Physiographics of Southland

- Understanding controls on water quality

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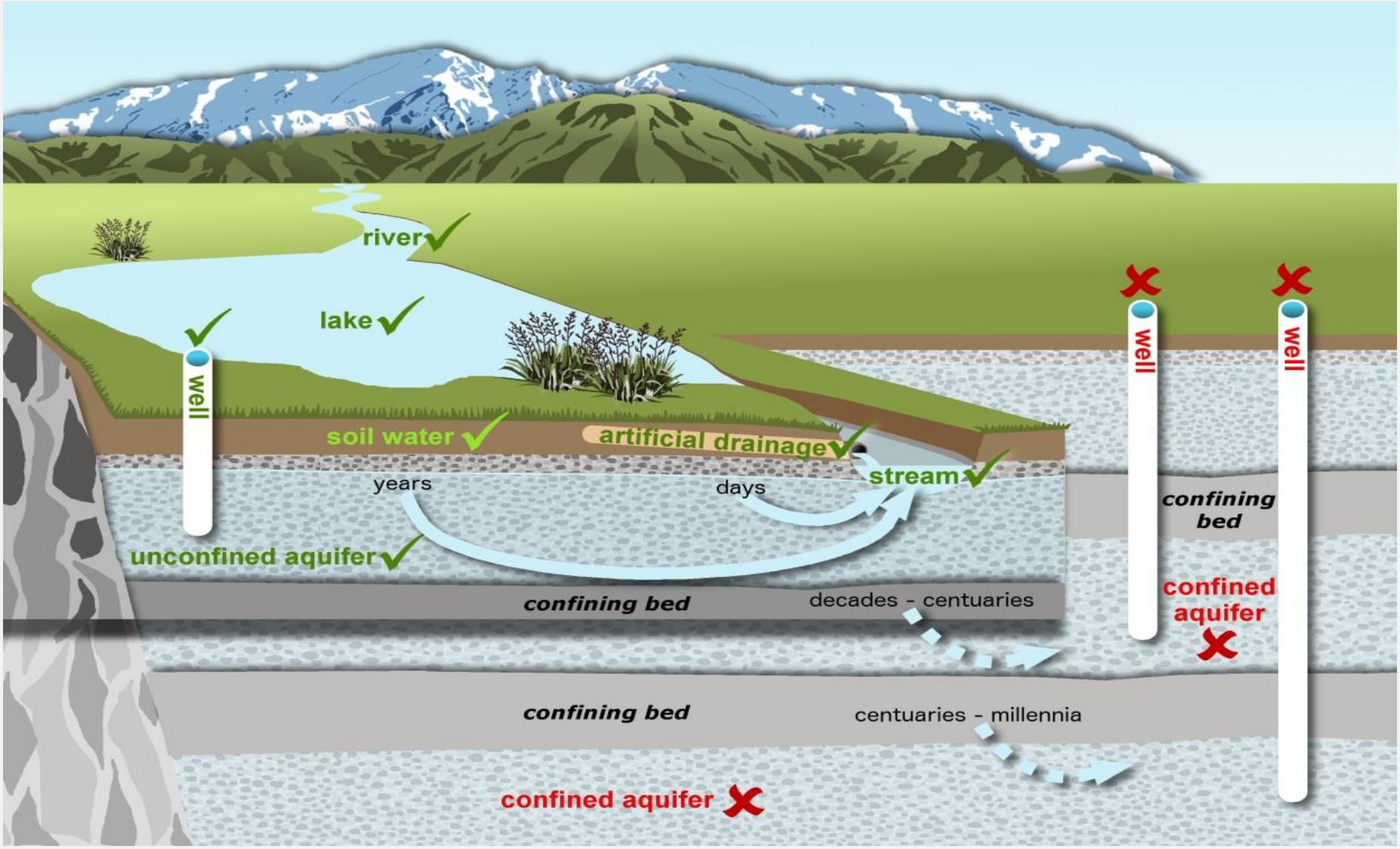
Waterways
Centre for Freshwater Management

Overview of Physiographic Science - Setting



Water contains lots of info (signals)

Lots of information in water regarding processes

- Redox
- Major ion facies
- Isotopic
- Saturation indices
- Physical and biological signals

= Water Composition

Not just N,P, sediment, and microbes

Age

Recharge altitude

Recharge Mechanism

Pathway

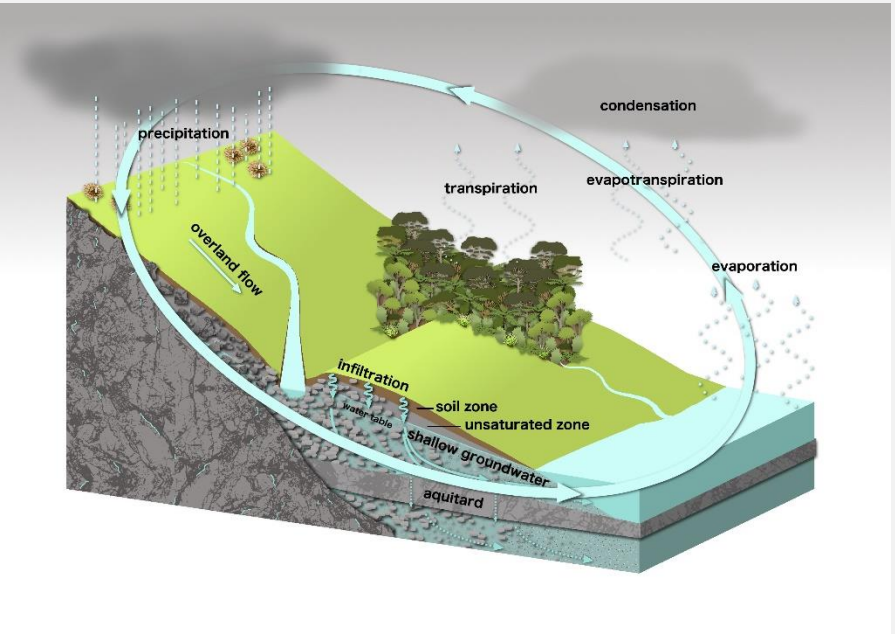
Redox

Water-rock interaction

Setting, Landscape

Relationship Between Landscape Attributes and Processes

Landscape **attributes** control the variation in **processes** that determine water composition:

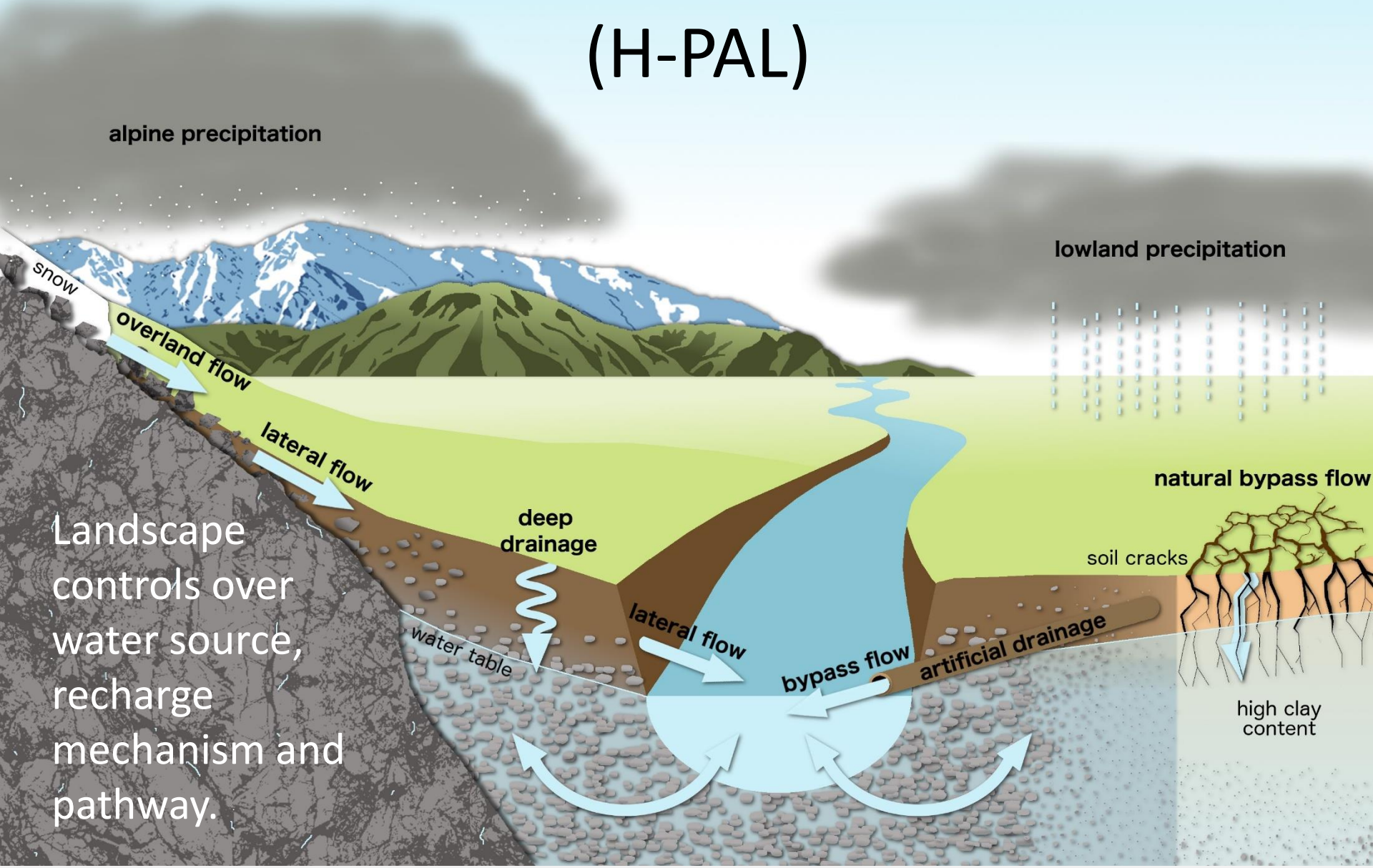


Key processes are:

- Atmospheric
- **Hydrological**
- **Redox**
- Weathering

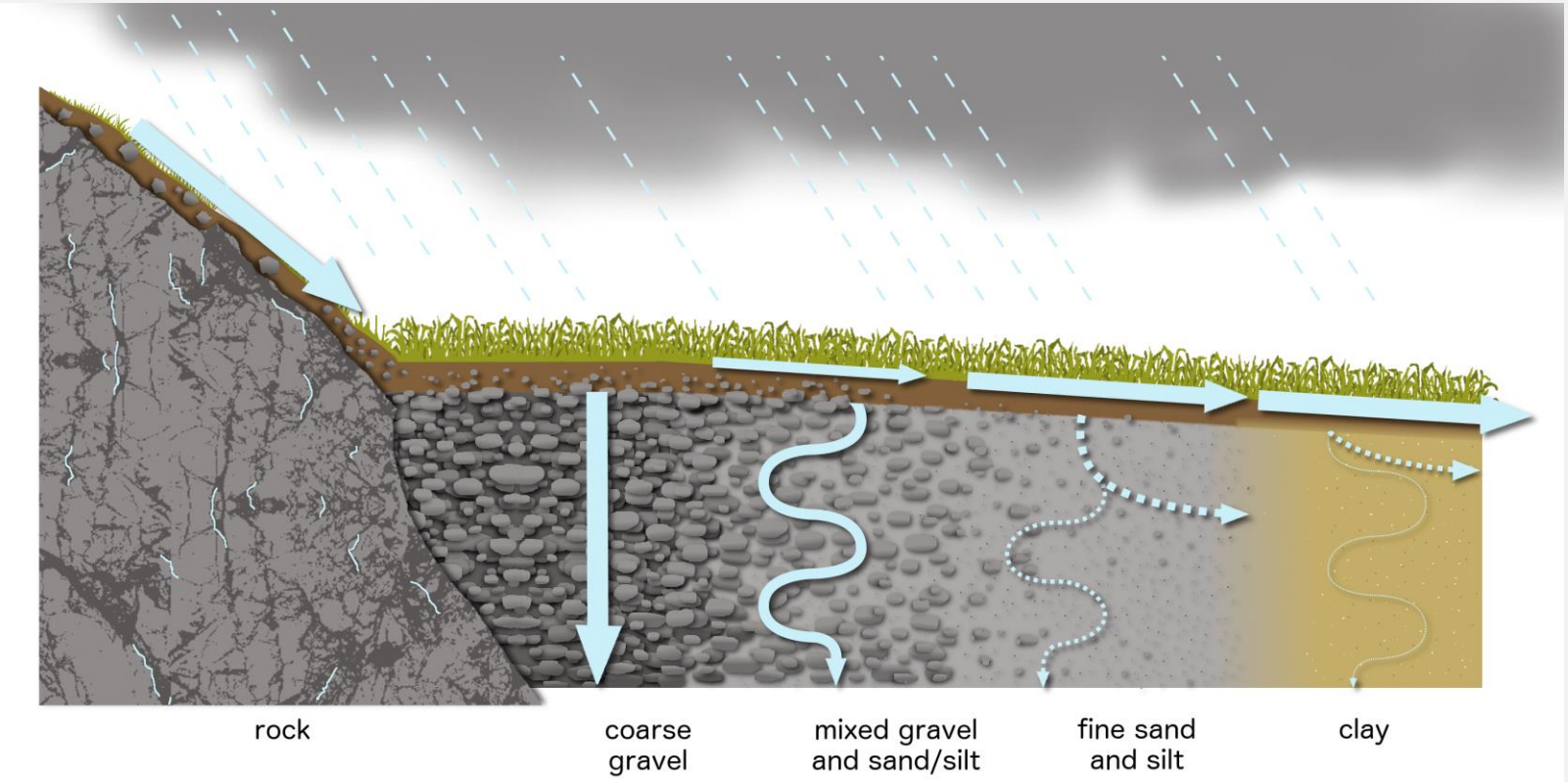
These processes occur in both natural state and areas of intensive land use

Hydrological Process-Attribute Layer (H-PAL)

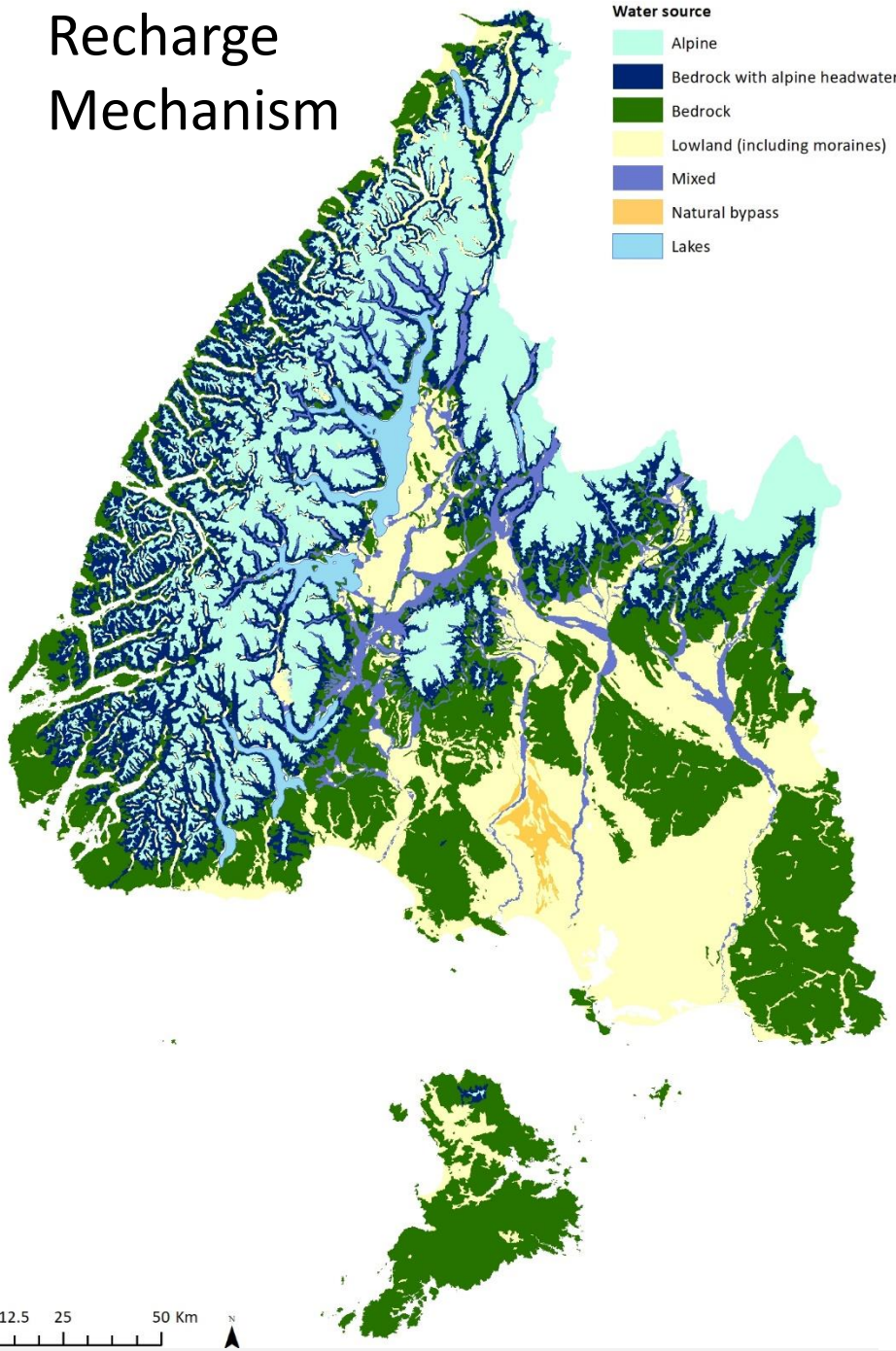


Landscape controls over water source, recharge mechanism and pathway.

Hydrological Process-Attribute Layer (H-PAL)

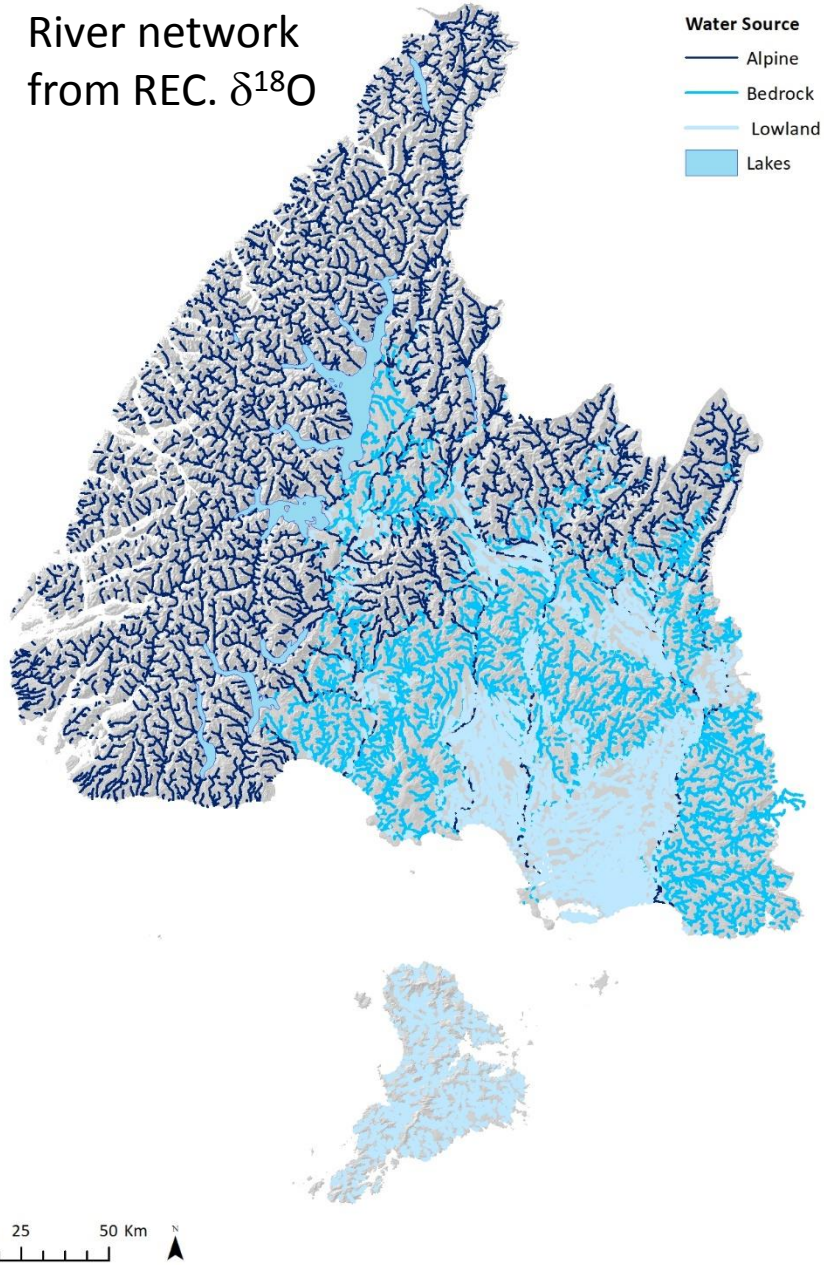


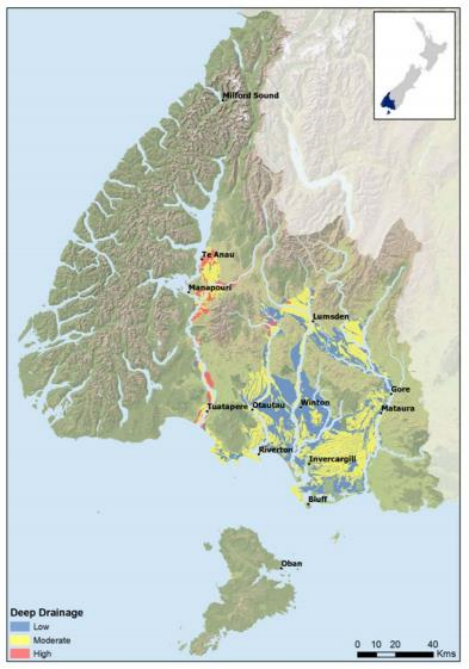
Recharge Mechanism

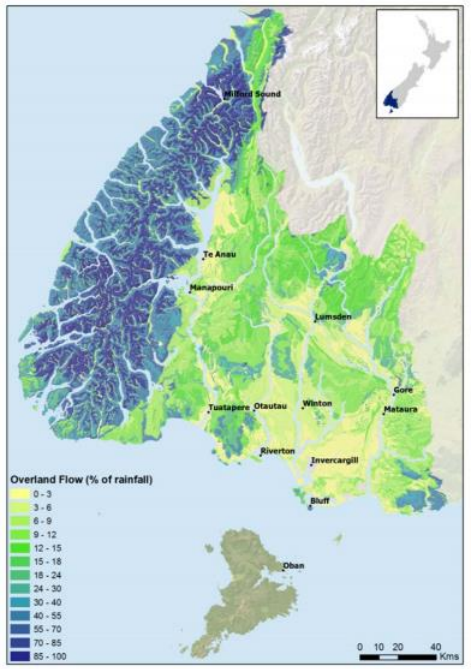


Water Source

River network from REC. $\delta^{18}O$

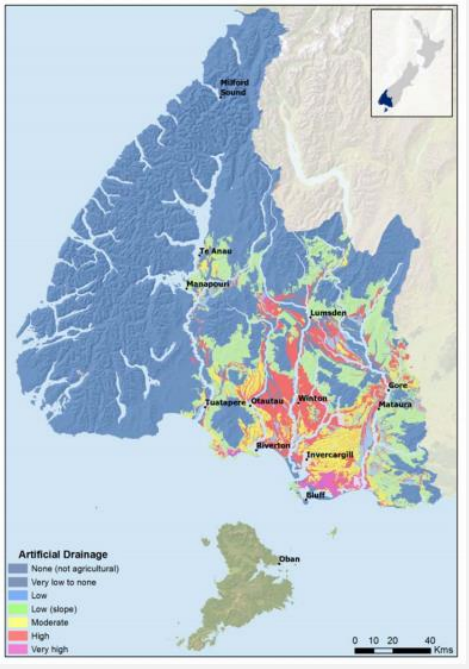


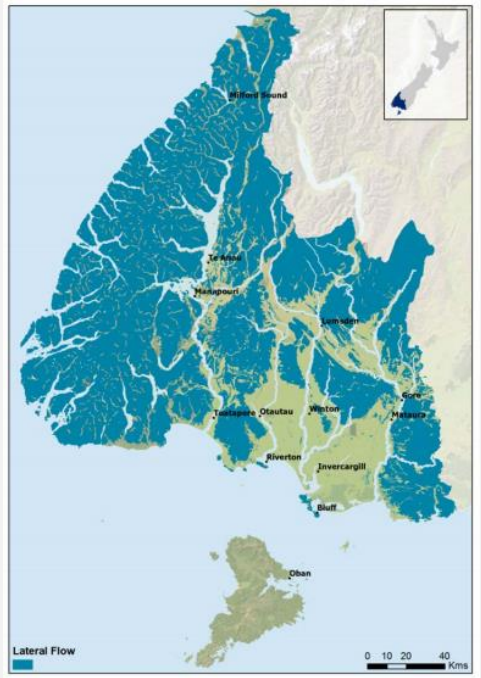


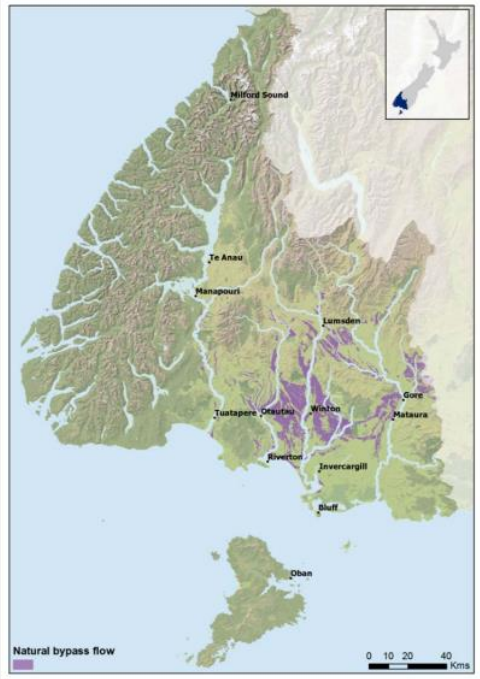


Water Pathway (Fine scale)

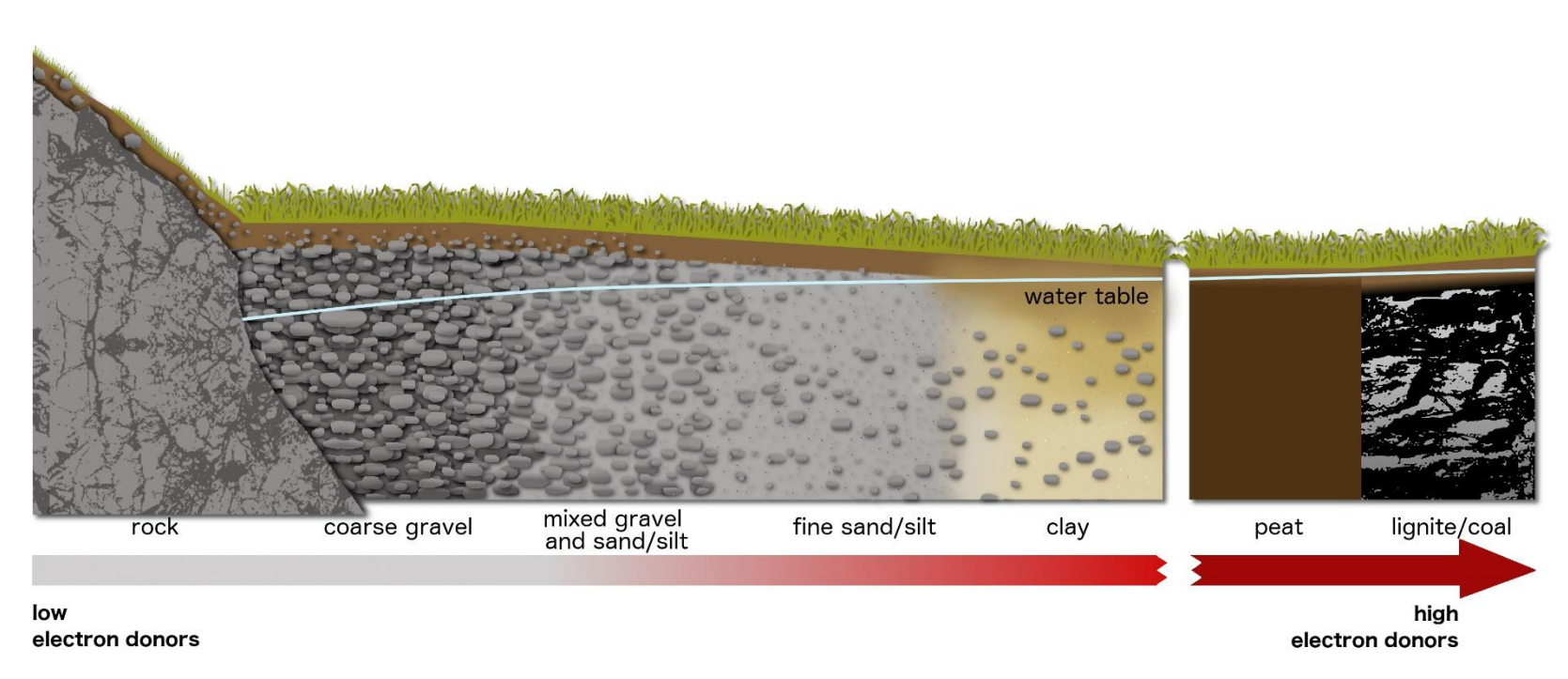
- Deep drainage
- Overland flow
- Artificial drainage
- Lateral flow
- Natural bypass



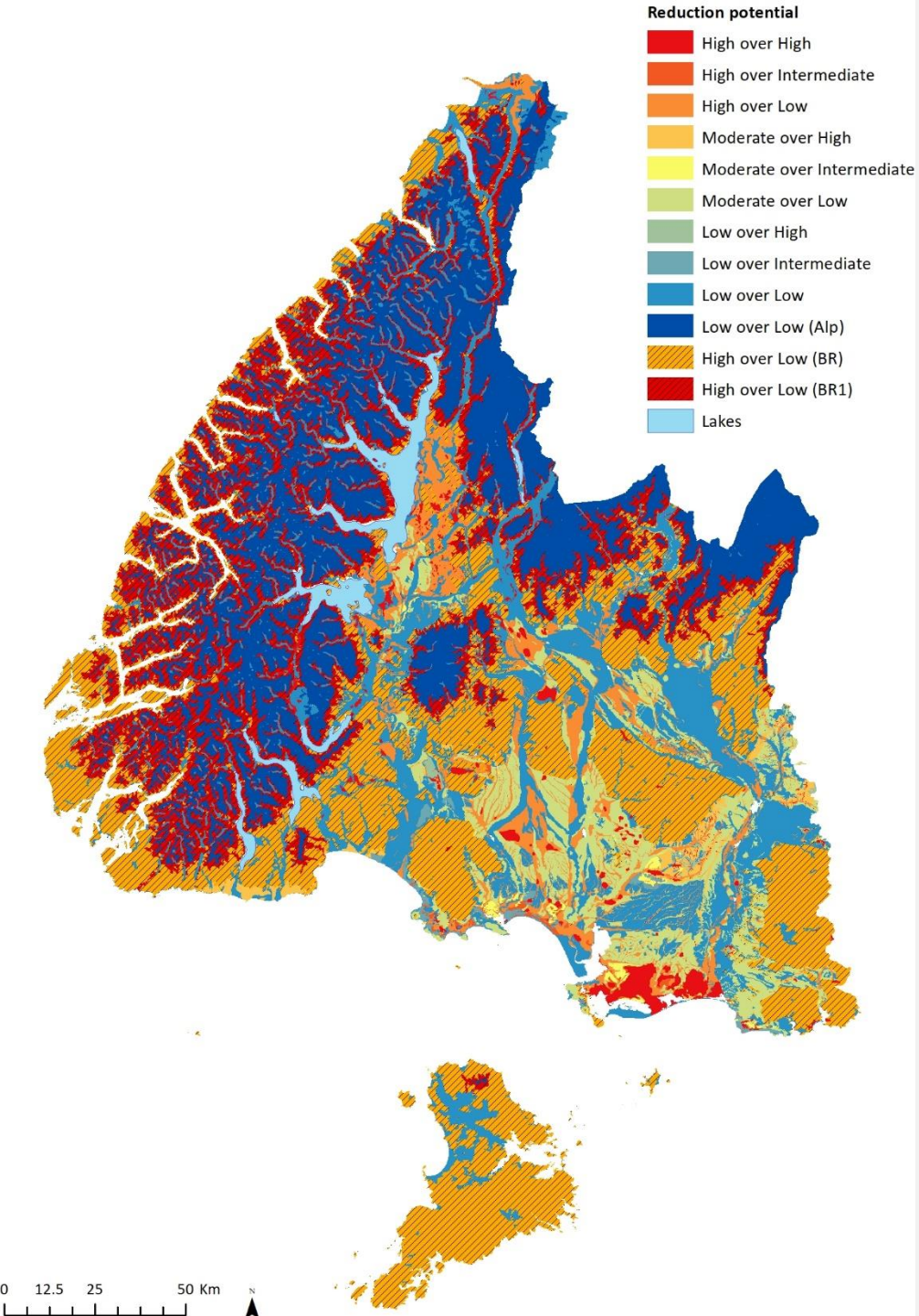




Redox Process-Attribute Layer (R-PAL)



Soil and aquifer reduction potential controls denitrification, the solubility, leachability and mobility of redox sensitive species



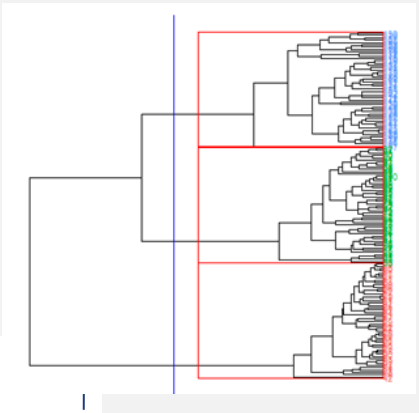
Redox

- Combined Reduction Potential
- Soil zone over aquifer

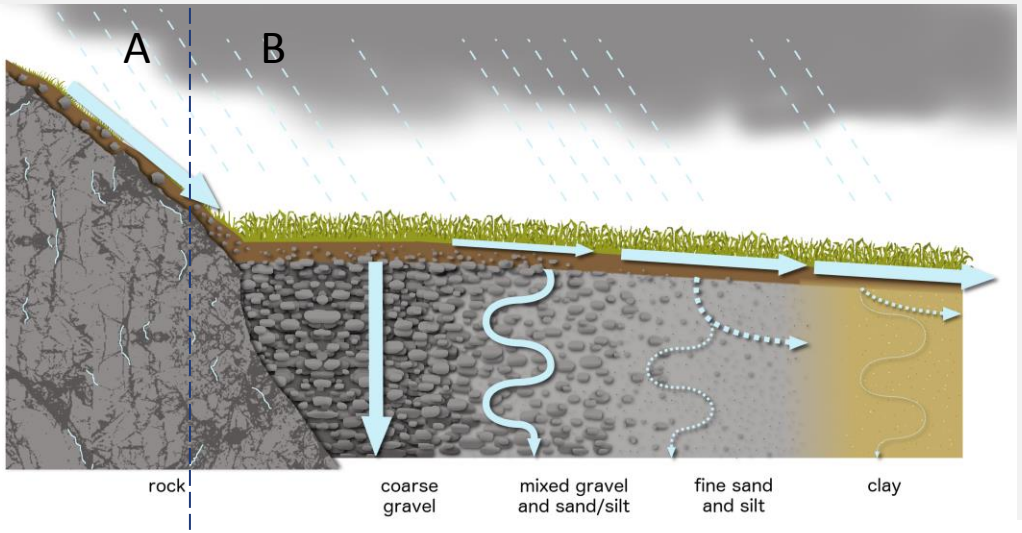
Concept

SW/GW composition used to identify unit boundaries

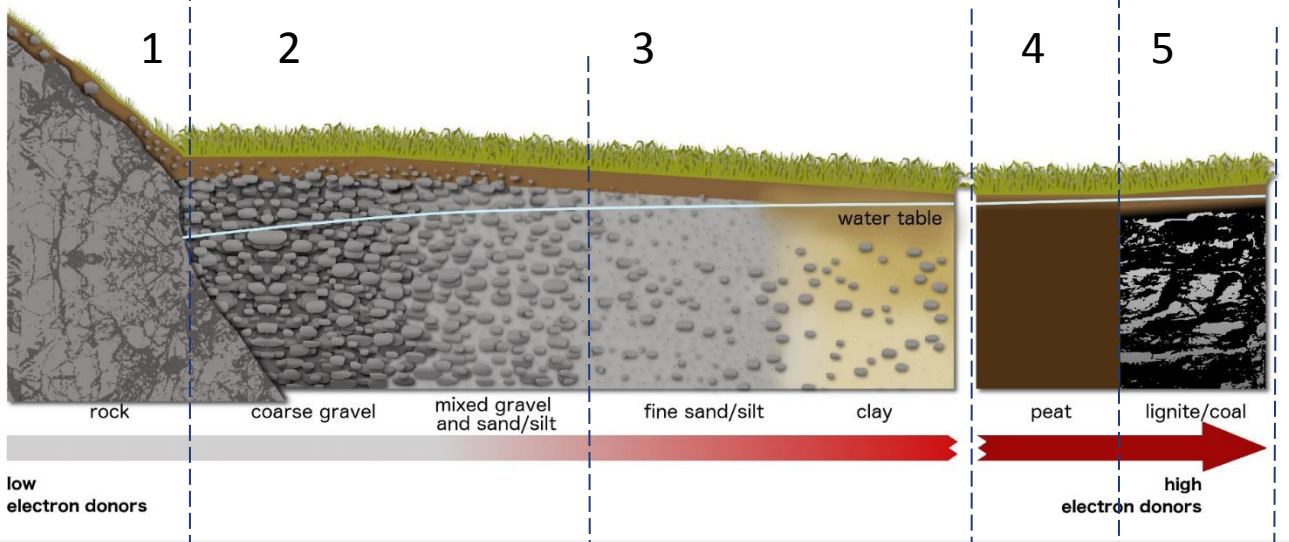
- PCA
- HCA



H-PAL



R-PAL

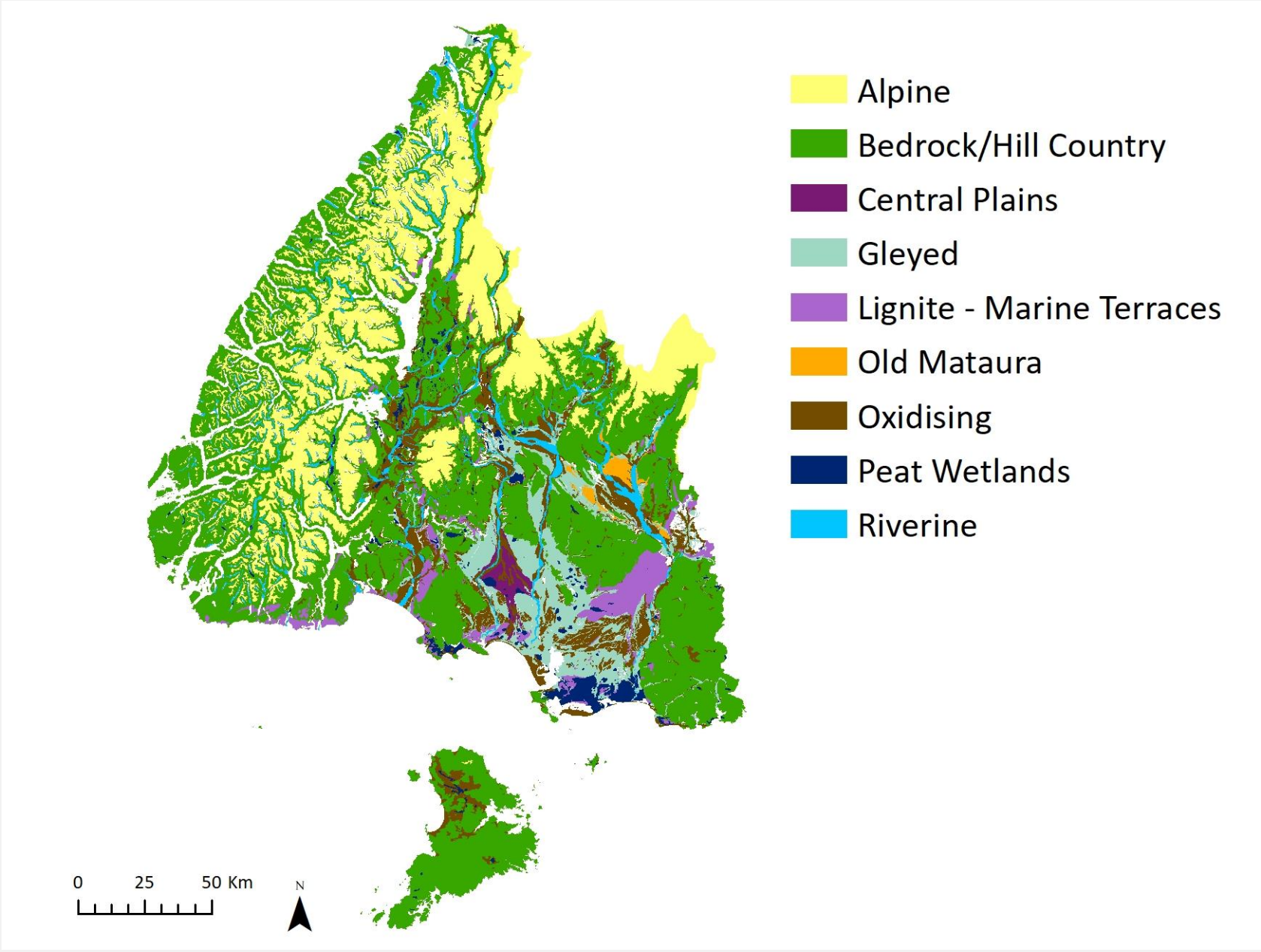


Independent of Land Use

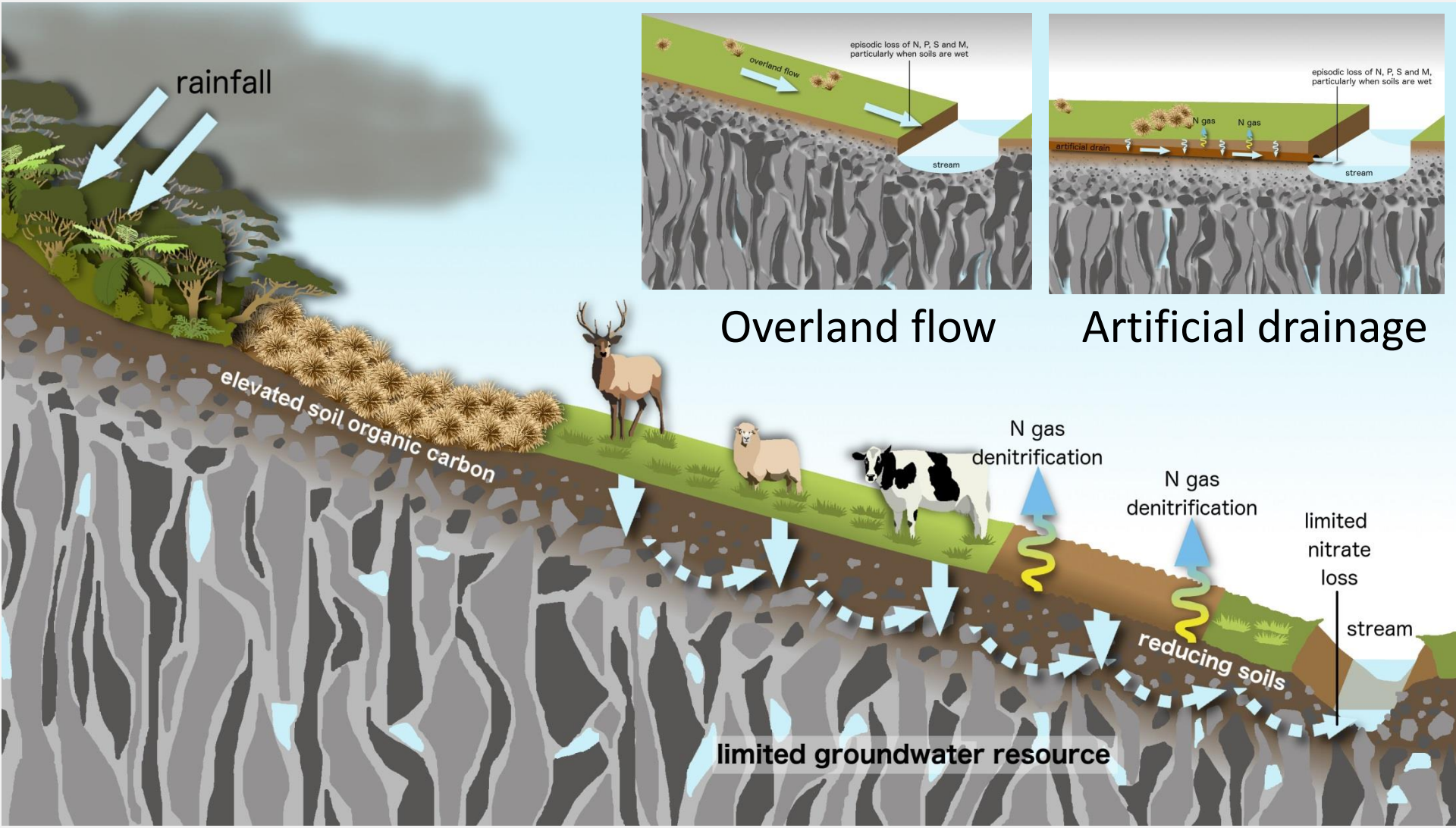
Unit

A1 B2 B3 B4 B5

Southland Physiographic Zones



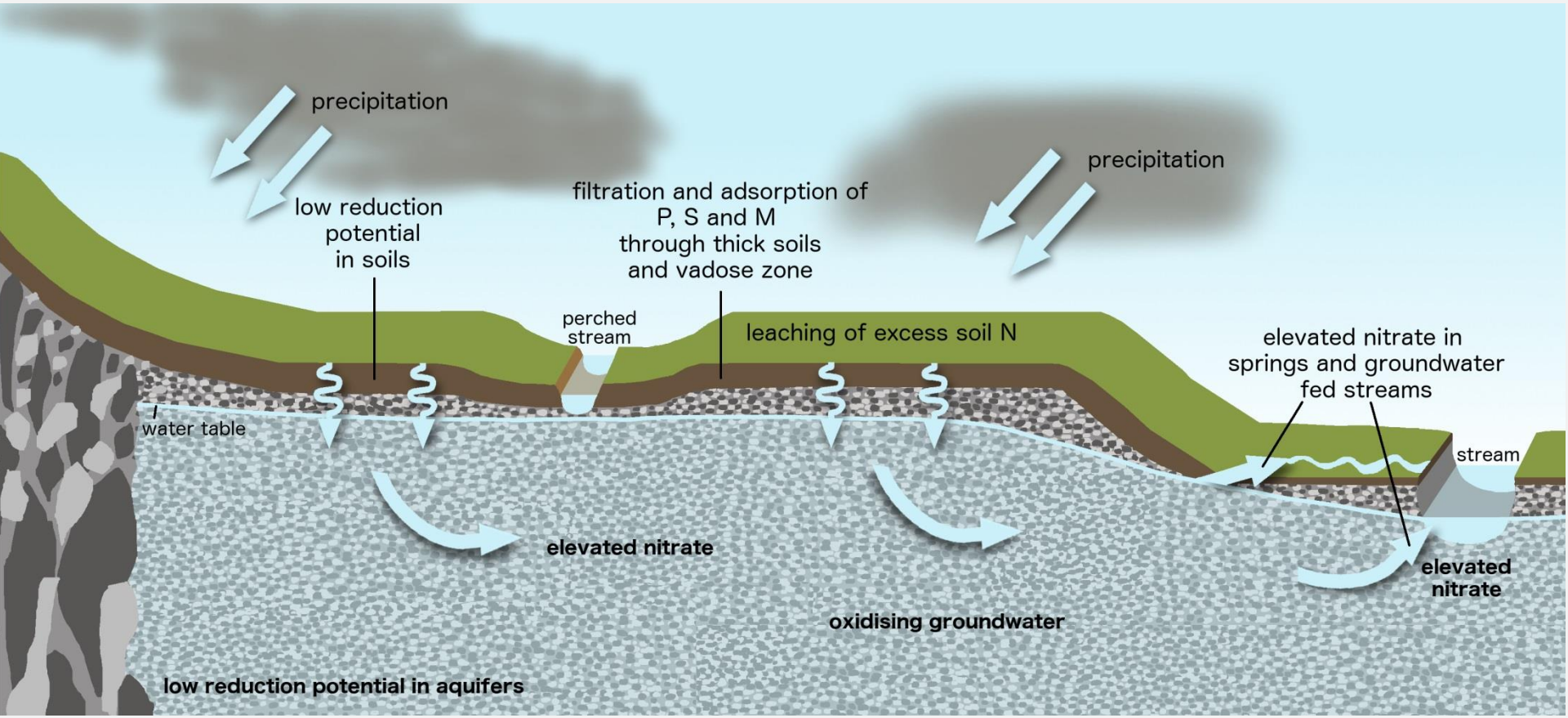
Bedrock/Hill Country



Overland flow

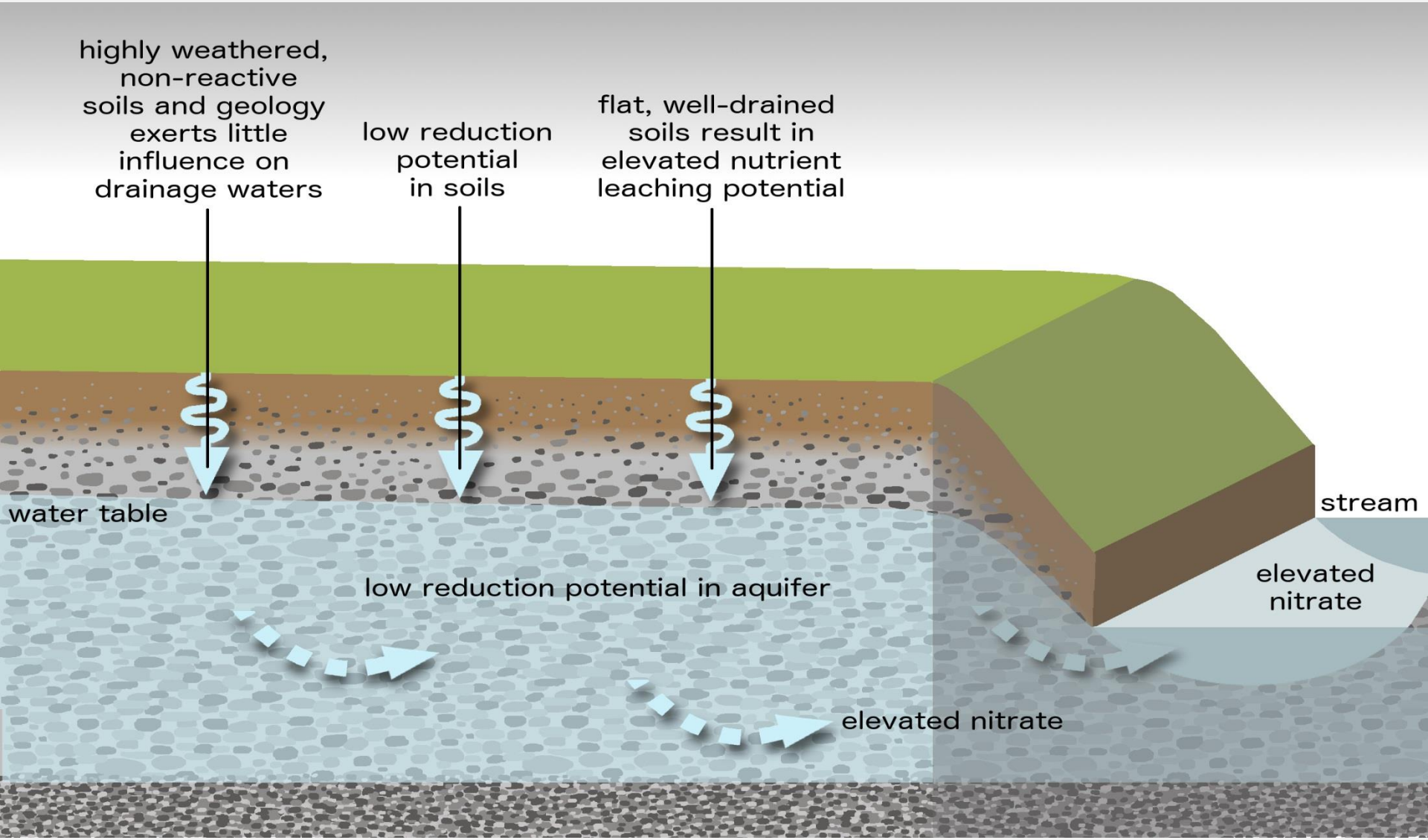
Artificial drainage

Oxidising

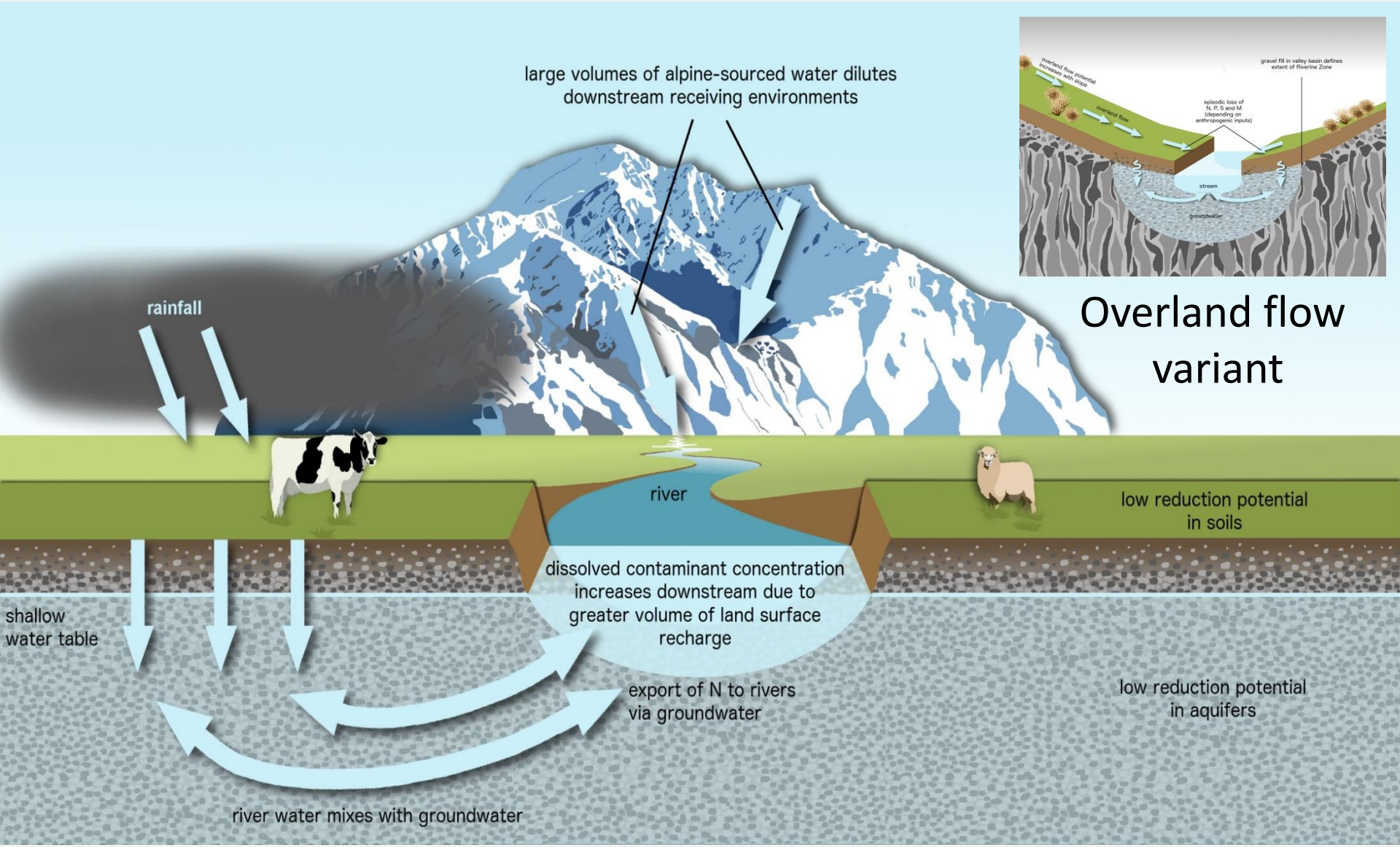


- Overland flow variant
- Artificial drainage variant

Old Mataura

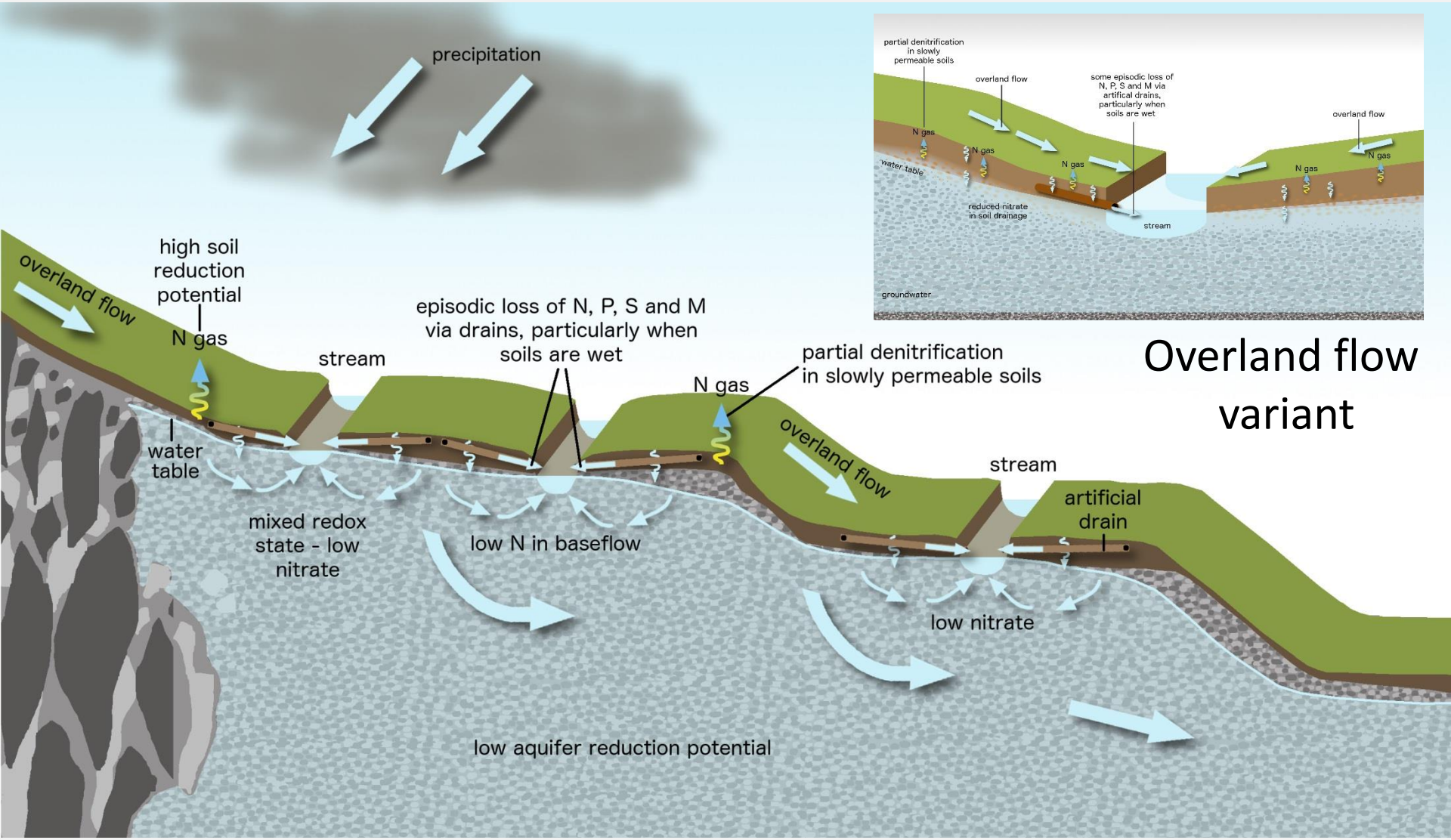

highly weathered, non-reactive soils and geology exerts little influence on drainage waters
low reduction potential in soils
flat, well-drained soils result in elevated nutrient leaching potential
water table
stream
elevated nitrate
low reduction potential in aquifer
elevated nitrate

Riverine



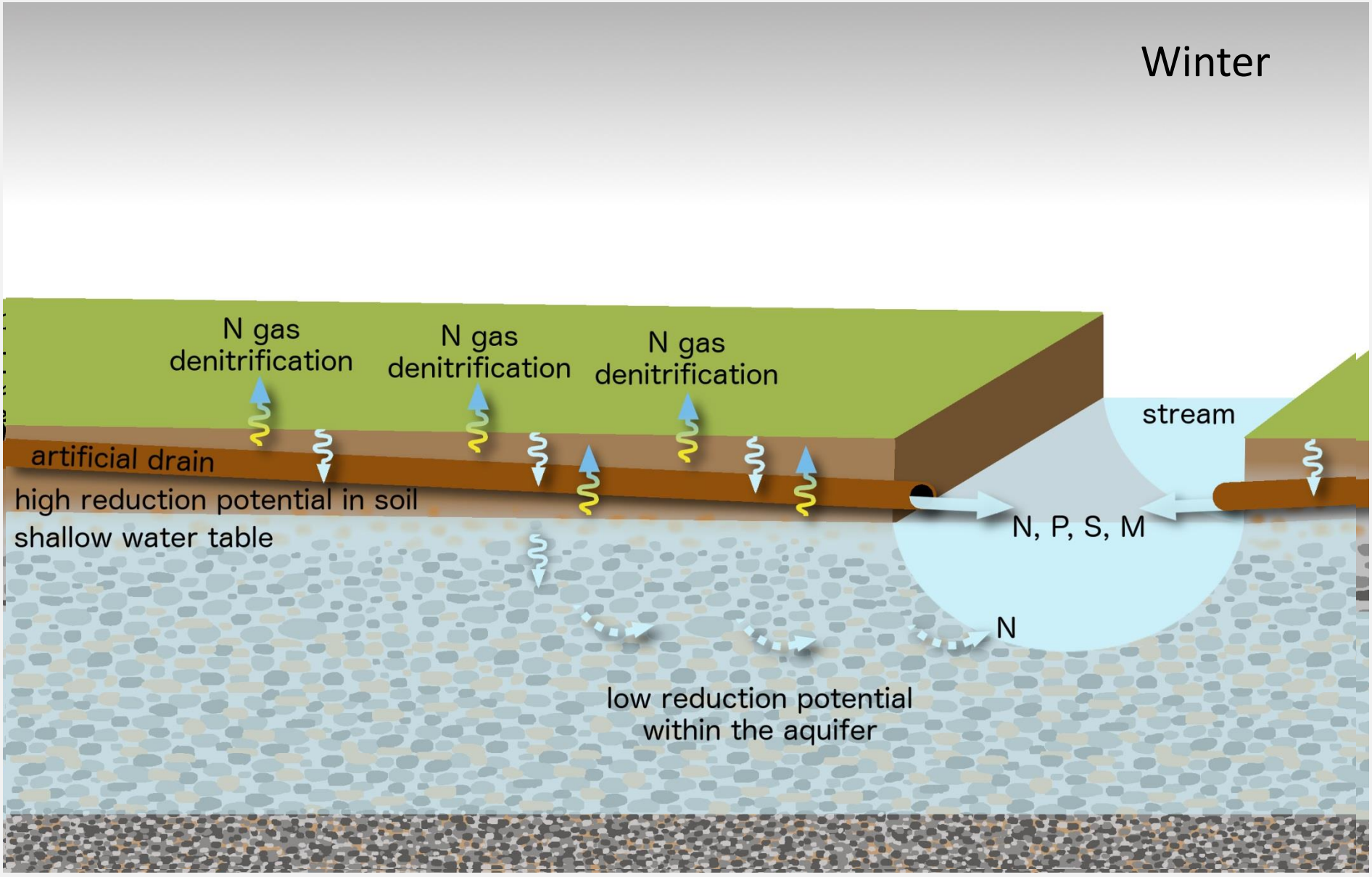
Overland flow variant

Gleyed

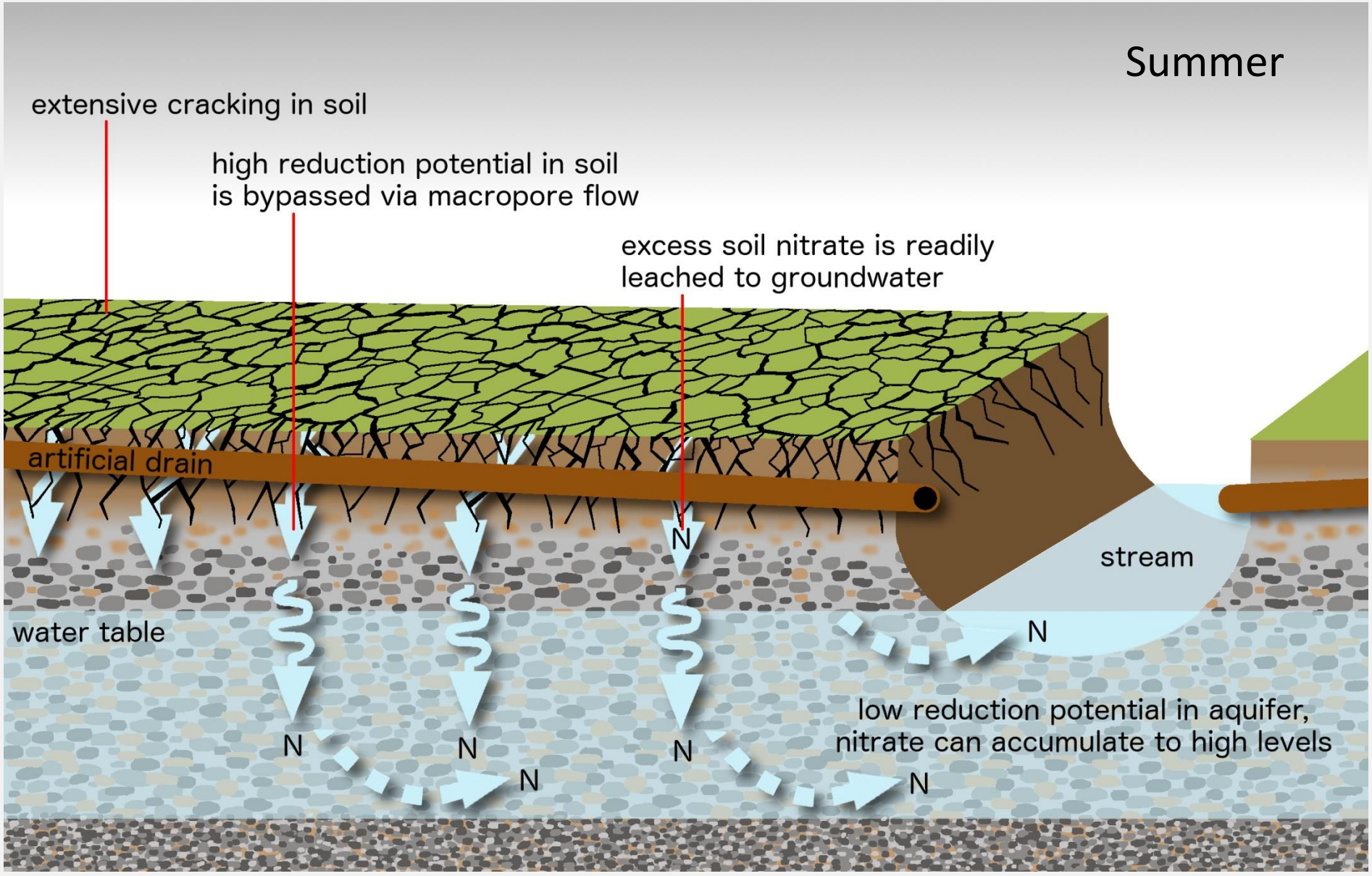


Overland flow variant

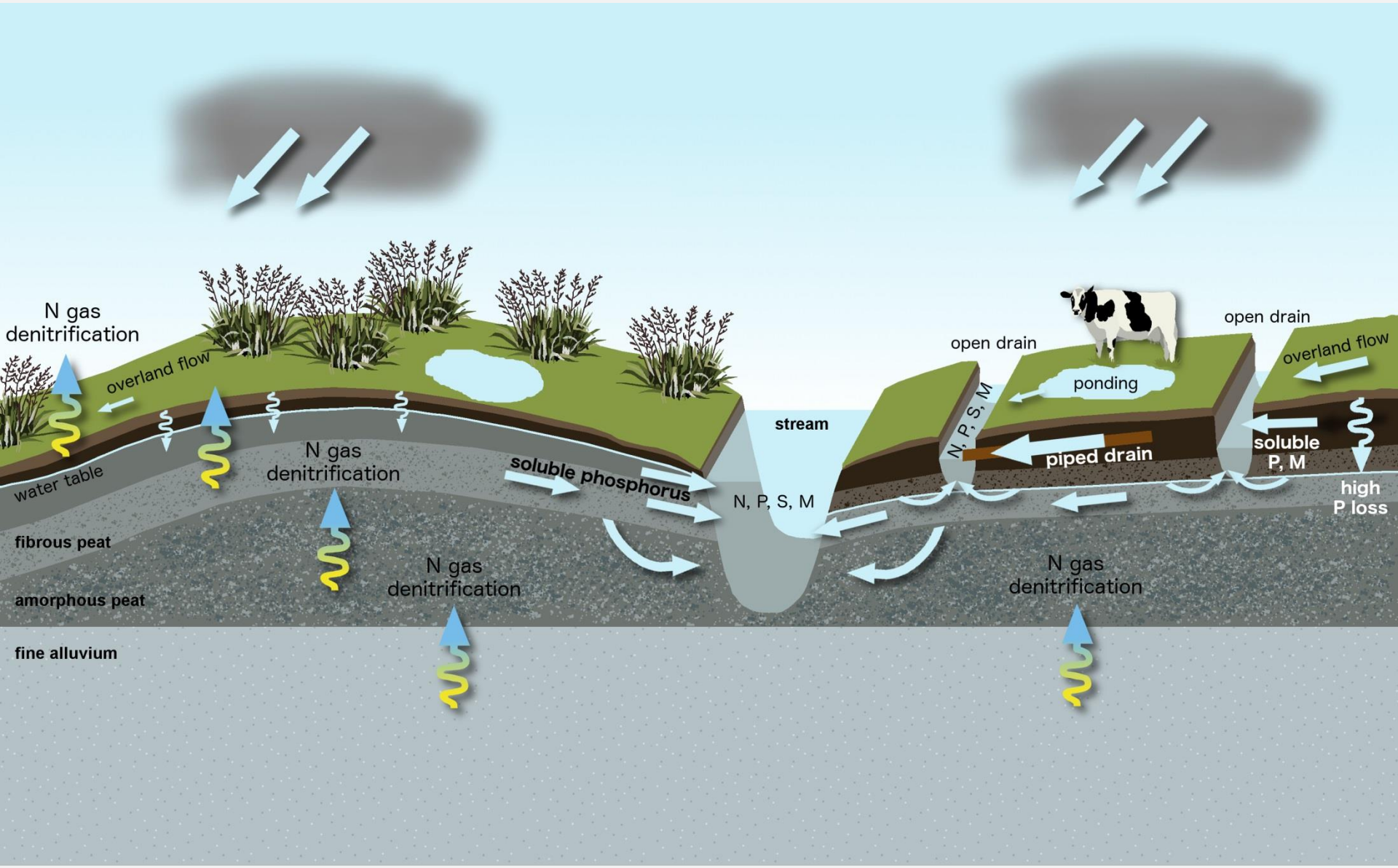
Central Plains



Central Plains

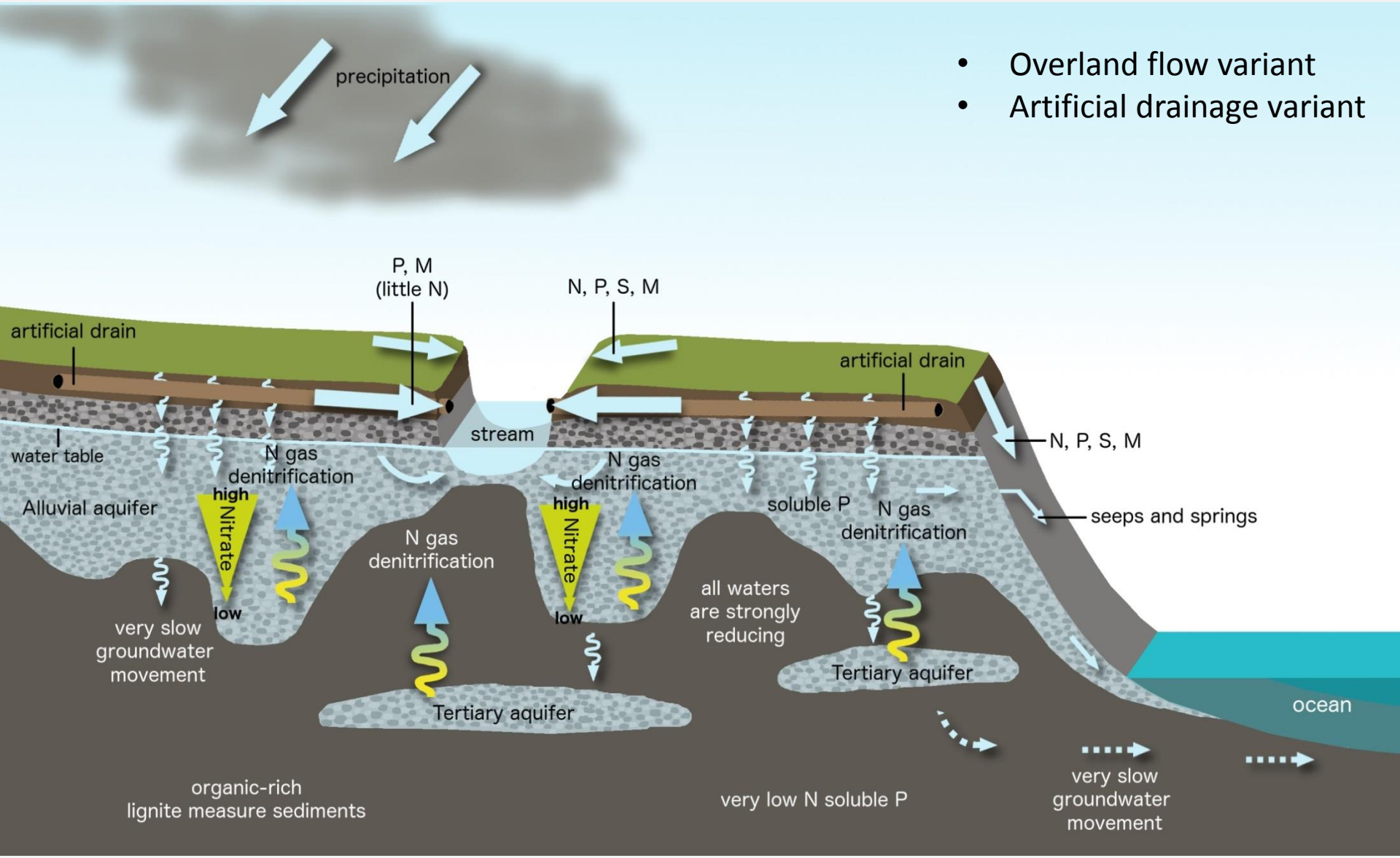


Peat Wetlands



Lignite/Marine Terraces

- Overland flow variant
- Artificial drainage variant



Water quality risk assessment

Physiographic Zone	Variant	Key contaminant pathways and contaminants				Water Quality Risk			
		Overland flow	Artificial drainage	Lateral drainage	Deep drainage	Nitrogen	Phosphorus	Sediment	Microbes
Alpine		N,P,S,M				High	High	High	High
Bedrock/Hill Country					N	Low*	Low	Low	Low
	Overland Flow	N,P,S,M				High	High	High	High
	Artificial Drainage		N,P,S,M			High	High	High	High
Central Plains			N,P,S,M		N	High	High	High	High
Gleyed			N,P,S,M			High	High	High	High
	Overland Flow	N,P,S,M				High	High	High	High
Lignite-Marine Terraces					N	Low*	Low	Low	Low
	Overland Flow	N,P,S,M				High	High	High	High
	Artificial Drainage		N,P,S,M			High	High	High	High
Old Mataura					N	High	Low	Low	Low
Oxidising					N	High	Low	Low	Low
	Overland Flow	N,P,S,M			N	High	High	High	High
	Artificial Drainage		N,P,S,M		N	High	High	High	High
Peat Wetlands			N,P,S,M	P, M	P	High	High	High	High
Riverine					N	High	Low	Low	Low
	Overland Flow	N,P,S,M			N	High	High	High	High

*Low risk due to high reduction potential (i.e. denitrification likely to occur)

Ref: Table 14 in Hughes *et al* (2016)

Thank you

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