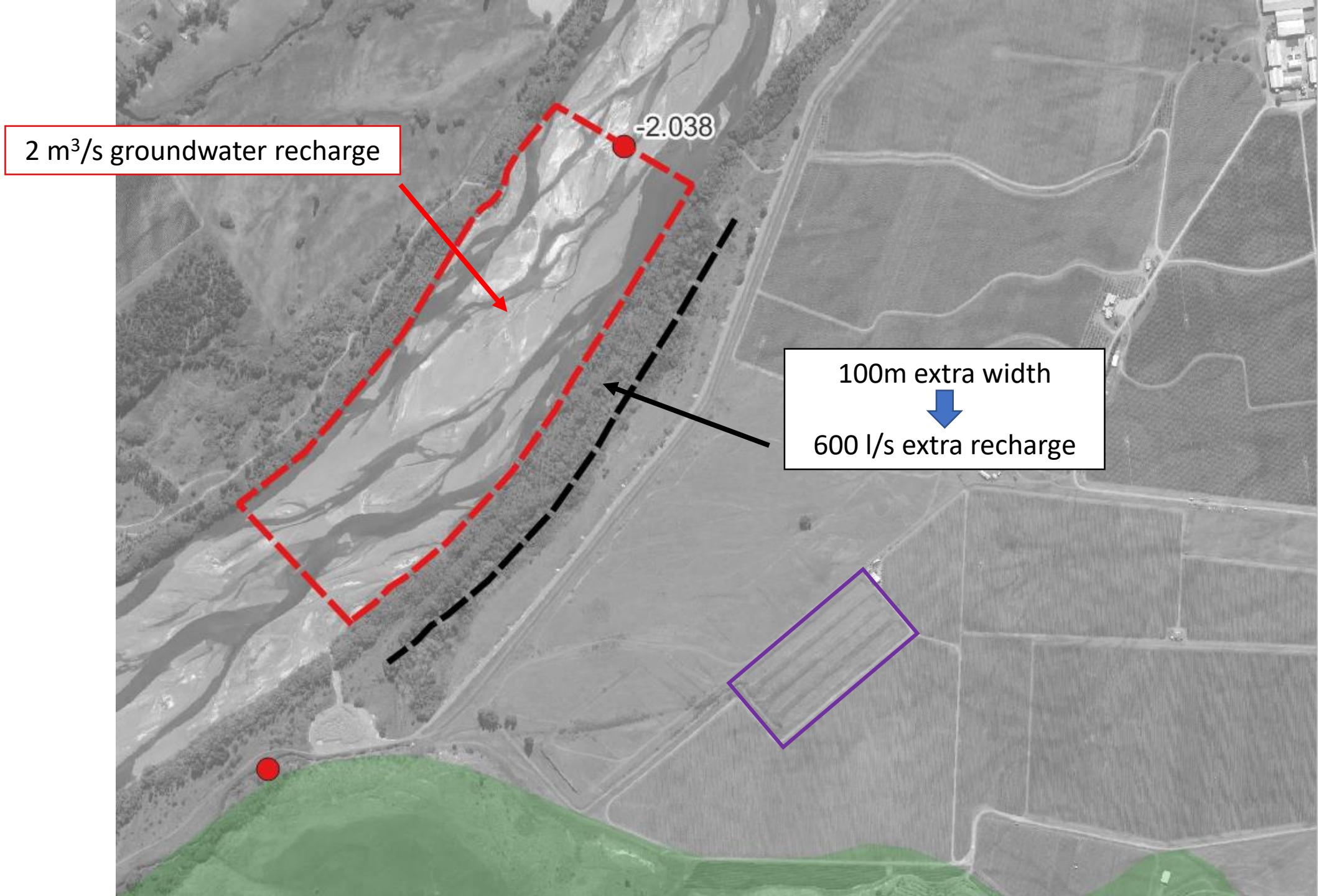
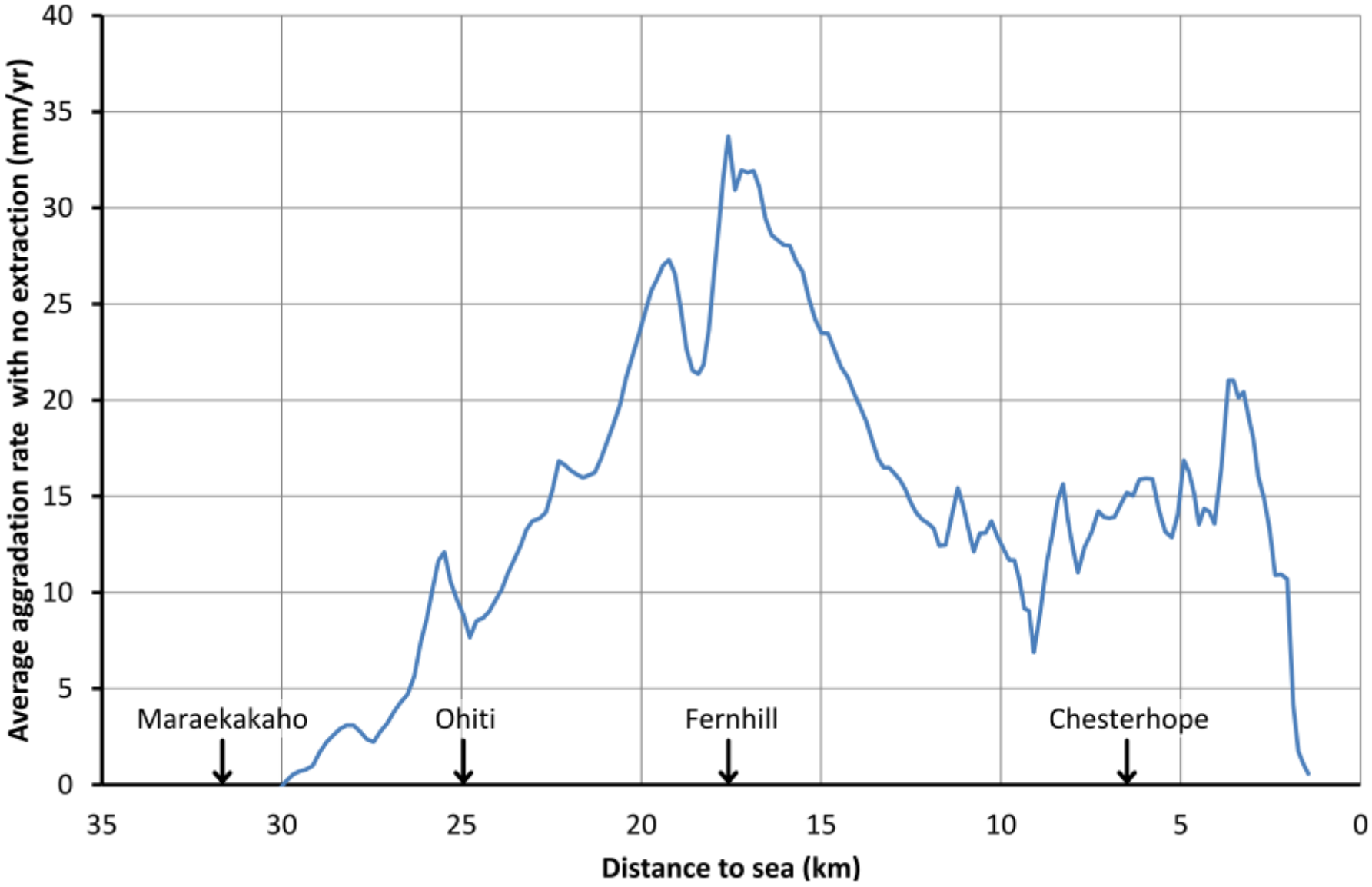


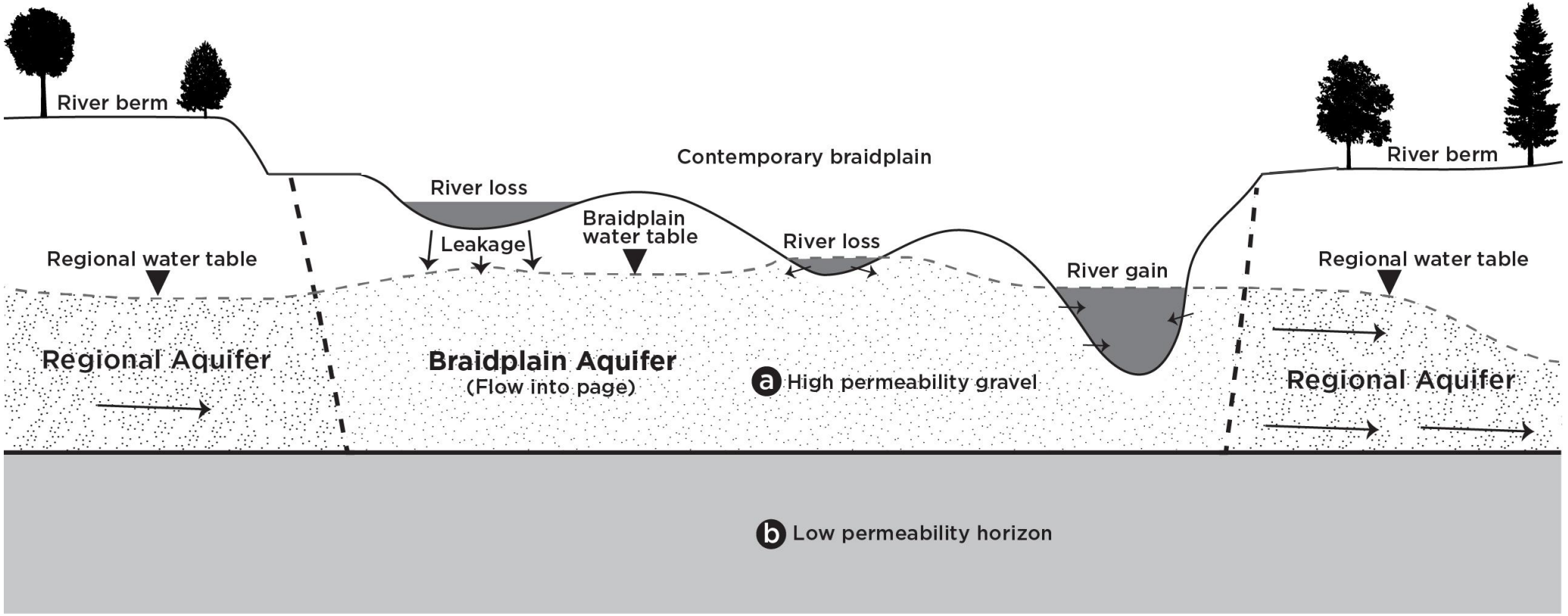

2 m³/s groundwater recharge
-2.038
100m extra width
600 l/s extra recharge

Changing river bed levels

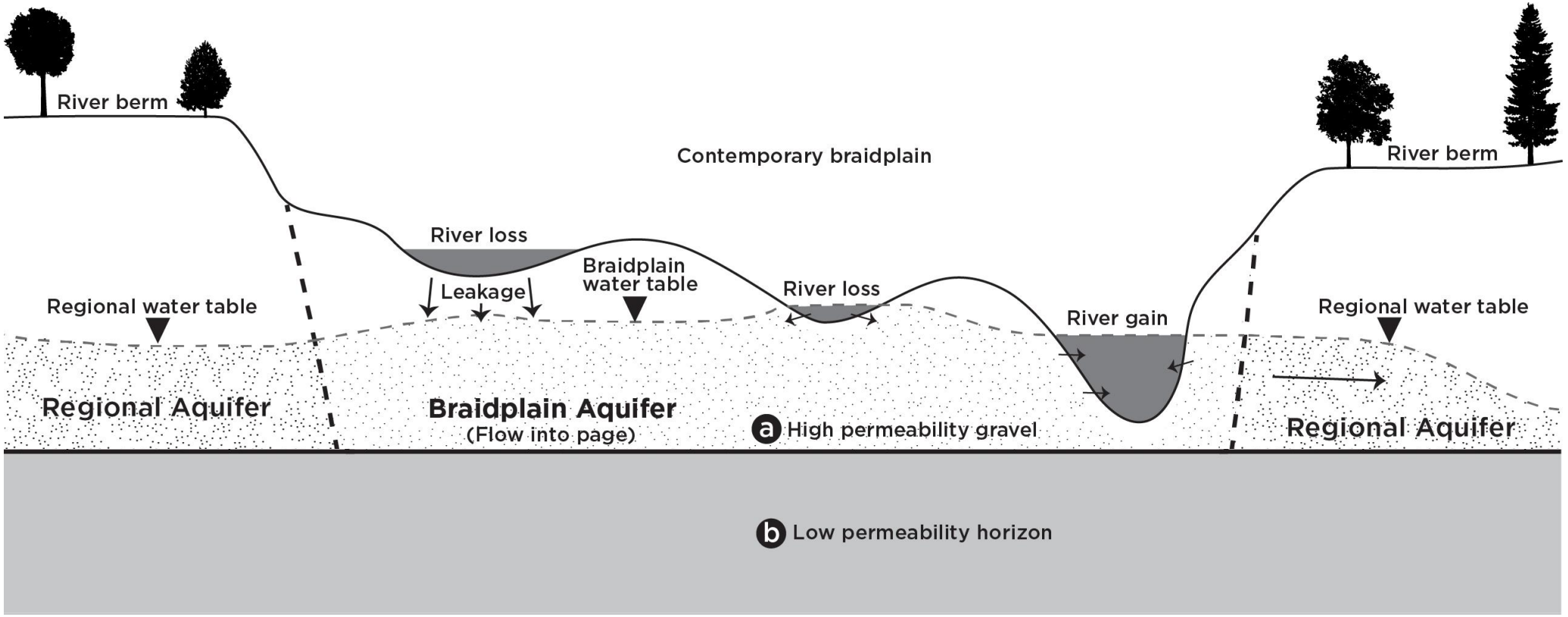



Some gravel extraction is required in order to manage flood risk
The balance of extraction and natural deposition controls bed levels
CAT
If deposition exceeds extraction – bed levels go up
If extraction exceeds deposition – bed levels drop

Lowering the river elevation



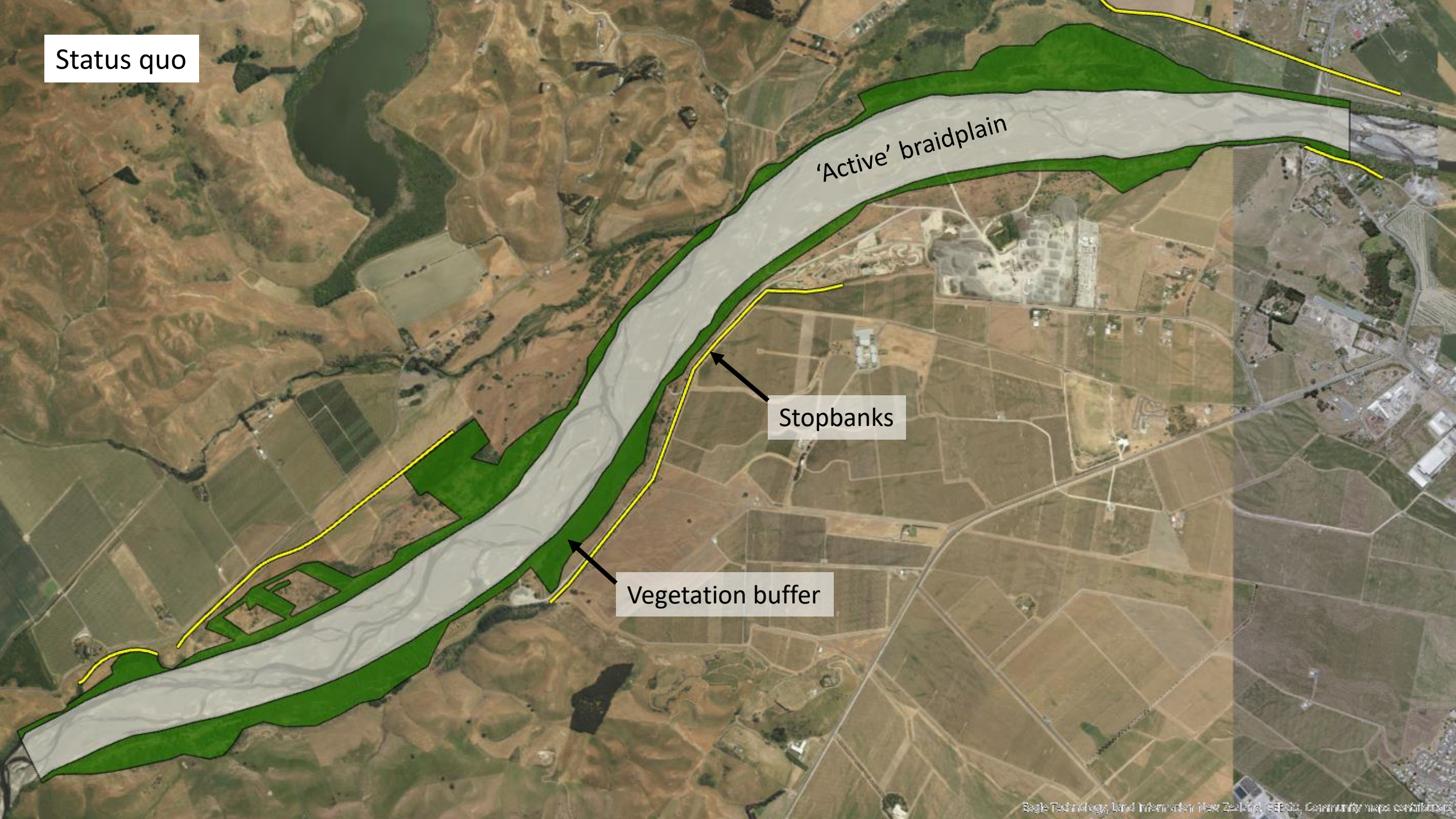
Lowering the river elevation

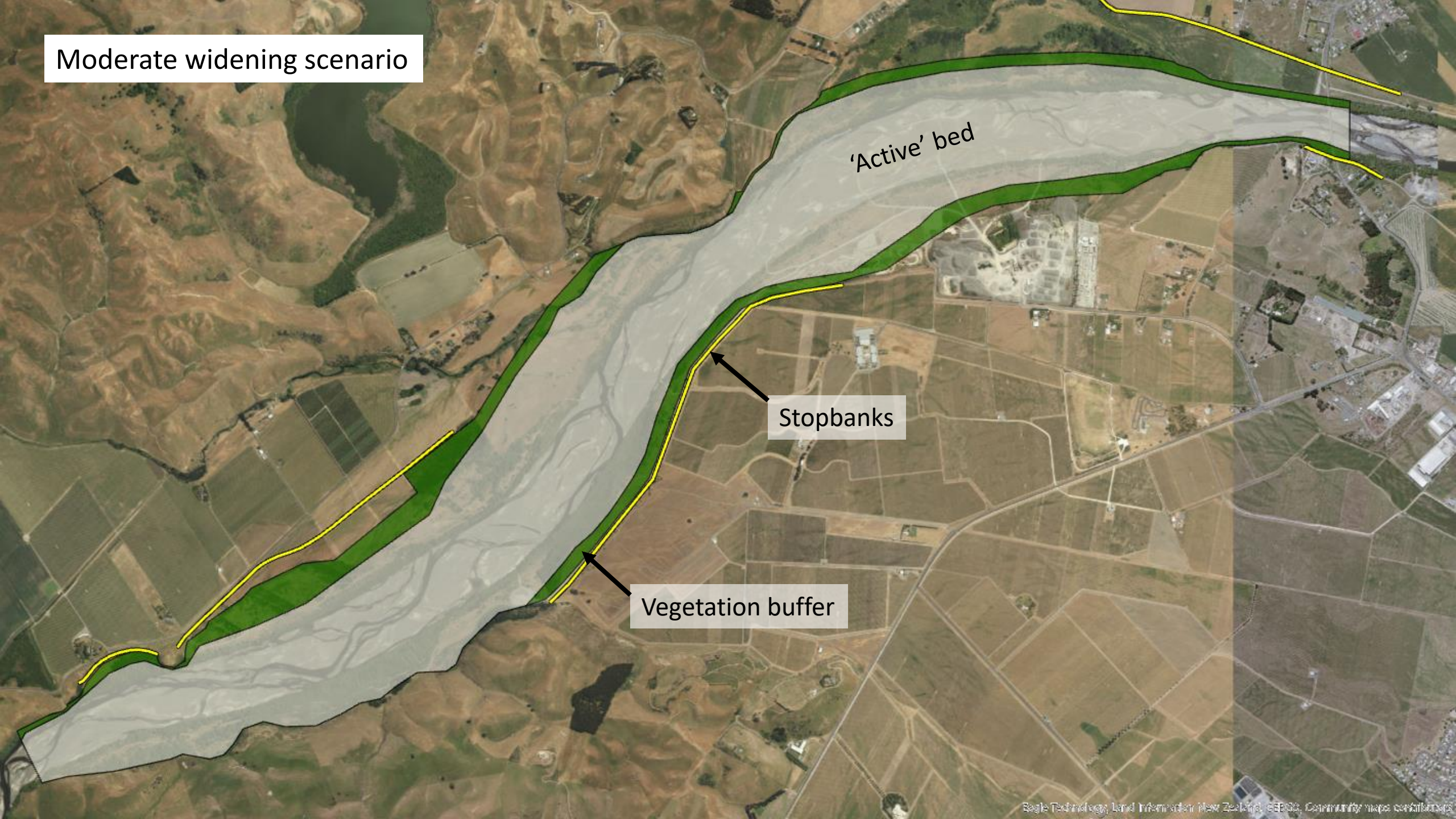


What might changed river management look like?

Scenario assessment…

- Workshops to develop scenarios
  - Changed bed levels (gravel extraction)
  - Changed width


Status quo
‘Active’ braidplain
Stopbanks
Vegetation buffer


Moderate widening scenario
'Active' bed
Stopbanks
Vegetation buffer

What might changed river management look like?

Scenario assessment…

- Workshops to develop scenarios
  - Changed bed levels (gravel extraction)
  - Changed width
- Modelling
- Economics/values analysis

Research Funding Sources:

MBIE (Endeavour Fund)

MDC, ECan, HBRC (co-funding)

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