Integrated Landscape Mapping of Water Quality Controls for Farm Planning

- Applying a high resolution physiographic approach to the Waituna Catchment, Southland

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Physiographic Environments of New Zealand

Year 1: Science Development

- Methodology paper with OLW ***Mar18***
- Development of process-attribute layers (PALs) ***Aug18***

Year 2: Validation

- Statistical analysis of WQ data to class PALs ***Oct18***
- Unvalidated Physiographic Environment Map ***Dec18***
- Validated Physiographic Environments of New Zealand Map
- Production of 2 papers on national application and validation with OLW ***Mar19***

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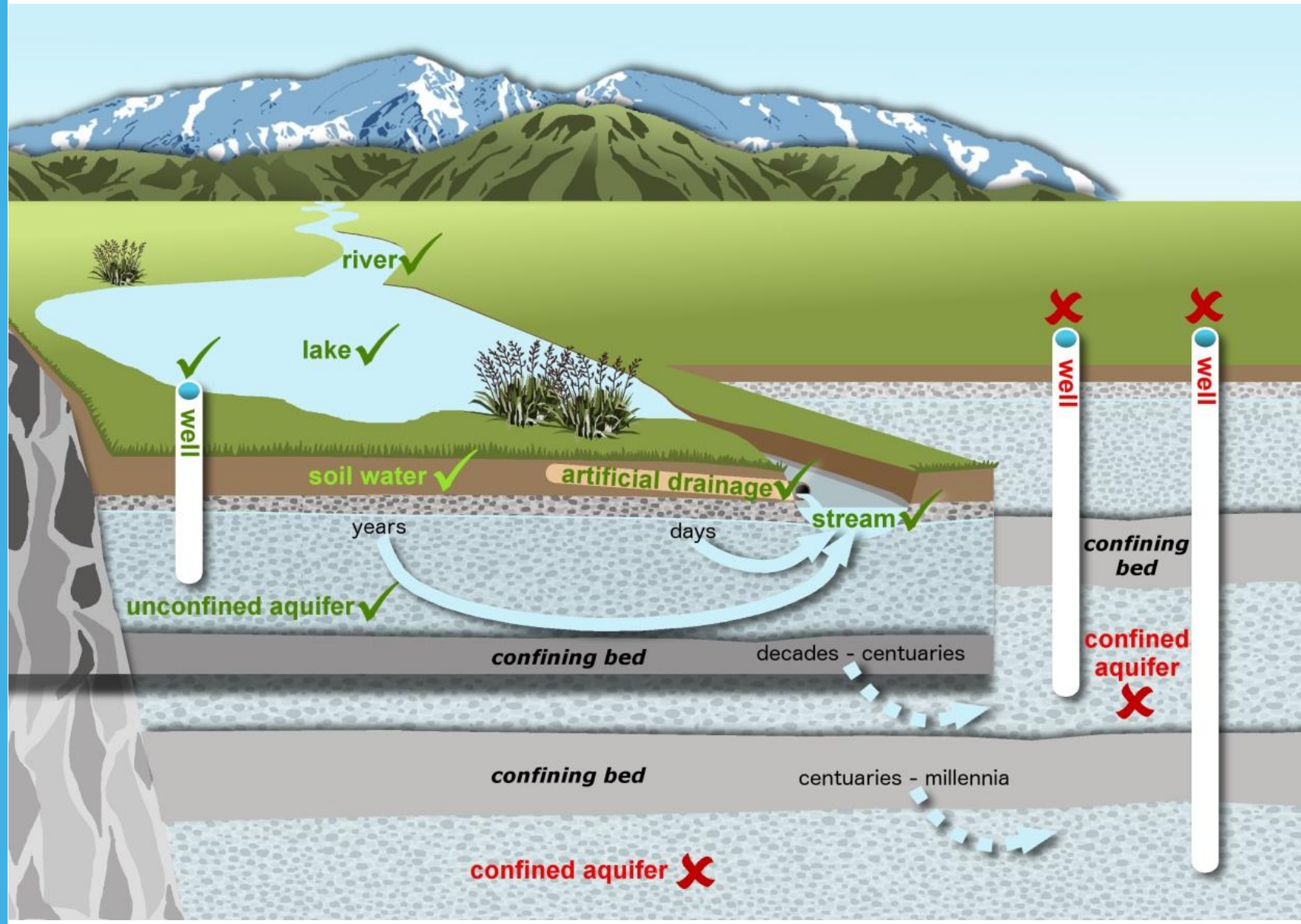
Sustainable Farming Fund (2018-2021)

- 4 Southland Catchment Groups
  - Waituna
  - Pourakino
  - Wendonside
  - Five Rivers
- Industry Groups that supported the application
  - Fonterra Co-operative Group
  - Beef & Lamb NZ
  - Deer Industry NZ
  - Foundation of Arable Research
  - Living Water
  - NZ Landcare Trust
- Environment Southland
  - Land Sustainability

Ministry for Primary Industries
Manatū Ahu Matua

Overview of Physiographic Science - Setting



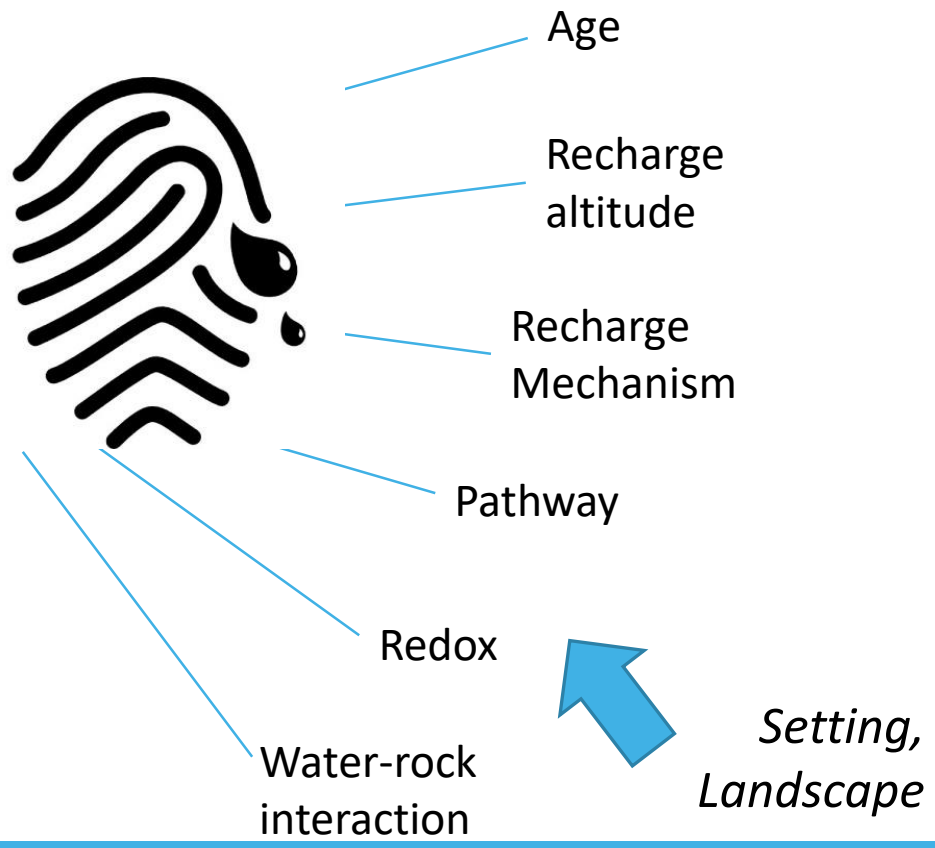
Water contains lots of info (signals)

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

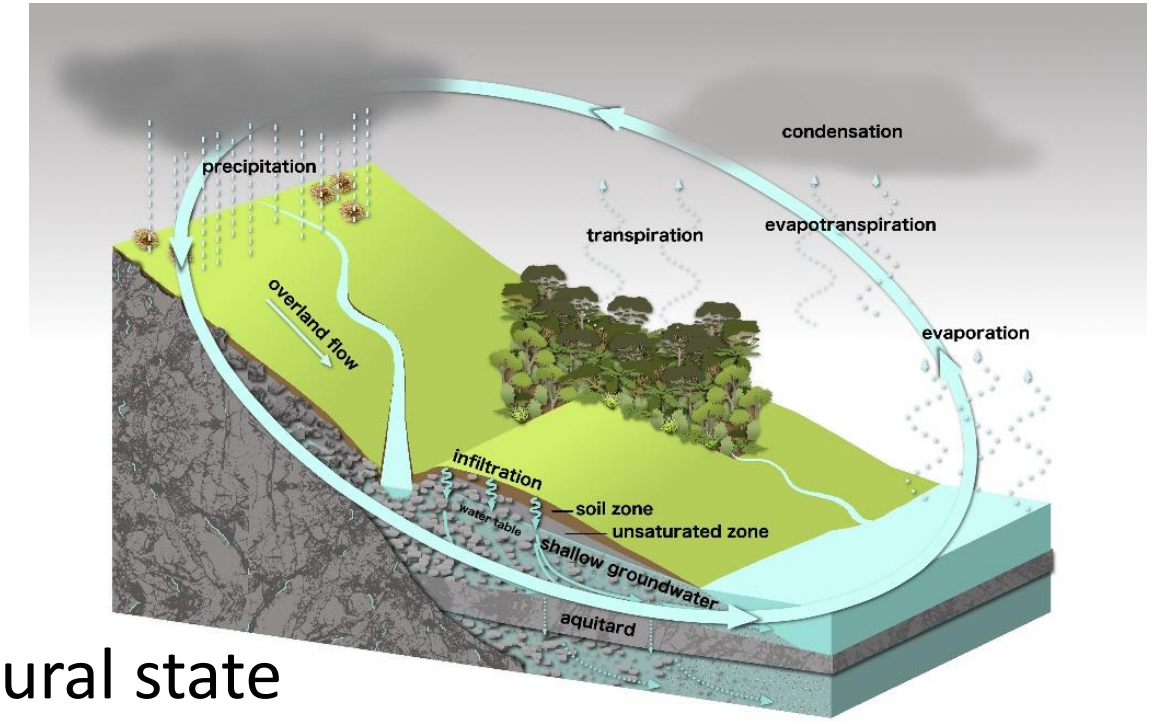


Relationship Between Landscape Attributes and Processes

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

Key processes are:

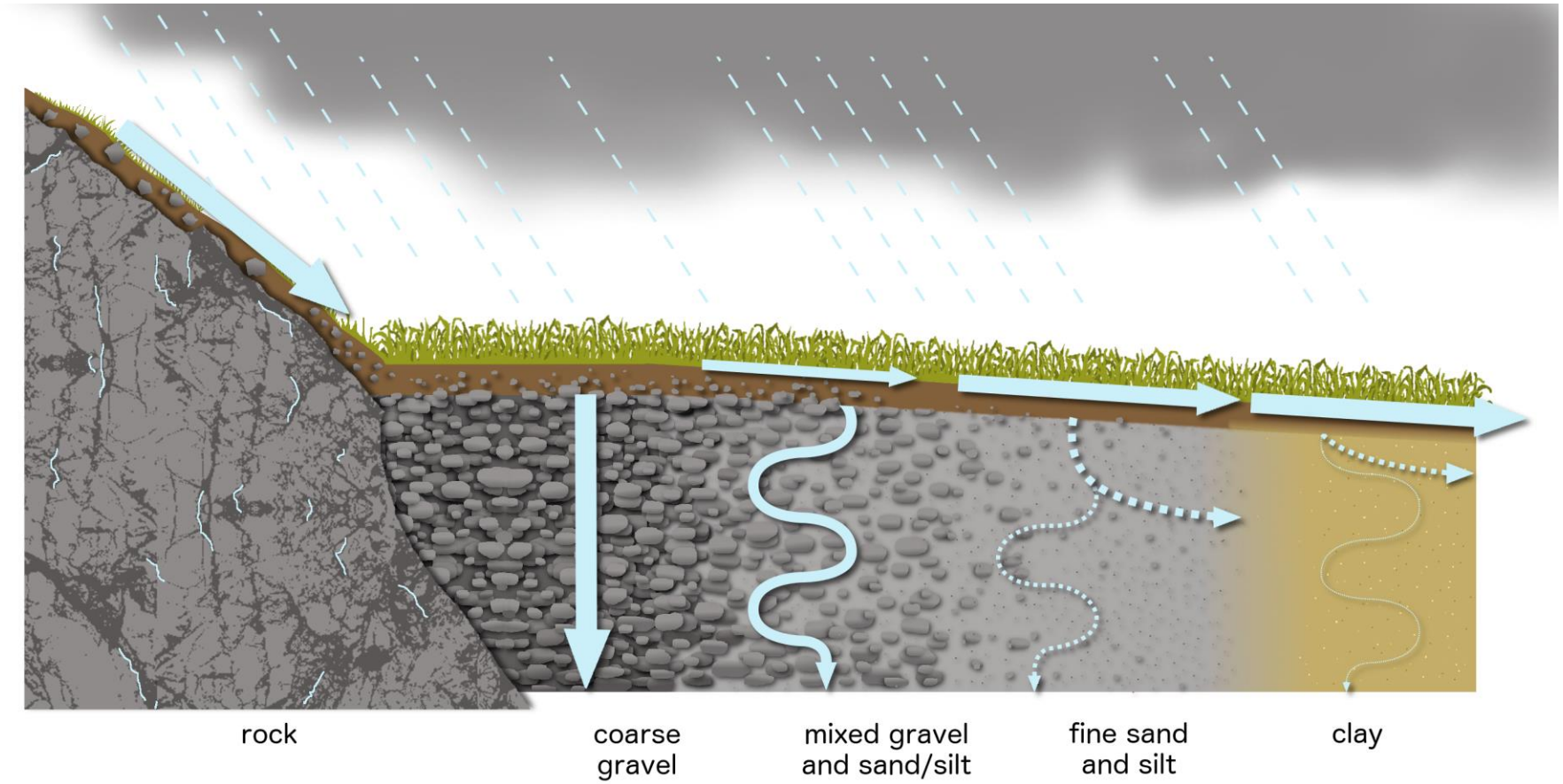
- Atmospheric
- **Hydrological**
- **Redox**
- Weathering



These processes occur in both natural state

And areas of intensive land use

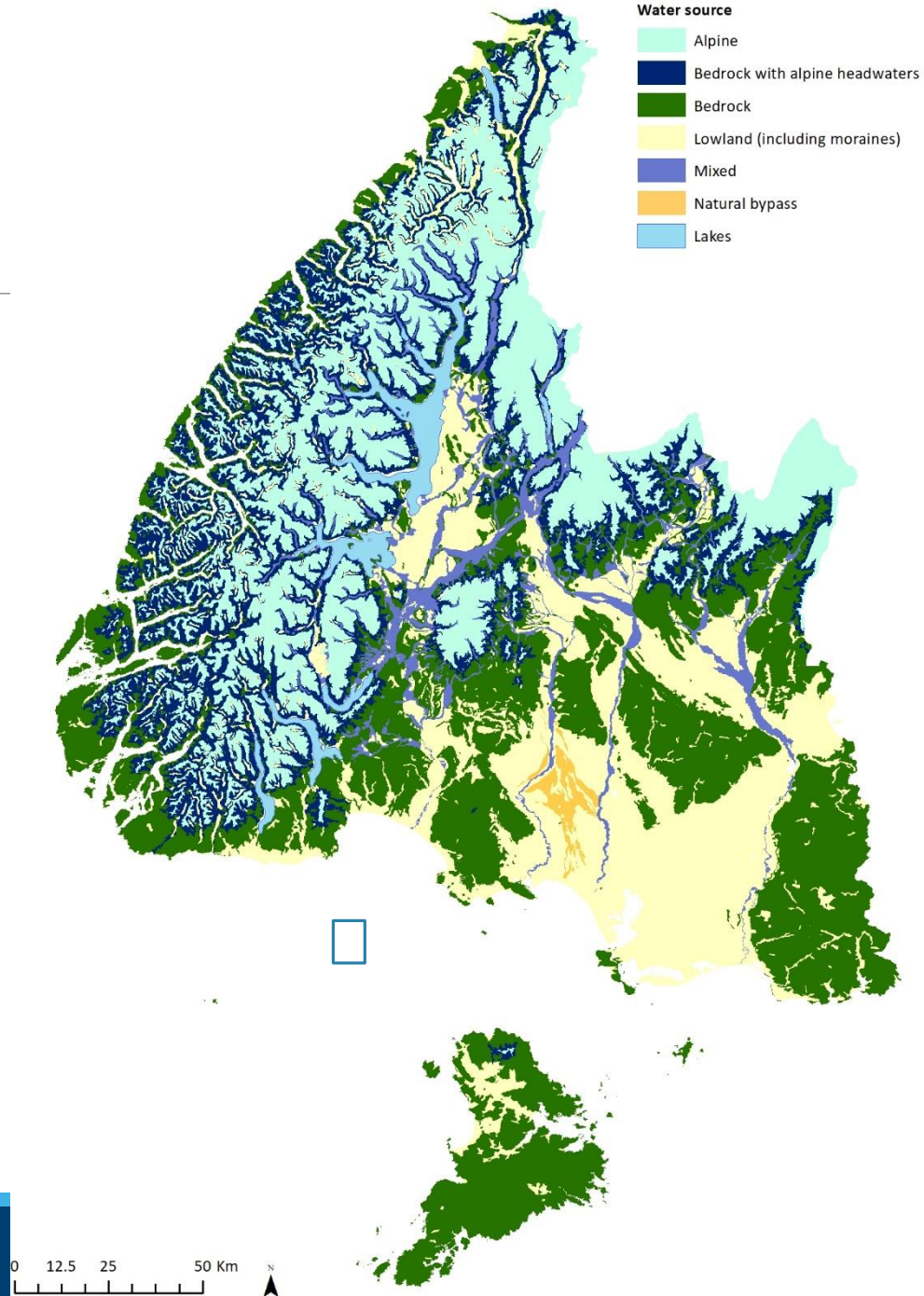
Hydrological Process-Attribute Layer (H-PAL)

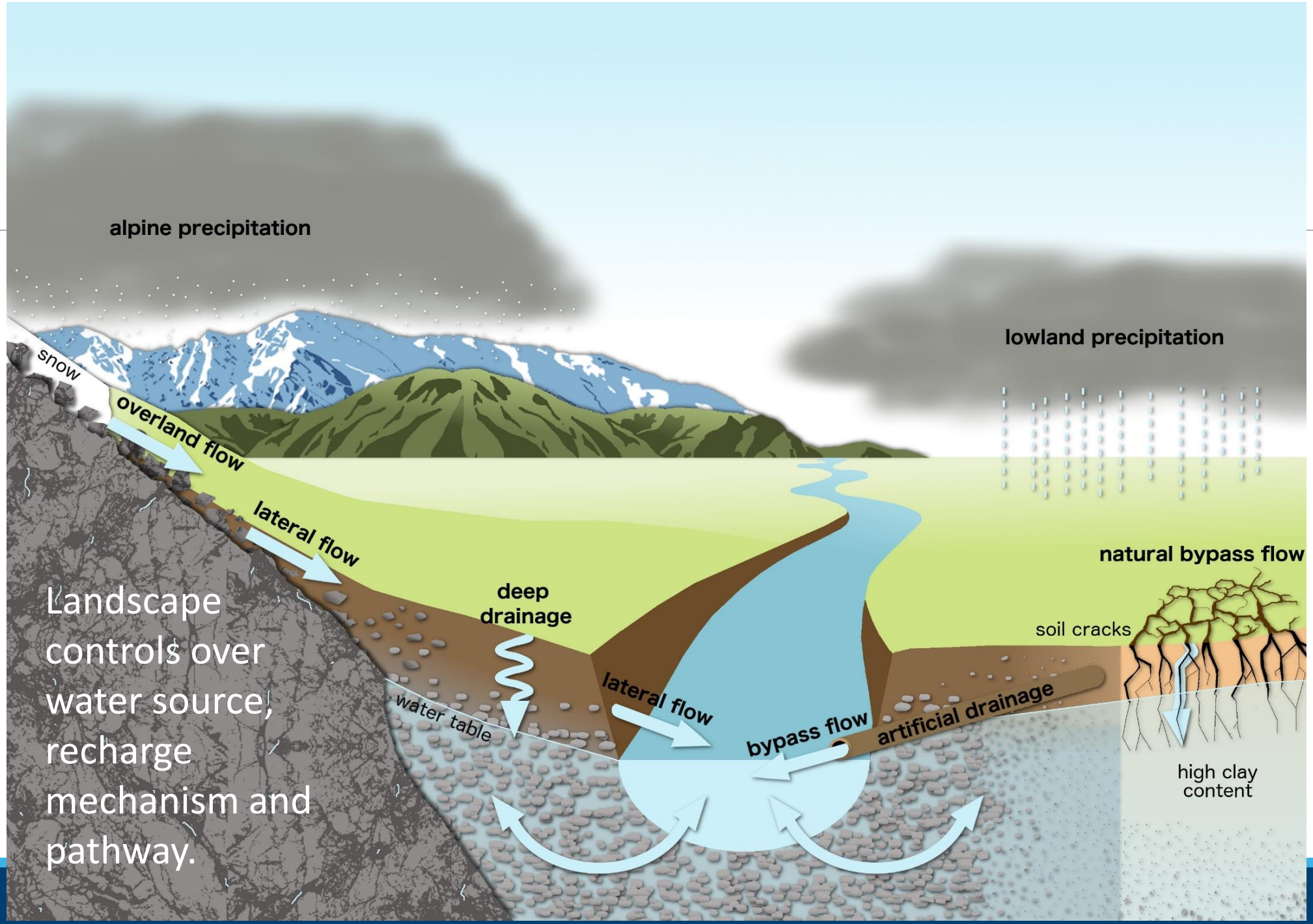


Water Source & Recharge Mechanism

(Regional Scale)

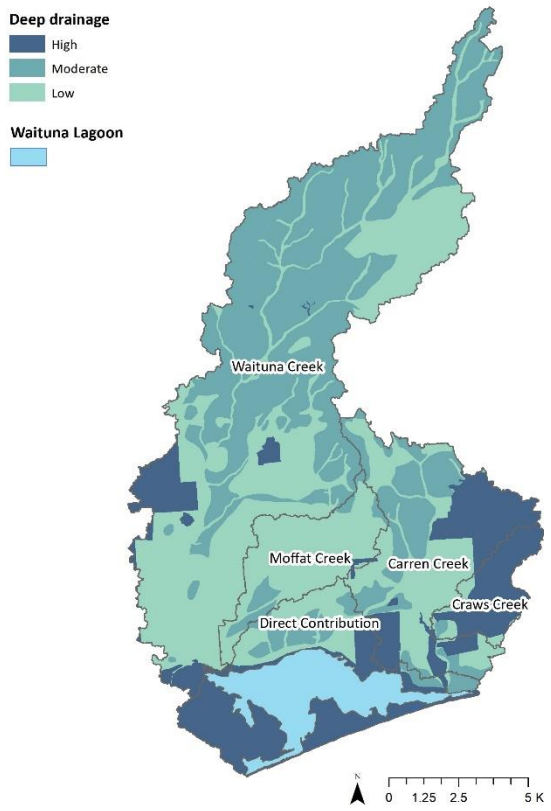
- Altitude of water source
- Recharge flux
- Dilution potential
- Transport mechanism

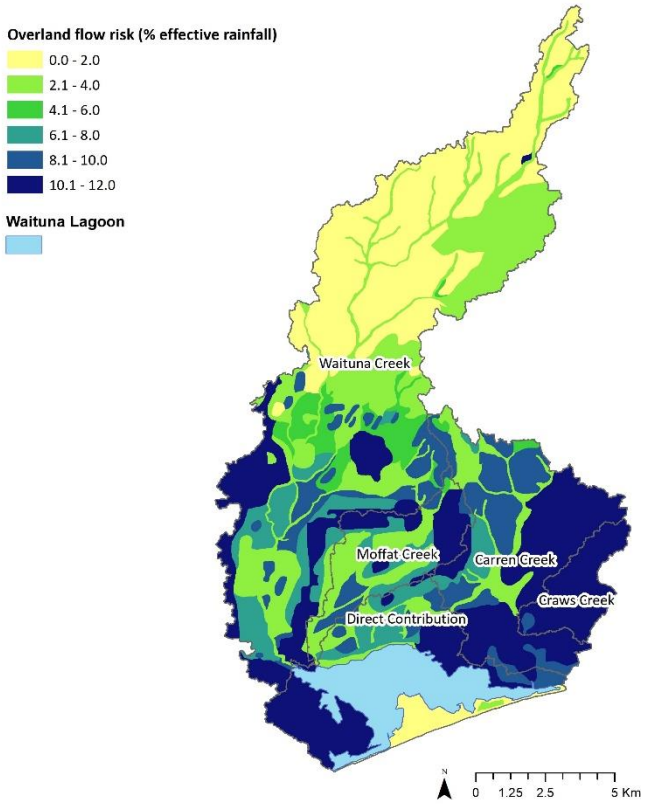


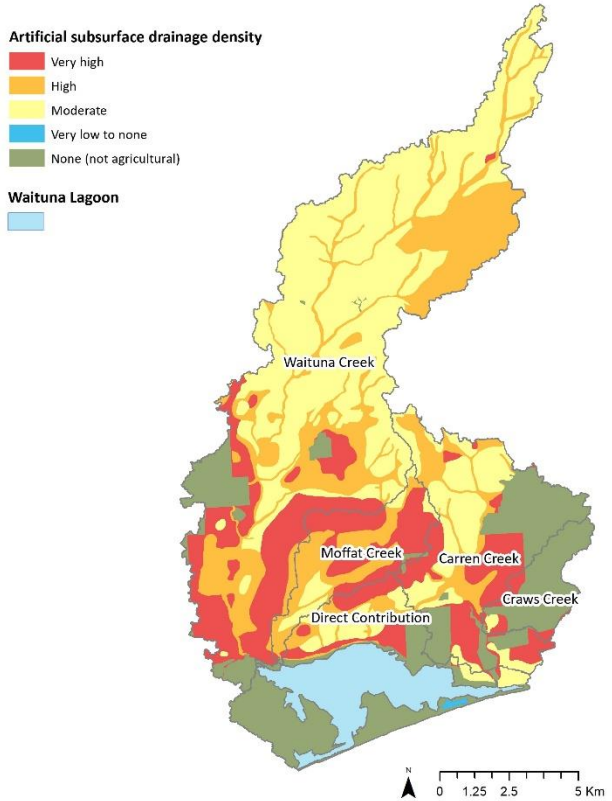


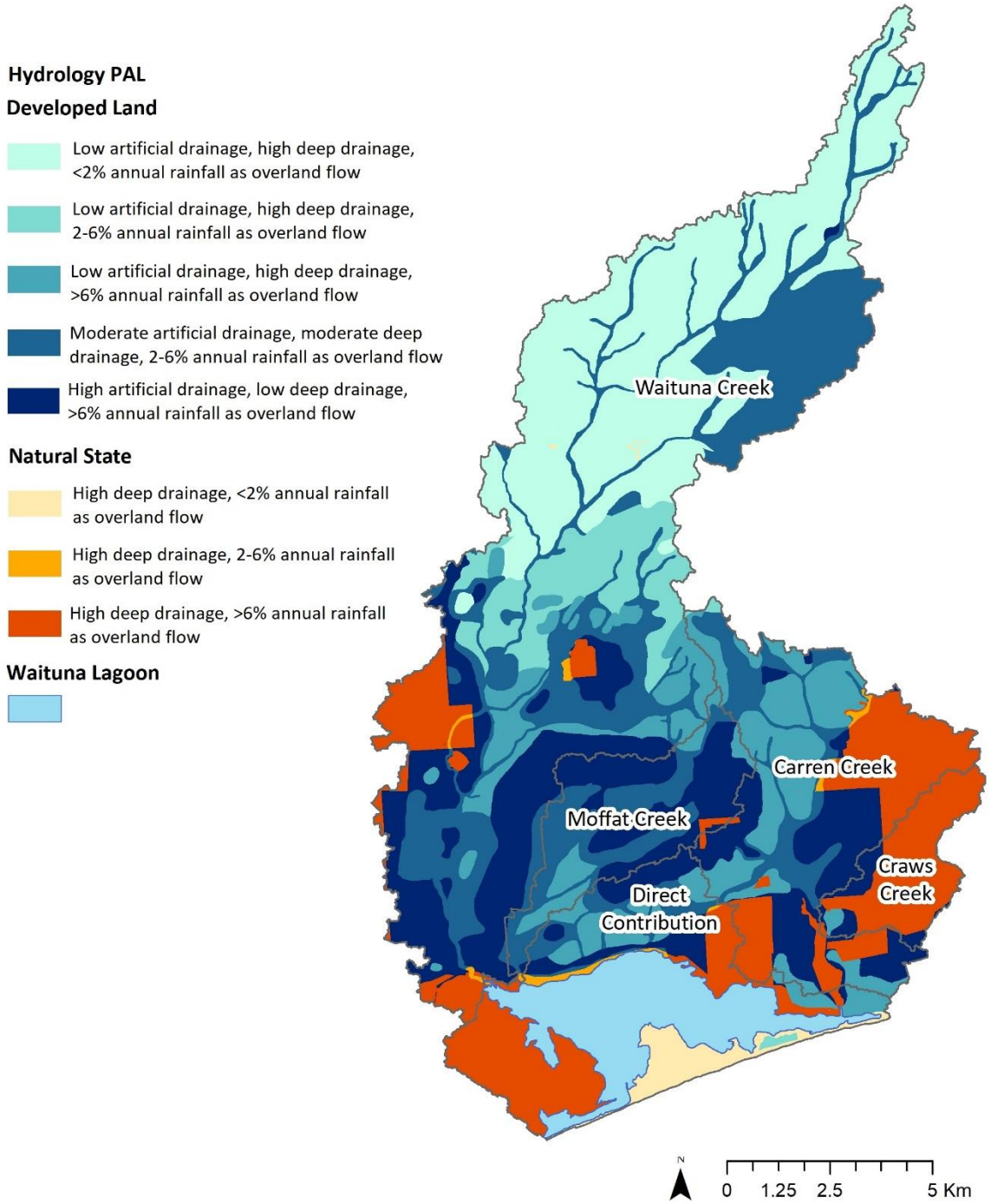
Landscape controls over water source, recharge mechanism and pathway.

Water Pathway (Catchment to Farm scale)



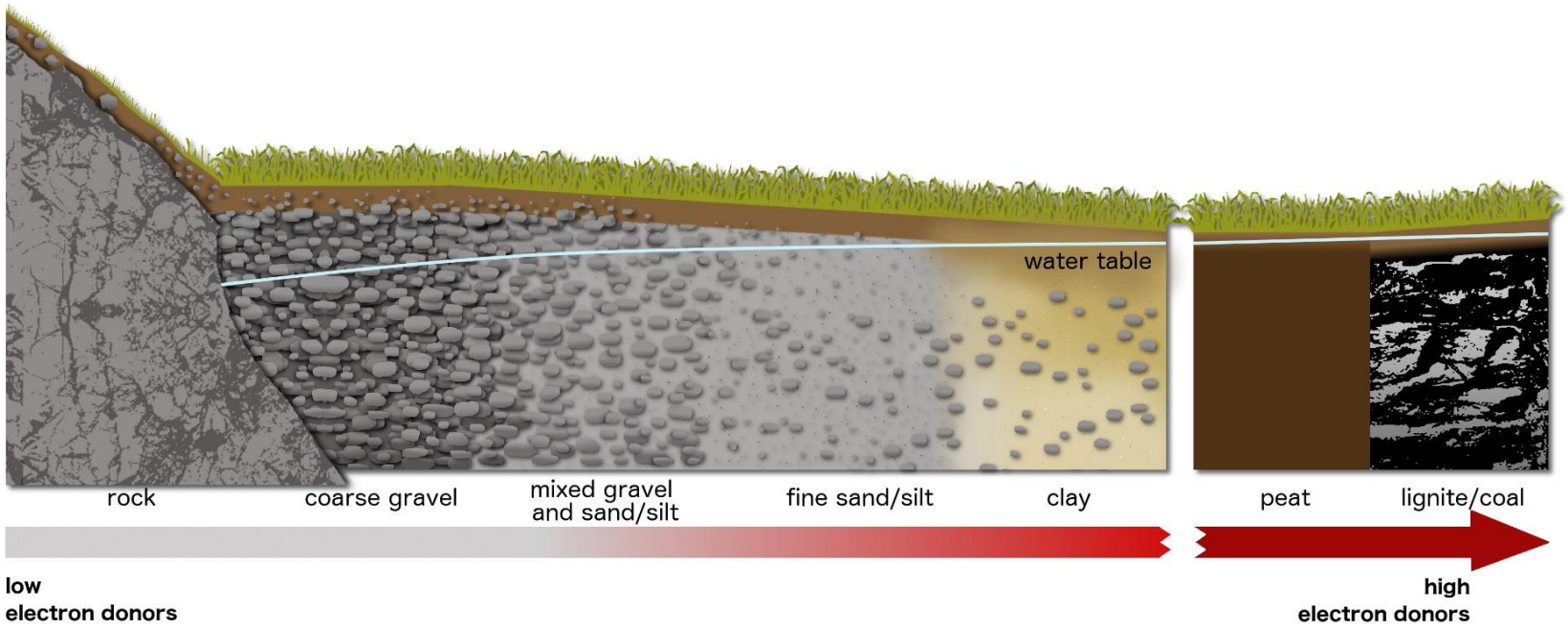





Hydrology PAL
Developed Land
Low artificial drainage, high deep drainage, <2% annual rainfall as overland flow
Low artificial drainage, high deep drainage, 2-6% annual rainfall as overland flow
Low artificial drainage, high deep drainage, >6% annual rainfall as overland flow
Moderate artificial drainage, moderate deep drainage, 2-6% annual rainfall as overland flow
High artificial drainage, low deep drainage, >6% annual rainfall as overland flow
Natural State
High deep drainage, <2% annual rainfall as overland flow
High deep drainage, 2-6% annual rainfall as overland flow
High deep drainage, >6% annual rainfall as overland flow
Waituna Lagoon
Waituna Creek
Carren Creek
Moffat Creek
Craws Creek
Direct Contribution
N
0 1.25 2.5 5 Km

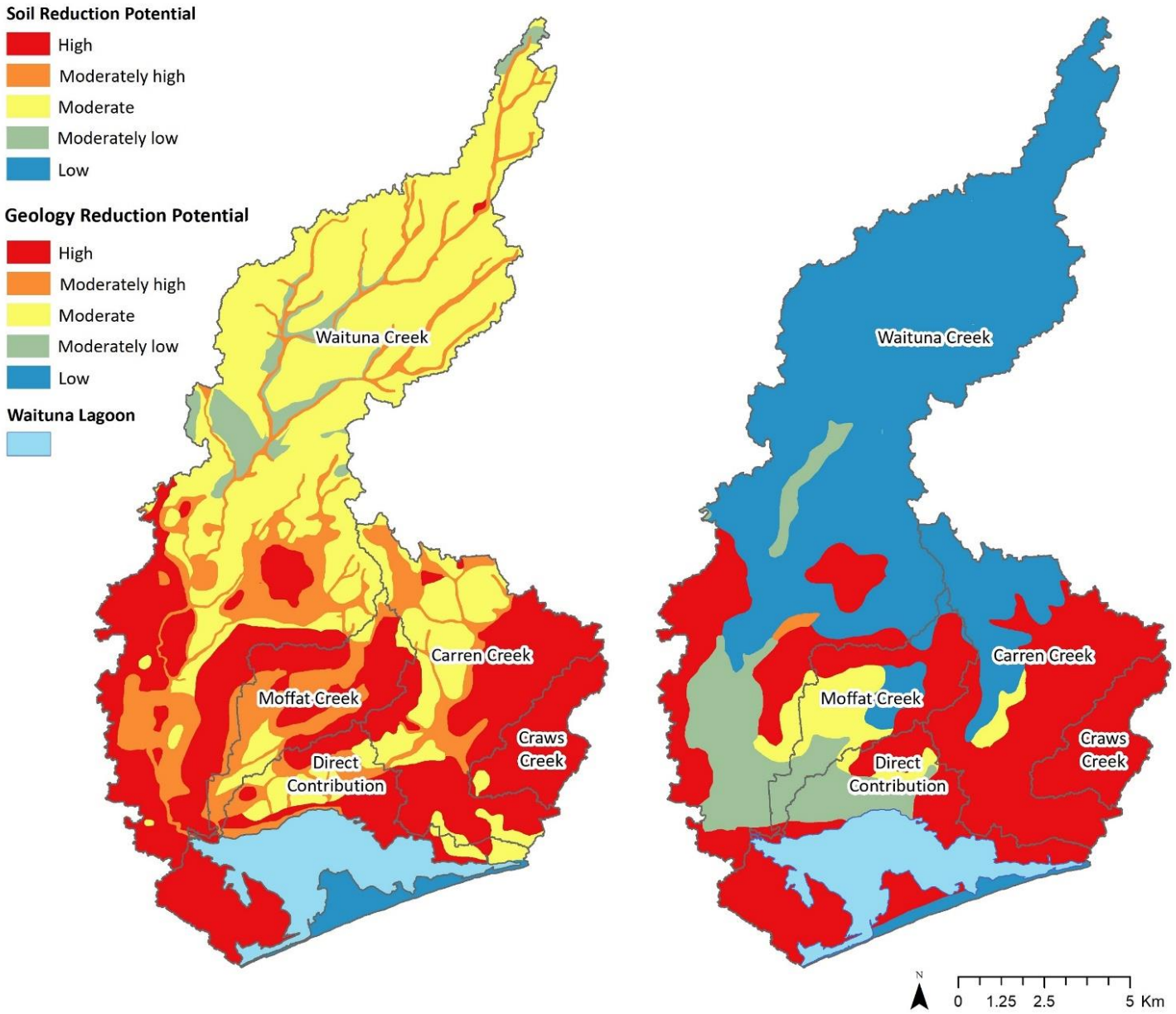
Redox Process-Attribute Layer (R-PAL)

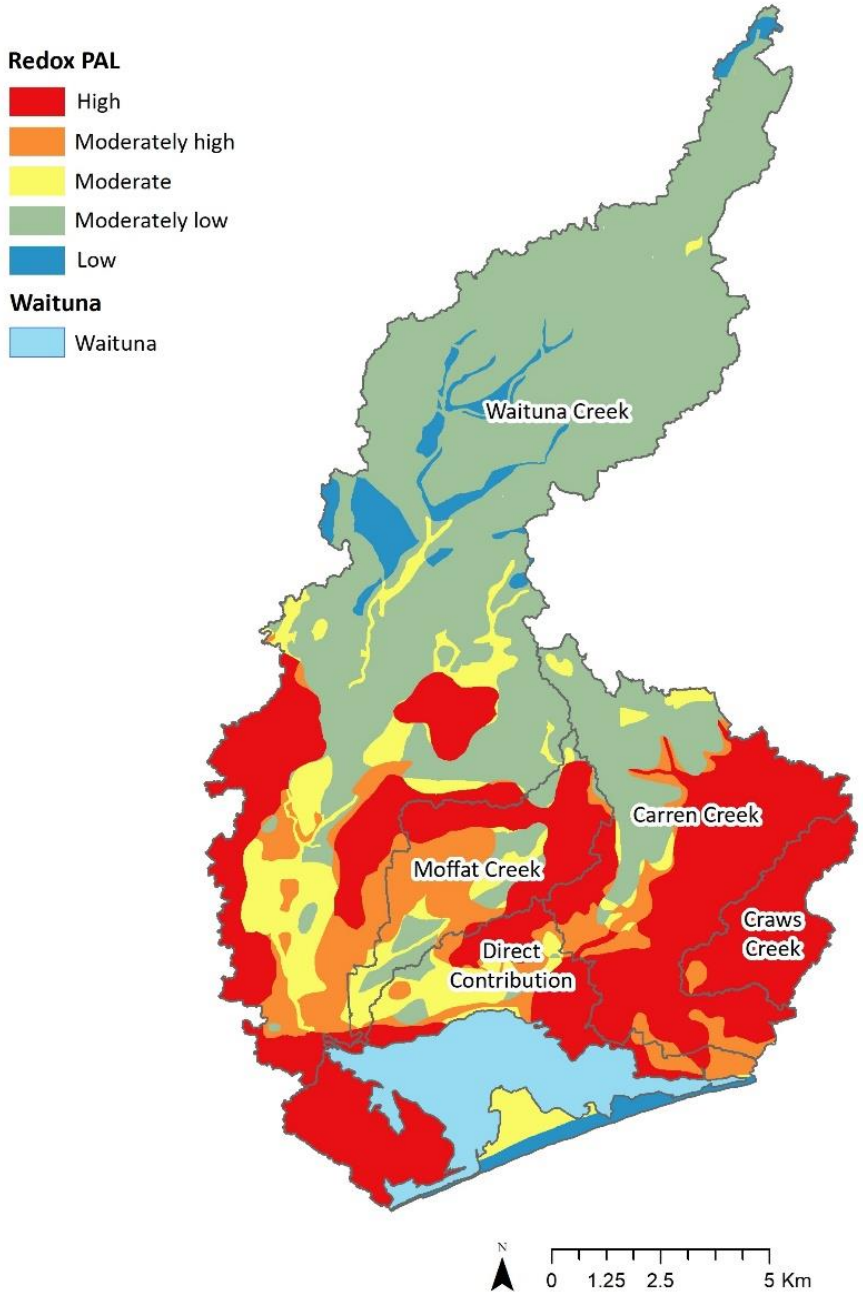
Soil and aquifer reduction potential controls denitrification, the solubility, leachability and mobility of redox sensitive species



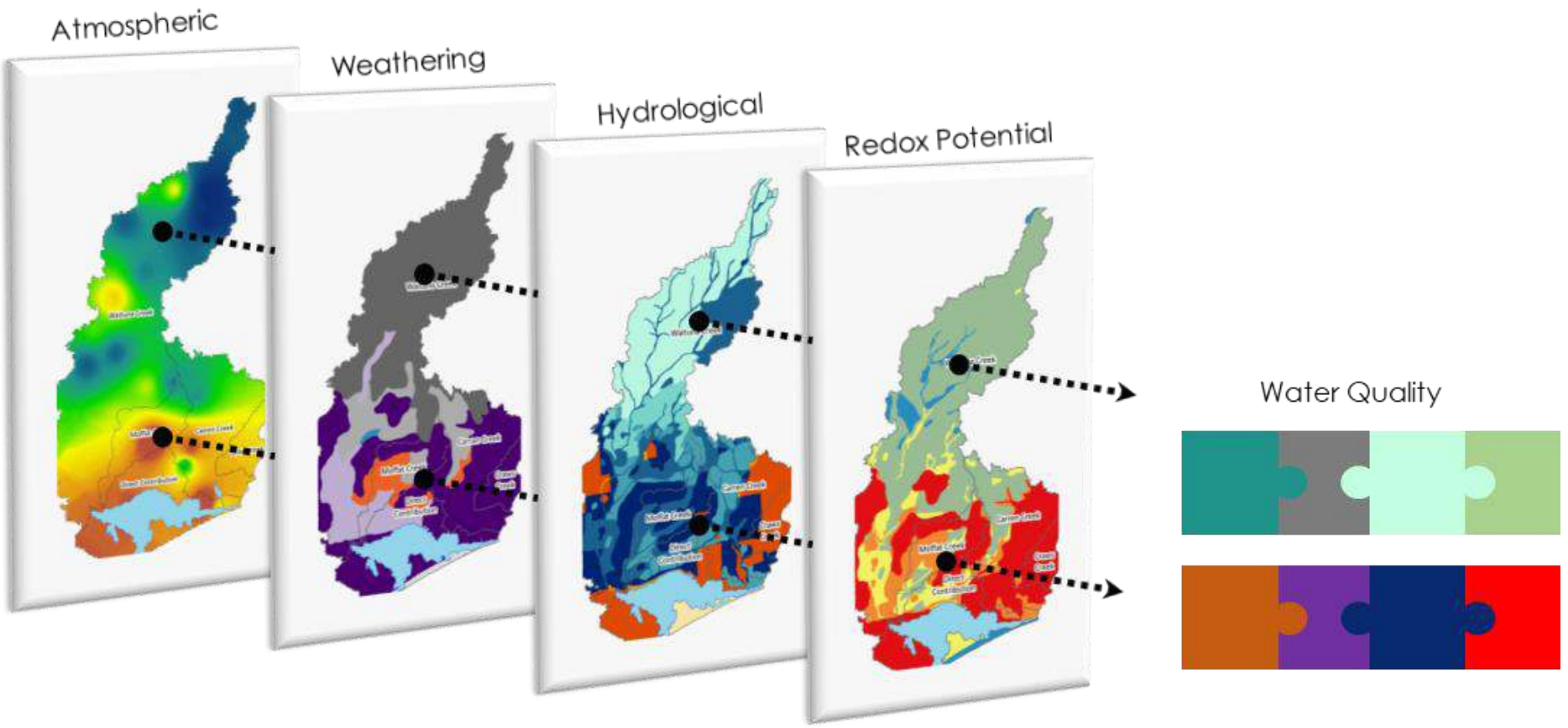
Redox PAL

- Soil zone
- Aquifer




Redox PAL
High
Moderately high
Moderate
Moderately low
Low
Waituna
Waituna
Waituna Creek
Carren Creek
Moffat Creek
Craws Creek
Direct Contribution
N
0 1.25 2.5 5 Km

Process Attribute Layer Integration



Fundamental Landscape Units

Wetland Complex

- Peat soils and geology
- Peat soils over mixed alluvial deposits and peat
- Peat soils over alluvial gravels

Lignite

- Peat soils over lignite
- Gley soils over lignite
- Podzol soils over lignite

Marine Terrace

- Peat soils over marine terraces
- Gley soils over marine terraces
- Podzol soils over marine terraces

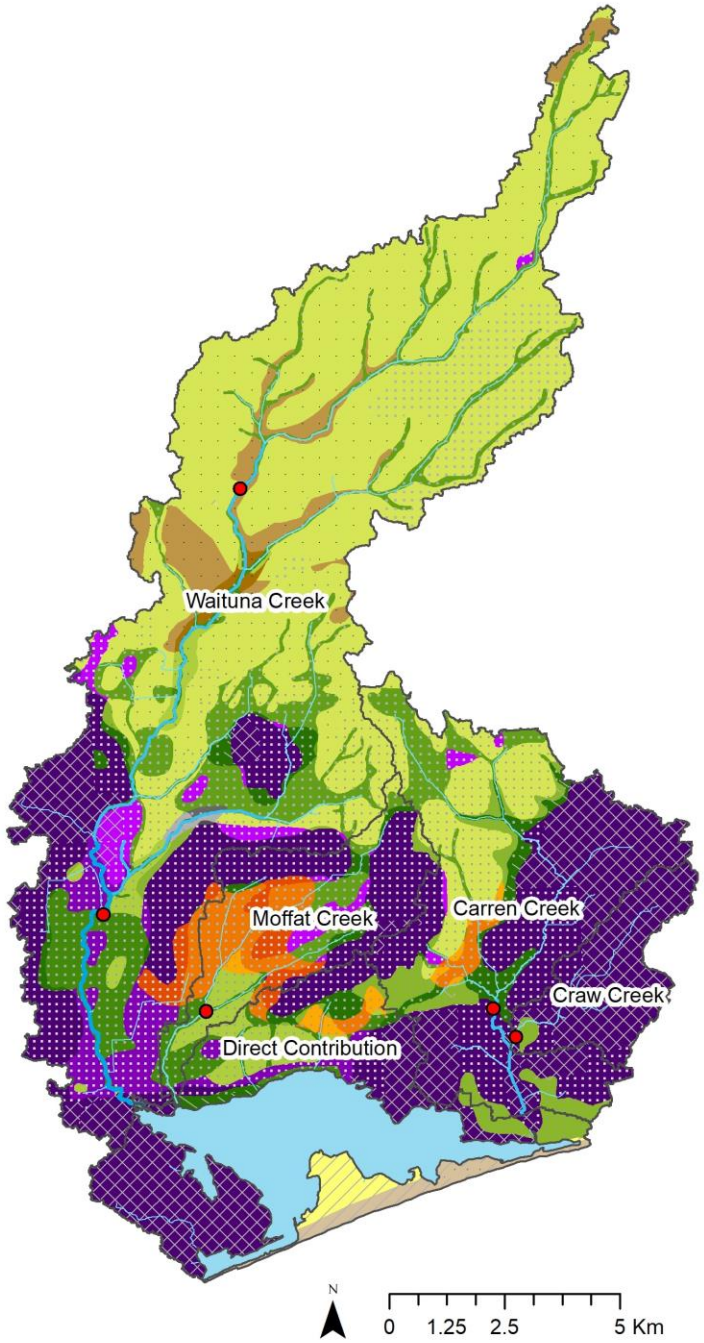
Reducing

- Gley soils over peat
- Gley soils over mixed alluvial deposits and peat
- Gley soils over alluvial terraces (Kamahi and Waikiwi)
- Podzol/Brown soils over peat
- Podzol/Brown soils over mixed alluvial deposits and peat
- Podzol/Brown soils over alluvial terraces (Kamahi and Waikiwi)
- Recent soils over peat

Oxidising

- Brown soils over alluvial gravels
- Brown soils over alluvial terraces (Kamahi Formation)
- Recent soil over beach sands and gravel

Waituna Lagoon



Hydrology

Flow pathways

Natural State

- High deep drainage, <2% annual rainfall as overland flow
- High deep drainage, 2-6% annual rainfall as overland flow
- High deep drainage, >6% annual rainfall as overland flow

Developed Land

- Low artificial drainage, high deep drainage, <2% annual rainfall as overland flow
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- Low artificial drainage, high deep drainage, >6% annual rainfall as overland flow
- Moderate artificial drainage, moderate deep drainage, 2-6% annual rainfall as overland flow
- High artificial drainage, low deep drainage, >6% annual rainfall as overland flow

Stream Order

- 4
- 5
- 6
- 7

Water quality monitoring site

- Surface water

LIVING WATER

Fonterra Dairy for life | Department of Conservation Te Papa Atawbai

WORKING TOGETHER TO CARE FOR FIVE KEY CATCHMENTS

Summary

- Physiographics explain the **HOW** and **WHY** water quality varies, given often similar land use intensities.
- Map for water – conceptual model
- Application for practical farm advice that can be targeted to landscape processes.
- Provides context for existing numerical models
- More than just water quality!

Acknowledgements

- **Living Water** – Fonterra and Department of Conservation
- **Our Land and Water**
- **Physiographics of Southland**

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WORKING TOGETHER TO CARE FOR FIVE KEY CATCHMENTS

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Landcare Research Manaaki Whenua Dr Allan Hewitt Trevor Webb	agresearch Dr Ross Monaghan Dr Liz Wedderburn	 Dr Clint Rissmann Dr Monique Beyer	DairyNZ Dr Mike Scarsbrook	NIWA Taihoro Nukurangi Dr Clive Howard-Williams
LANDPRO Karen Wilson	***Land Water People*** Brydon Hughes Dr Ton Snelder	environment SOUTHLAND Dr Abbas Akbaripasand James Dare Dr Tim Ellis Roger Hodson Lawrence Kees Michael Killick Darren May Jane McMecking Rachael Millar Dr Lisa Pearson Ewen Rodway Nick Ward	***Future by Design*** Dr Maggie Lawton	GNS Science Dr Troy Baisden Dr Chris Daughney Dr Cath Moore
SciArt Janet Hodgetts	***Envirolink Coordinator*** Bill Dyck		***Independent Consultants*** Dr Vince Bidwell Dr Tapuwa Marapawa	E/S/R Dr Murray Close Dr Cath Moore
Laurentian University Université Laurentienne Dr Matthew Leybourne	UBC The University of British Columbia Prof. Hans Schreier	Lincoln University Associate Professor Peter Almond	Massey University Dr Ranvir Singh	UC University of Canterbury Prof. Jenny Webster-Brown Dr Travis Horton