WAIRAKEI
ESTATE

Block 1 Evidence - Plan Change 1

Figure 1 - Location of the Ruahuwai Sub-Catchment

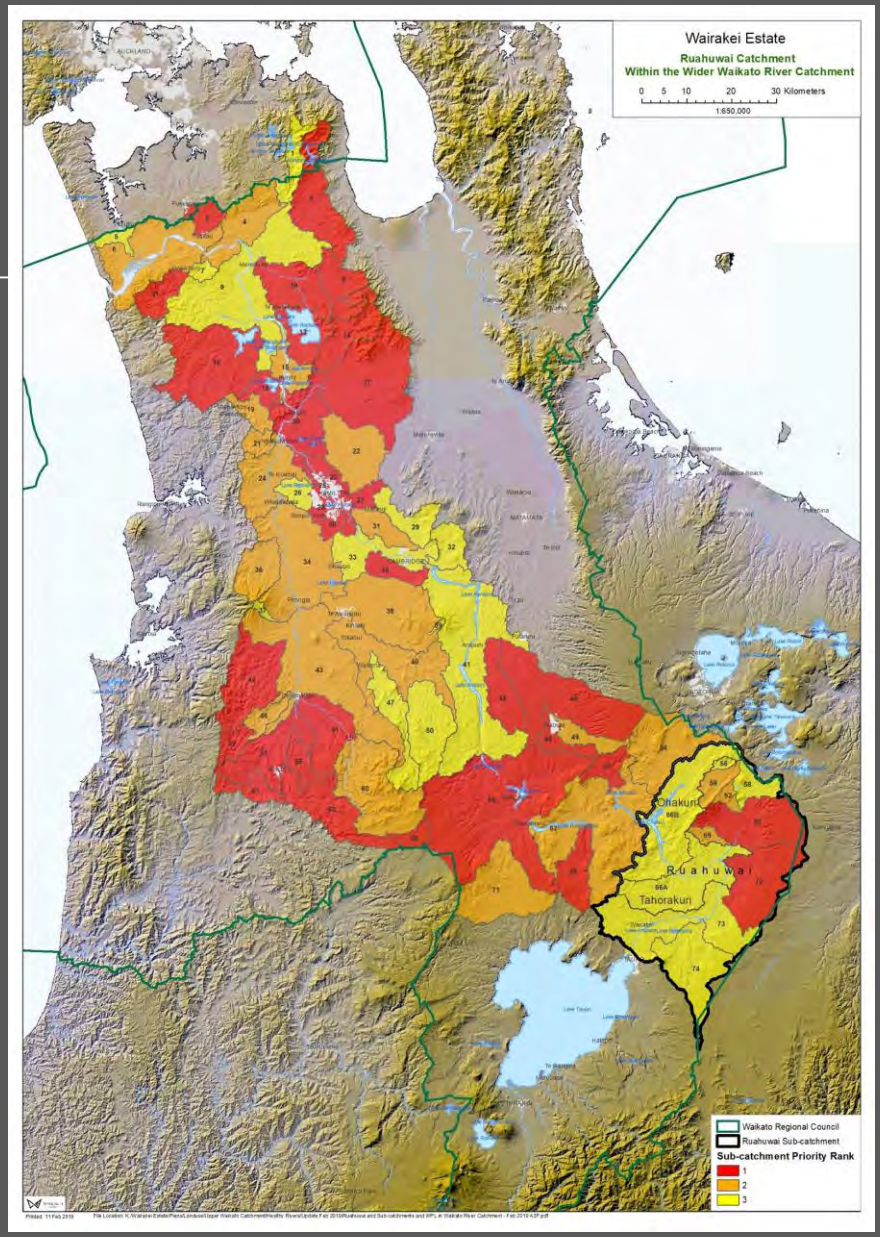


Figure 2 - Location of Estate

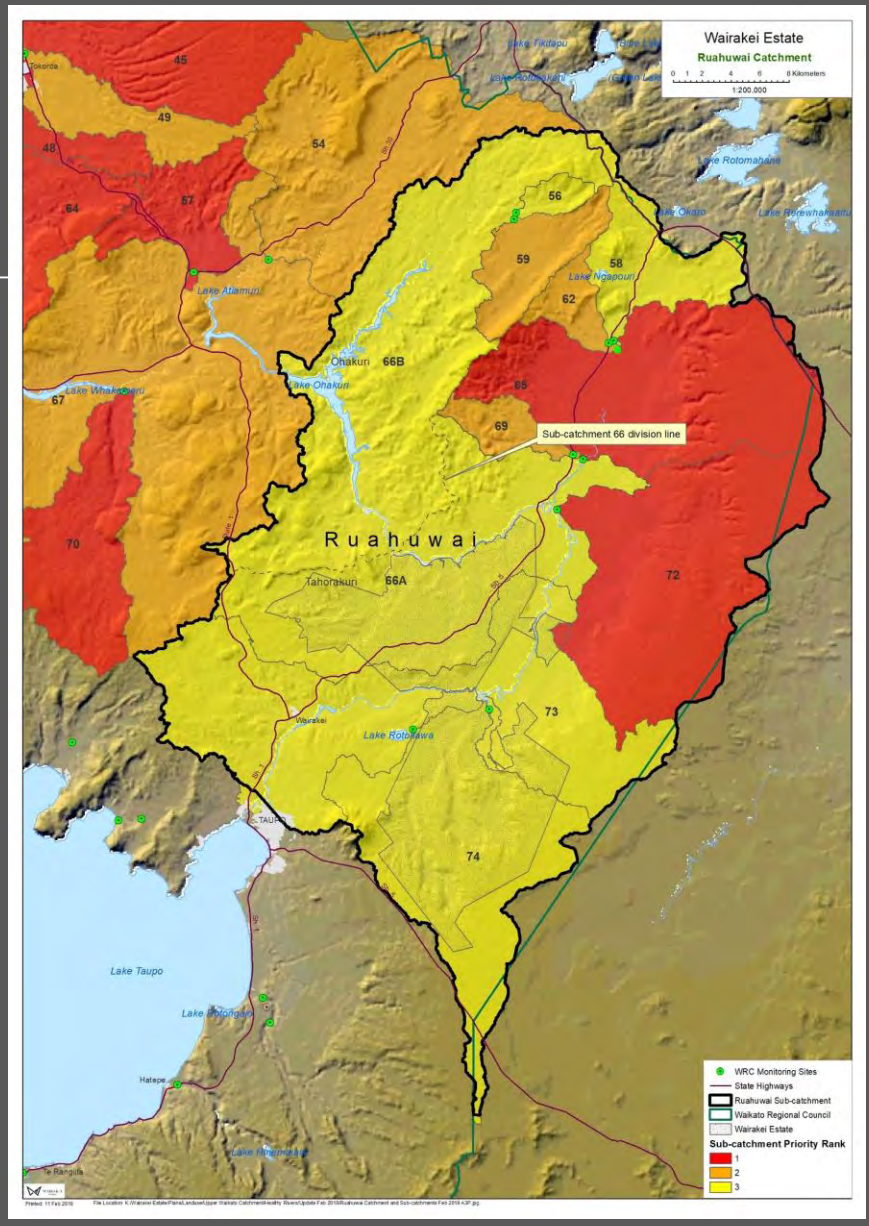


Figure 8 : Overlay of WPL's mitigation Protocol 4 (Bunds) installed at 2018

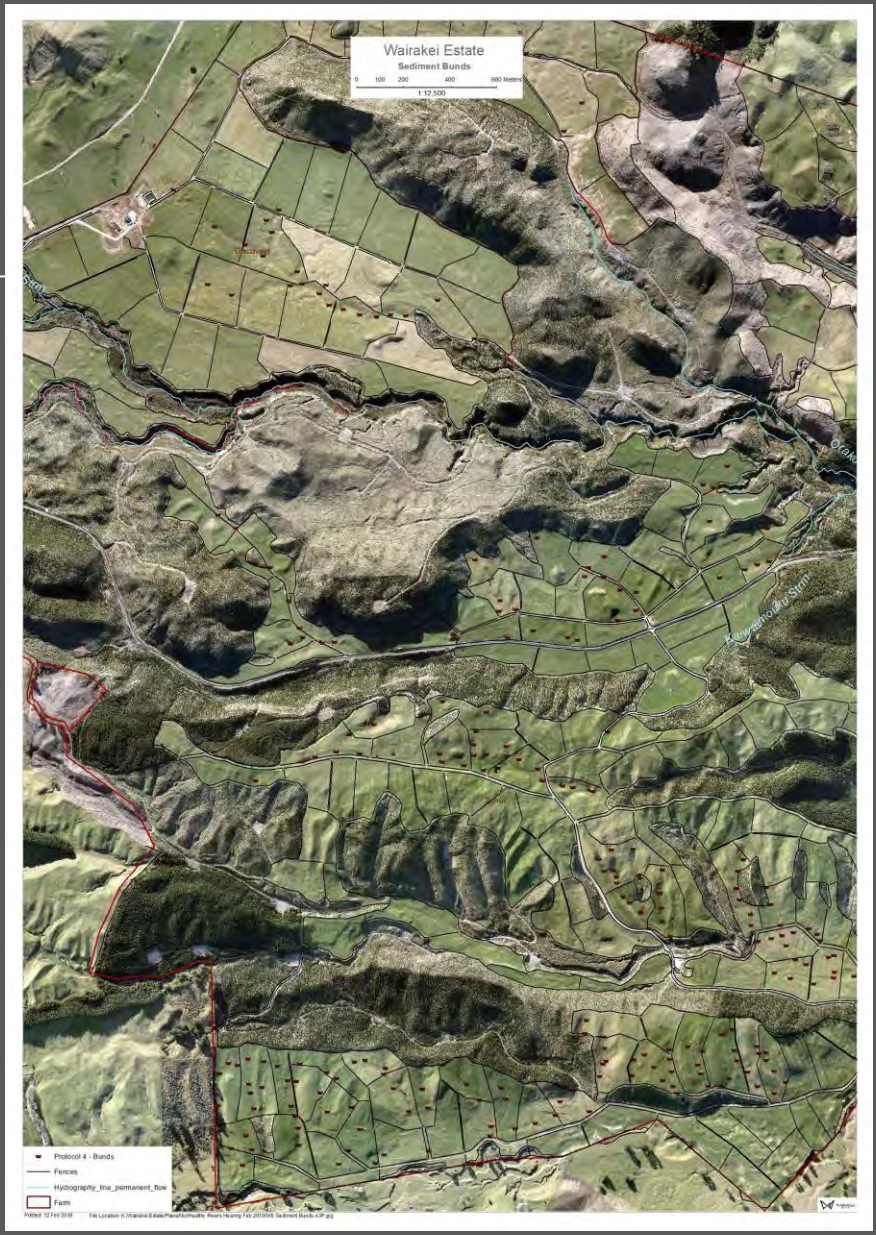


Figure 9 : Overlay of WPL's mitigation Protocols 2 and 3 (Erosion Prone Land and Gulley Protection)

Figure 10 : Overlay of riparian margins under WPL's mitigation Protocol 1 (2018)

Figure 11 : Overlay of wetland areas under WPL's Protocol 5 (2018)

Dr Neale - EIC

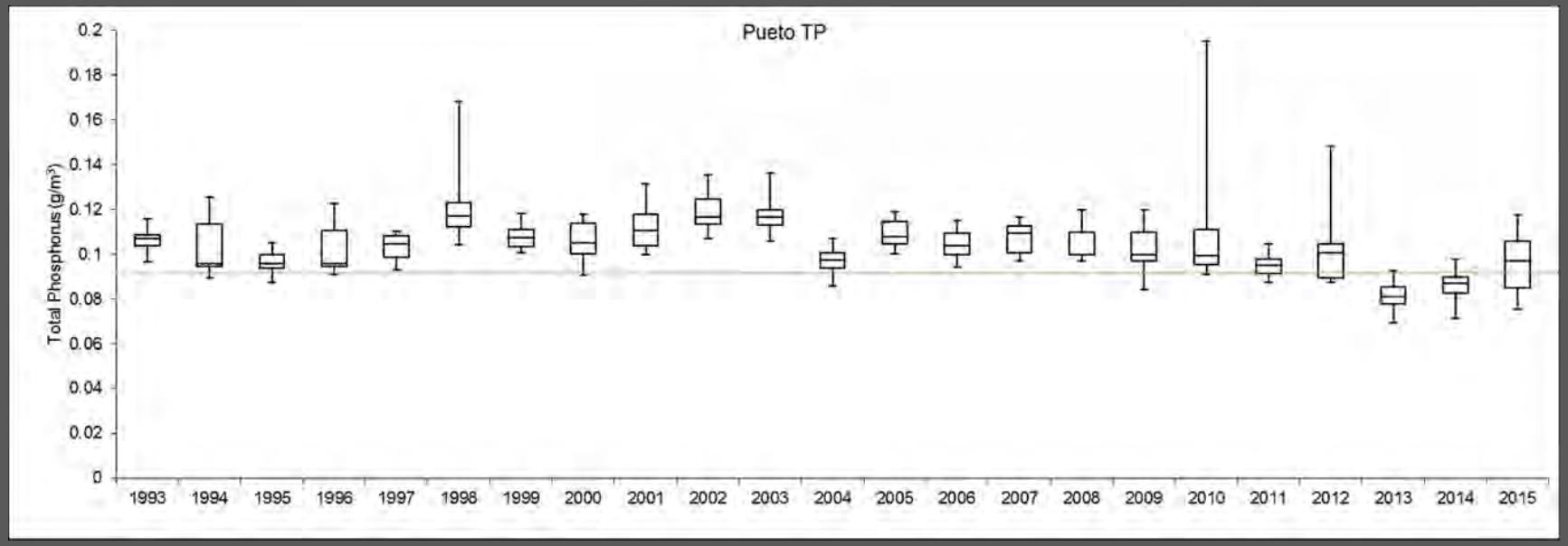
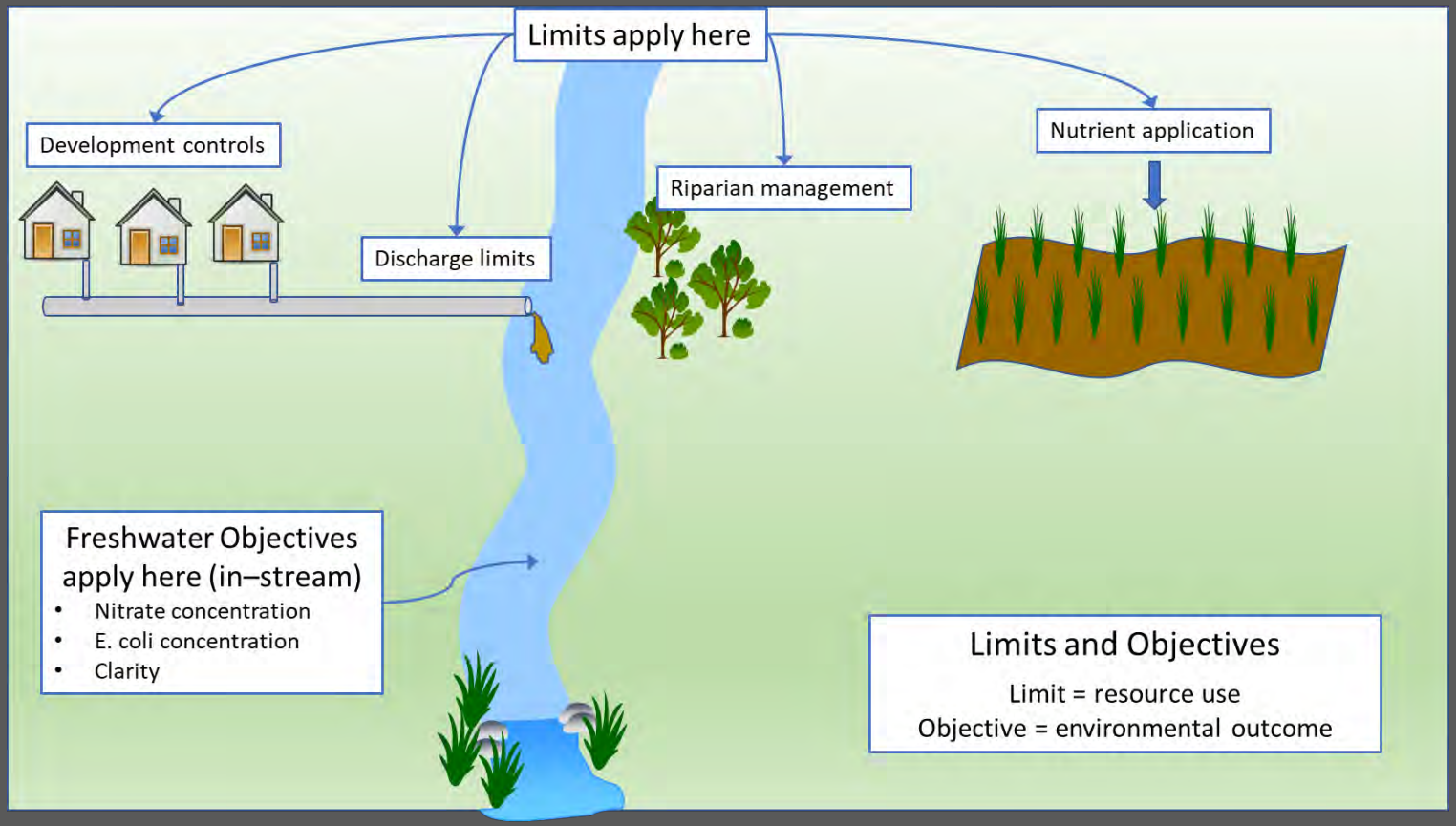


Figure 1; Long term monitoring record for total phosphorus (TP) in the Pueto Stream. The green line is the current state based on monitoring data collected between 2010 and 2014.

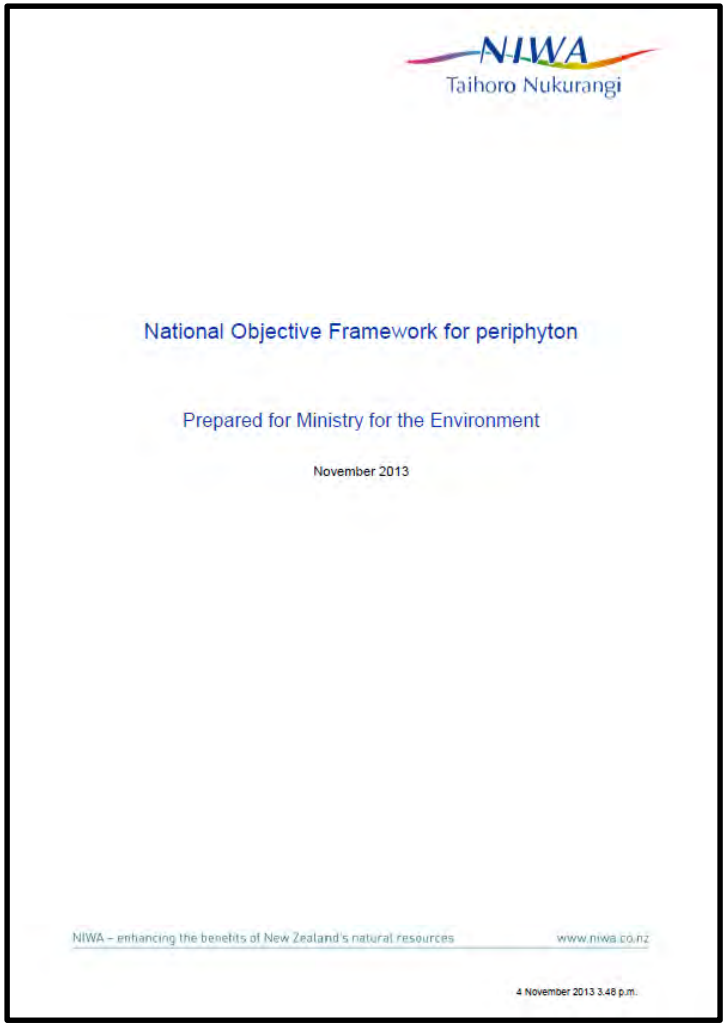
Objectives and limits (targets)



Periphyton attribute

NOF Periphyton Panel

- Attribute supported by NIWA Technical Report


NIWA
Taihoro Nukurangi

National Objective Framework for periphyton

Prepared for Ministry for the Environment

November 2013

NIWA – enhancing the benefits of New Zealand's natural resources www.niwa.co.nz

4 November 2013 3.48 p.m.

Periphyton attribute

Supported by river classification

- Attribute state associated with river type
- Fine (substrate) category
  - "Another important consideration in applying the proposed objective is that some streams and rivers can have fine bed material that does not support much periphyton and thus where high abundance may not be an issue"
  - It is likely that up to 26% of New Zealand's streams and rivers by length will not support conspicuous amounts of periphyton (Figure 4-1).

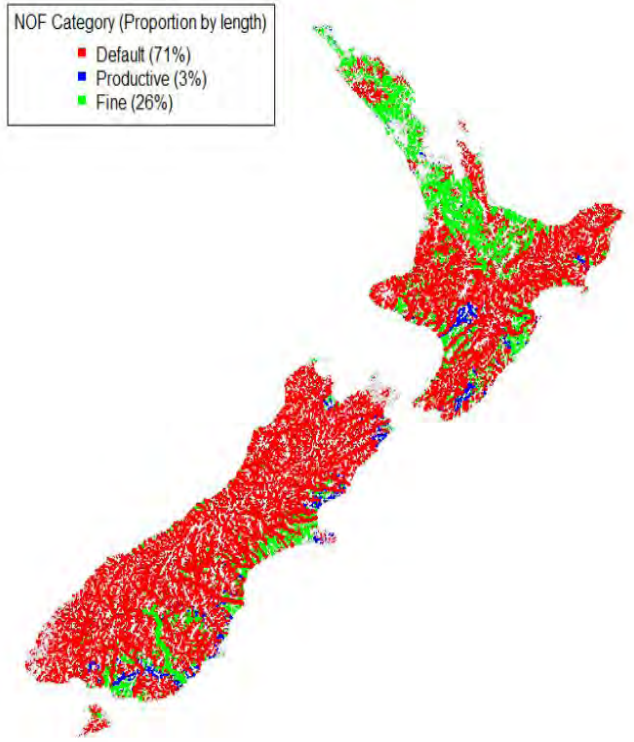


Figure 4-1: Classification of rivers and streams for NOF periphyton attribute. The Default class (red) has a proposed exceedance frequency of 1 per year; the Productive class (blue) has a proposed exceedance frequency of 2 per year. Locations that are likely to have fine substrates, which will not support conspicuous amounts of periphyton, are shown in green.

Periphyton attribute

Supported by river classification

- Attribute state associated with river type
- Fine (substrate) category
  - "Another important consideration in applying the proposed objective is that some streams and rivers can have fine bed material that does not support much periphyton and thus where high abundance may not be an issue"
  - It is likely that up to 26% of New Zealand's streams and rivers by length will not support conspicuous amounts of periphyton (Figure 4-1).

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Periphyton (Trophic state)		
Attribute Unit	mg chl-a/m² (milligrams chlorophyll-a per square metre)		
Attribute State	Numeric Attribute State (Default Class)	Numeric Attribute State (Productive Class)[1]	Narrative Attribute State
	Exceeded no more than 8% of samples[2]	Exceeded no more than 17% of samples[2]	
A	≤50	≤50	Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat.
B	>50 and ≤120	>50 and ≤120	Occasional blooms reflecting low nutrient enrichment and/ or alteration of the natural flow regime or habitat.
C	>120 and ≤200	>120 and ≤200	Periodic short-duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat.
National Bottom Line	200	200	

Figure 1 - Ecological succession of electron-accepting processes and sequential production of final products (source McMahon and Chapelle 2008)

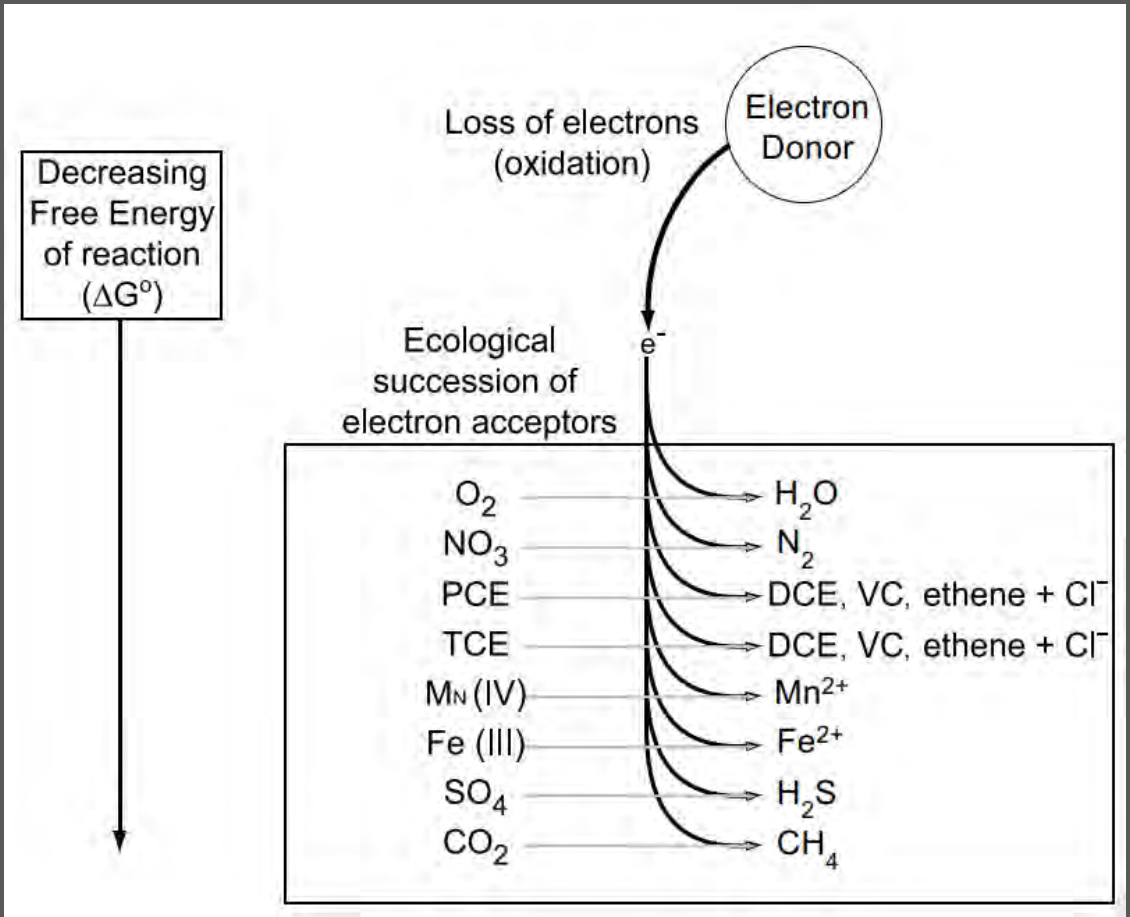


Figure 2 - Idealised cross section showing groundwater flow paths and indication of timing from recharge to discharge areas (source Focazio et al 2002)

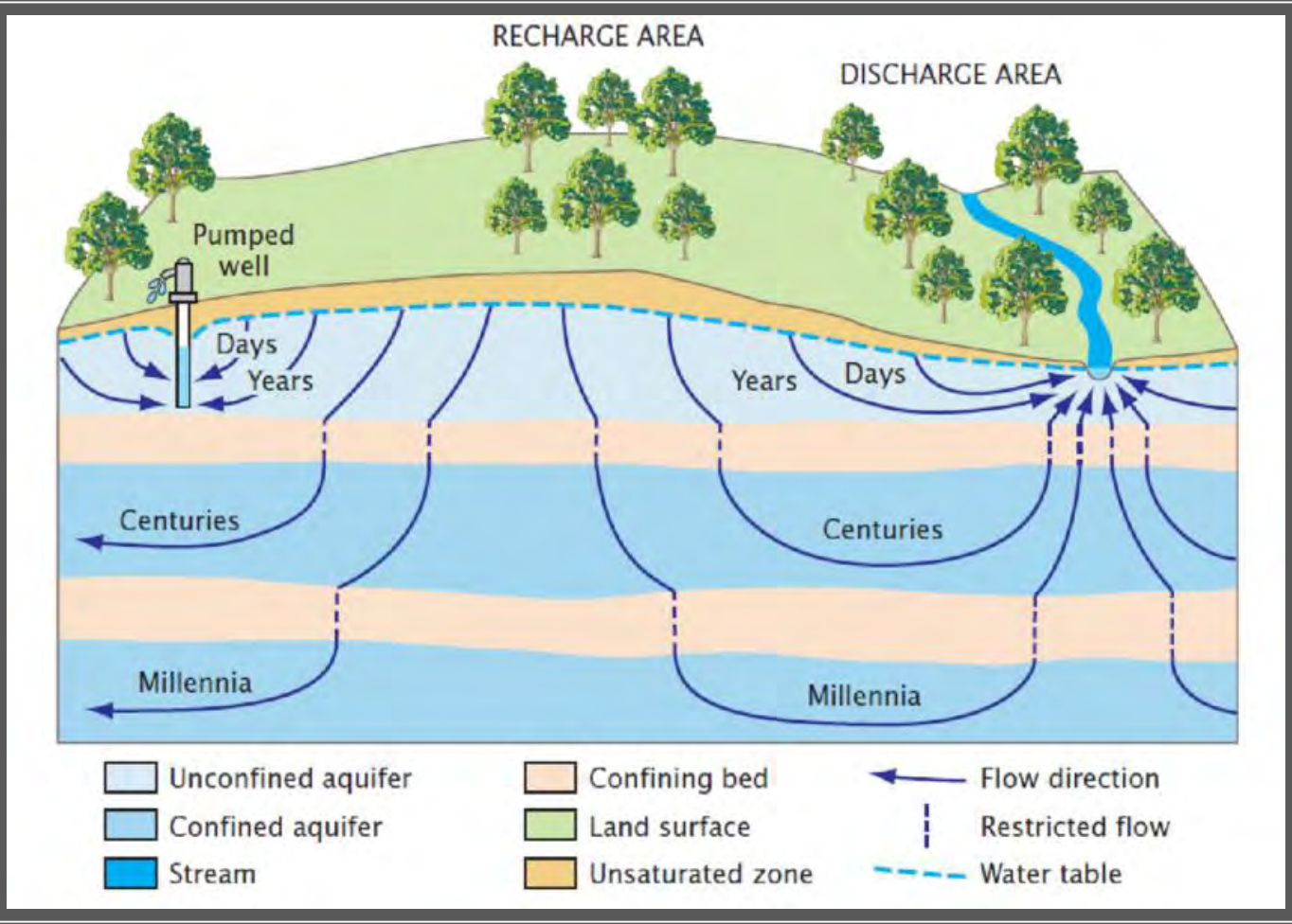


Figure 6 Idealised groundwater redox hydrogeological cross section, showing groundwater dentification through reduced zones

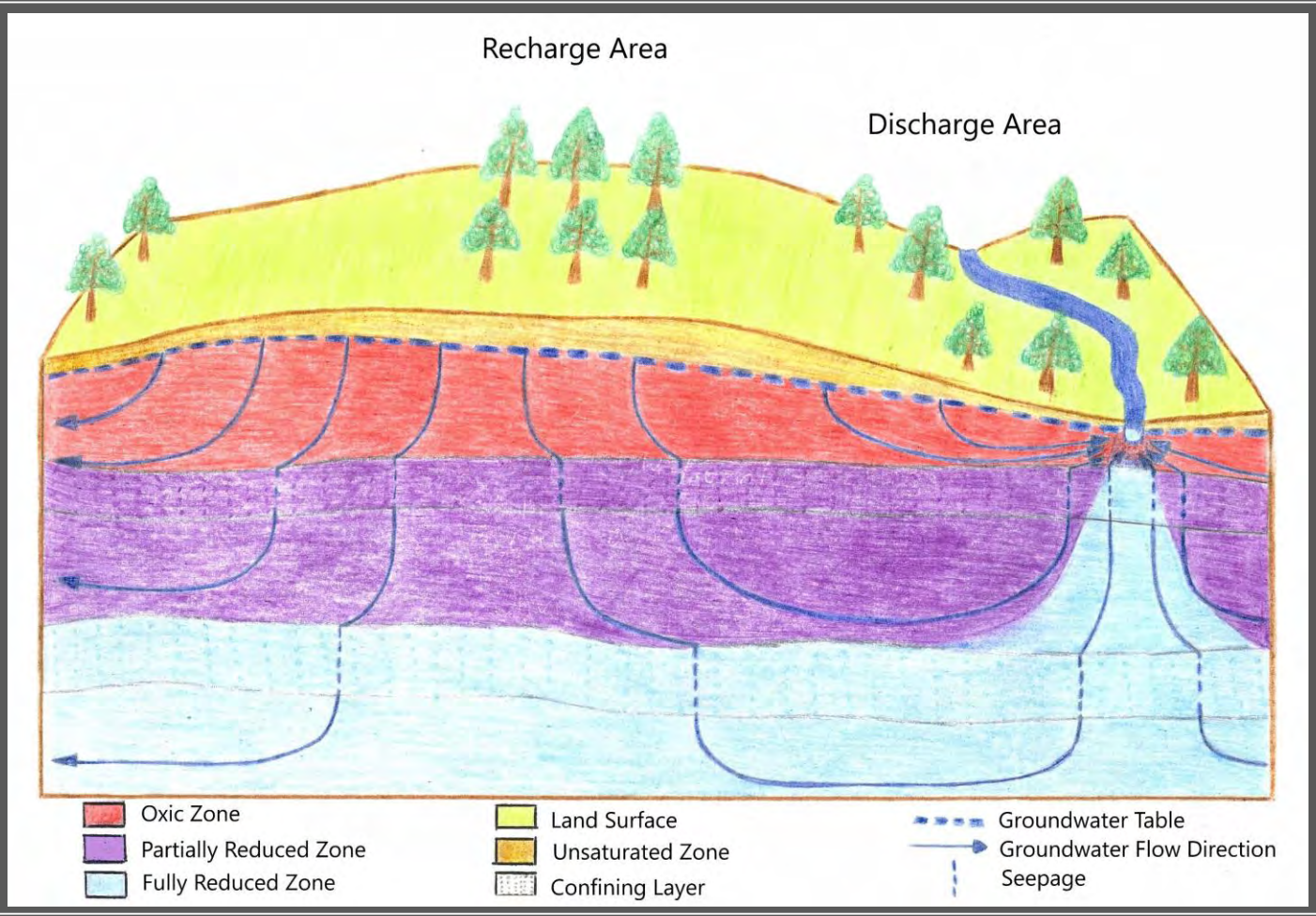


Figure 7 - Ruahuwai nitrogen source area risk map

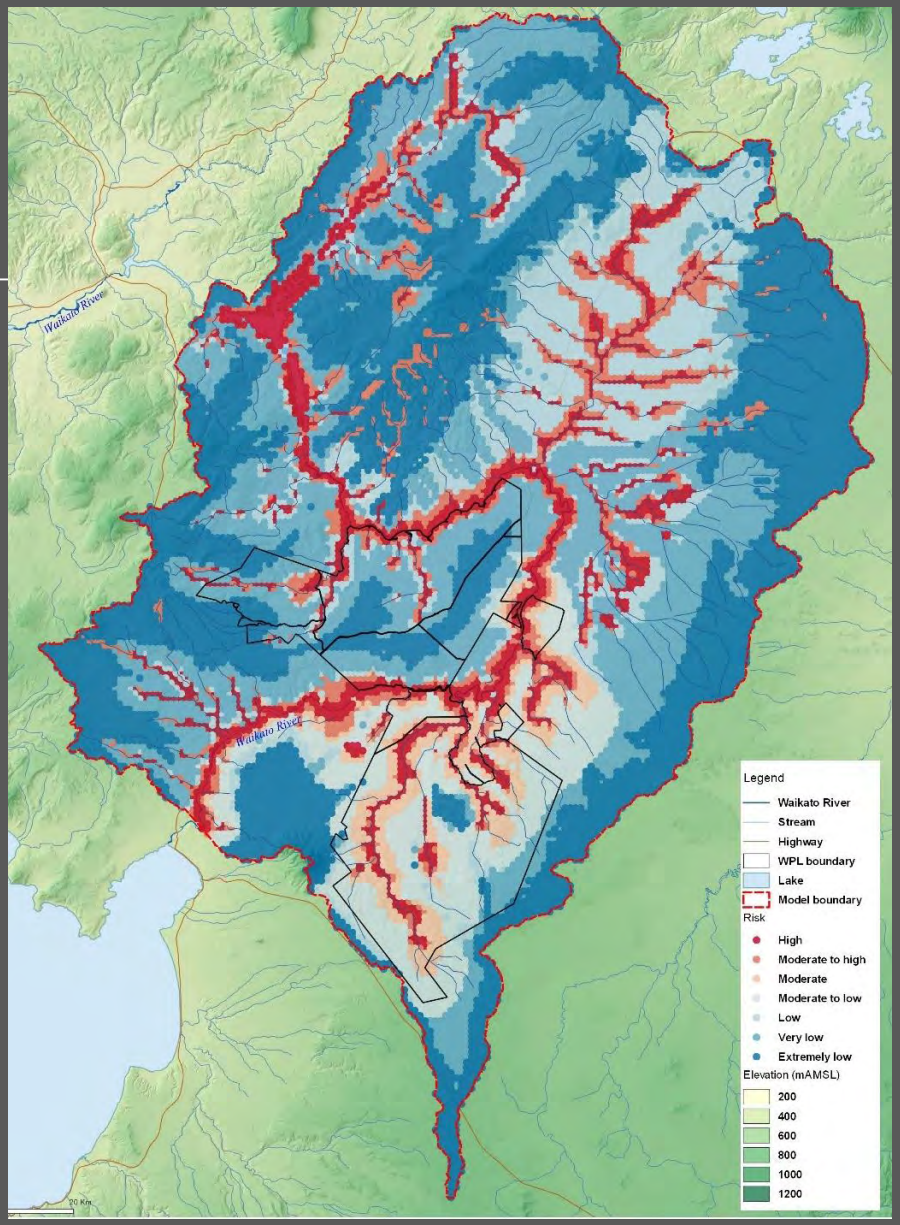
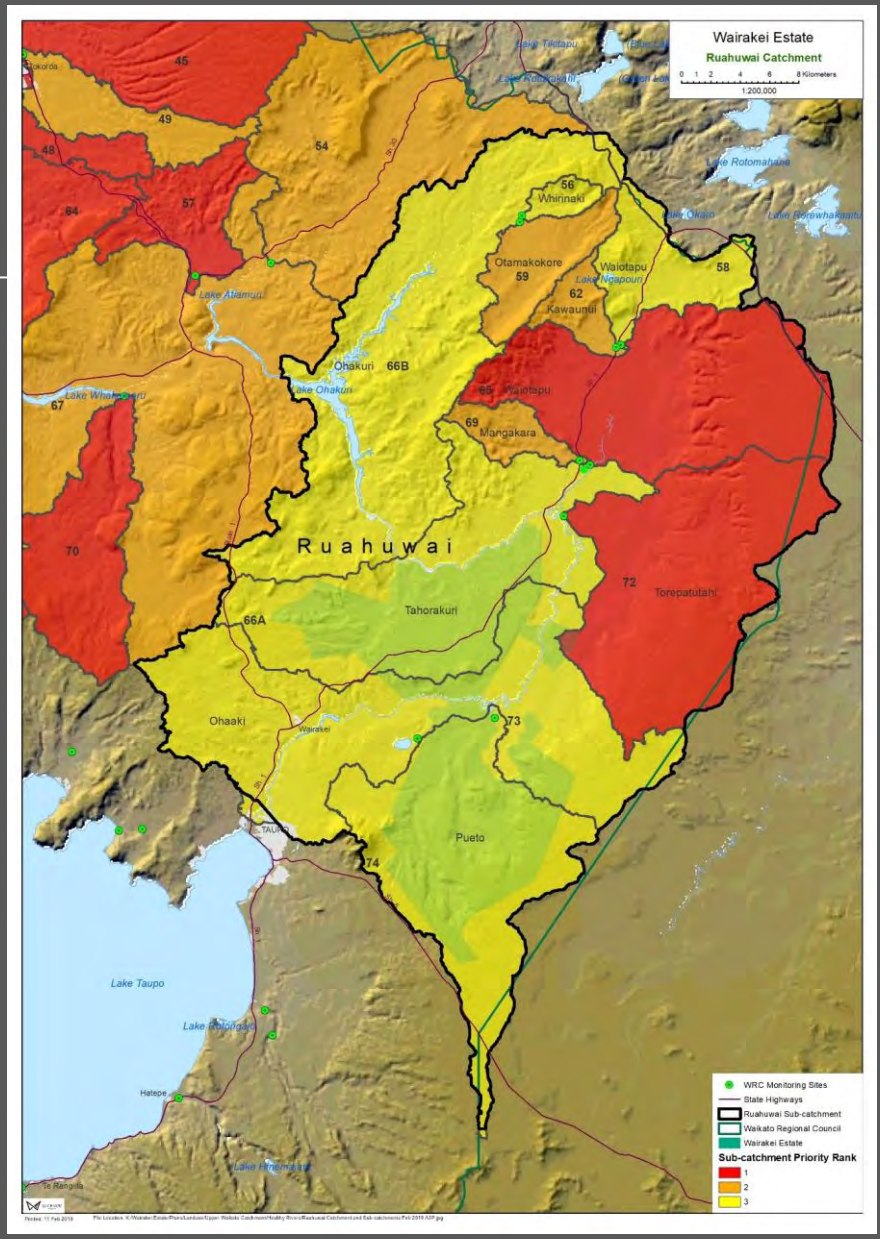
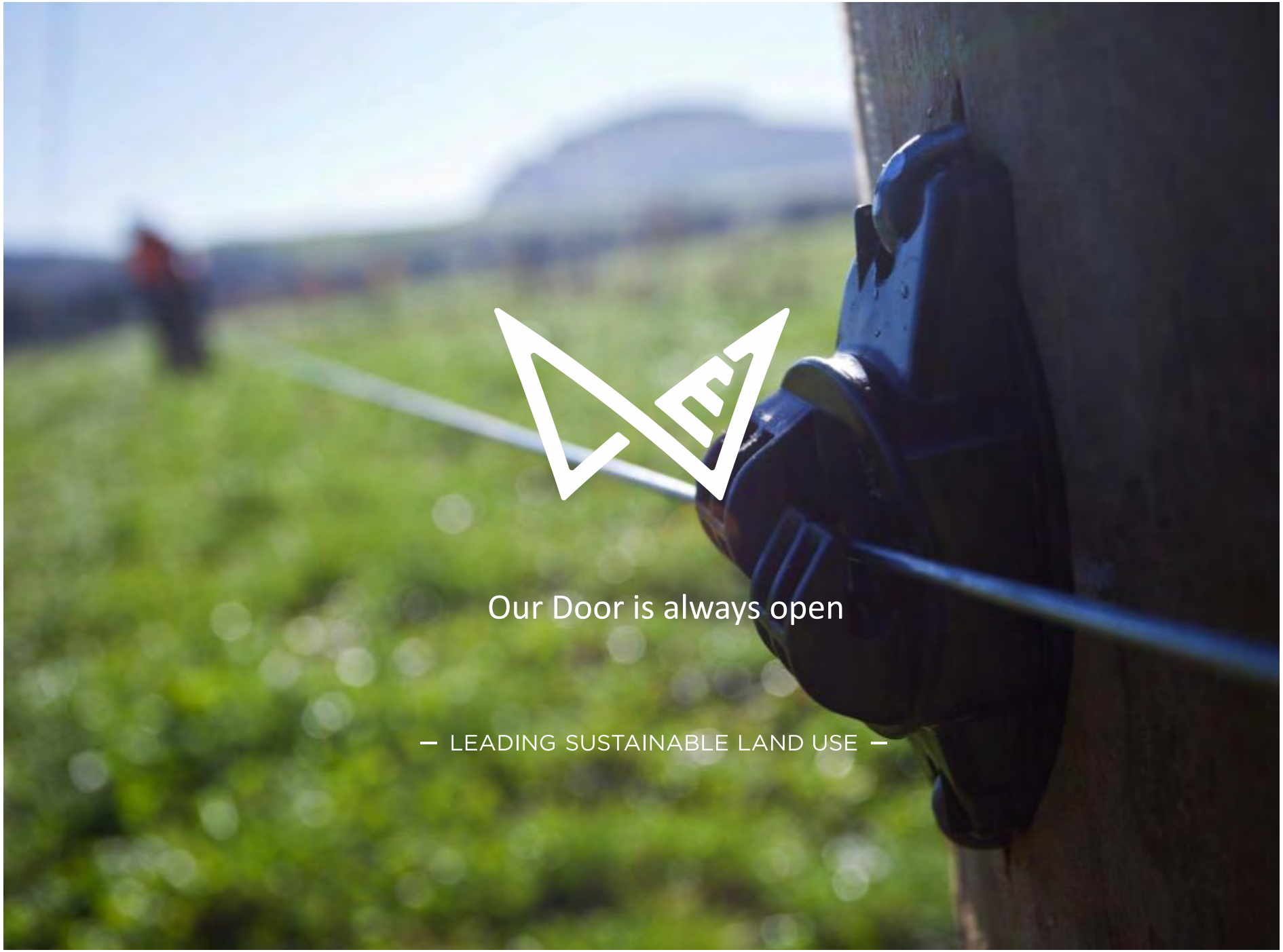


Figure 8 - Subdivision of Sub-catchment 66

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