

New Zealand Application of SPARROW

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Why interested in SPARROW?

- Graham McBride reviewed a paper...
- 13 years of national monitoring records
 - Relation between landuse and nutrients?
 - Loads in un-monitored streams?
 - Effects of landuse change?
 - National N load?
- Statistically-oriented

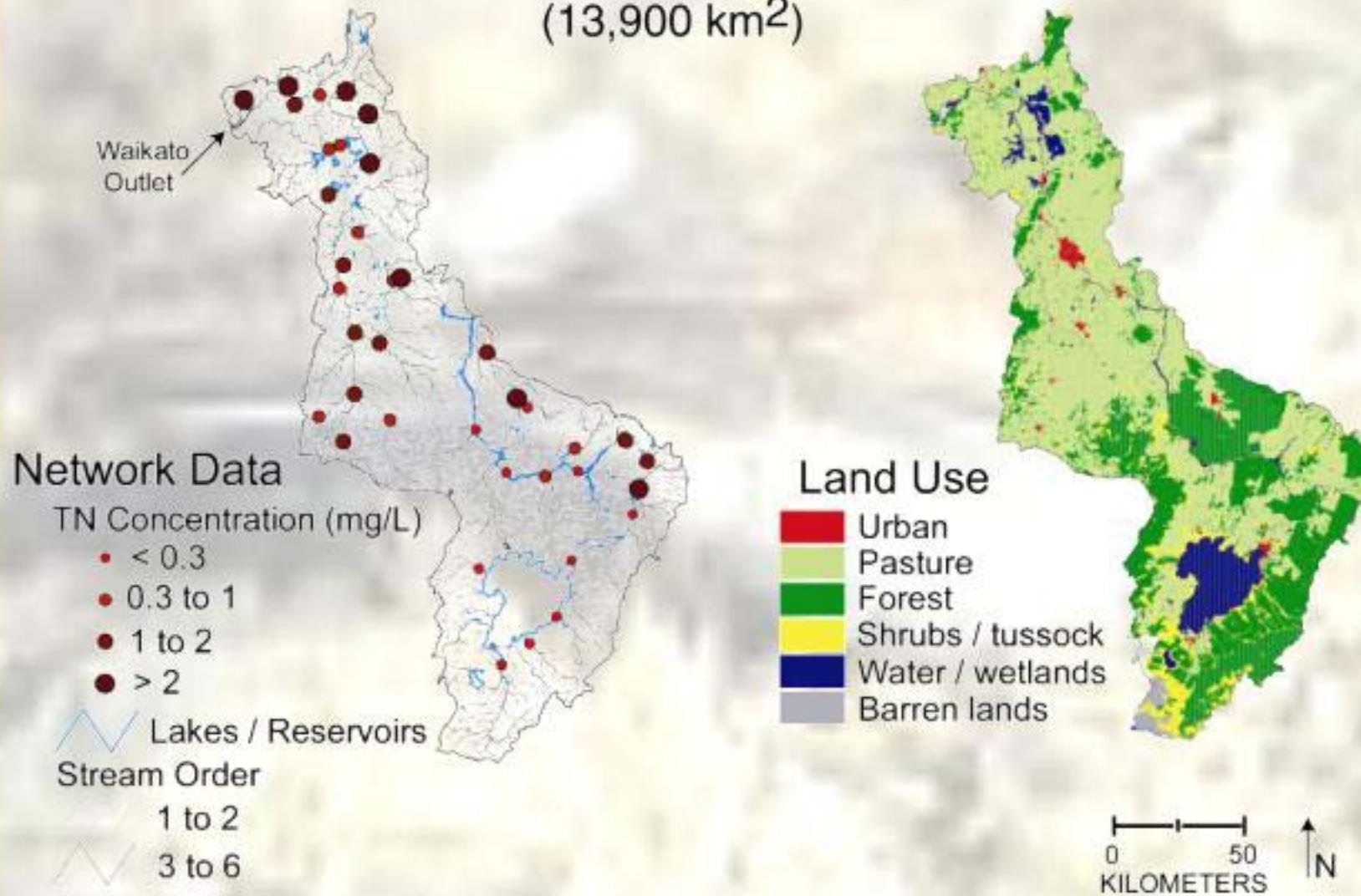
Sponsoring agencies

- Foundation for Research Science and Technology
- Environment Waikato

Waikato pilot application



Waikato River Basin, New Zealand (13,900 km²)



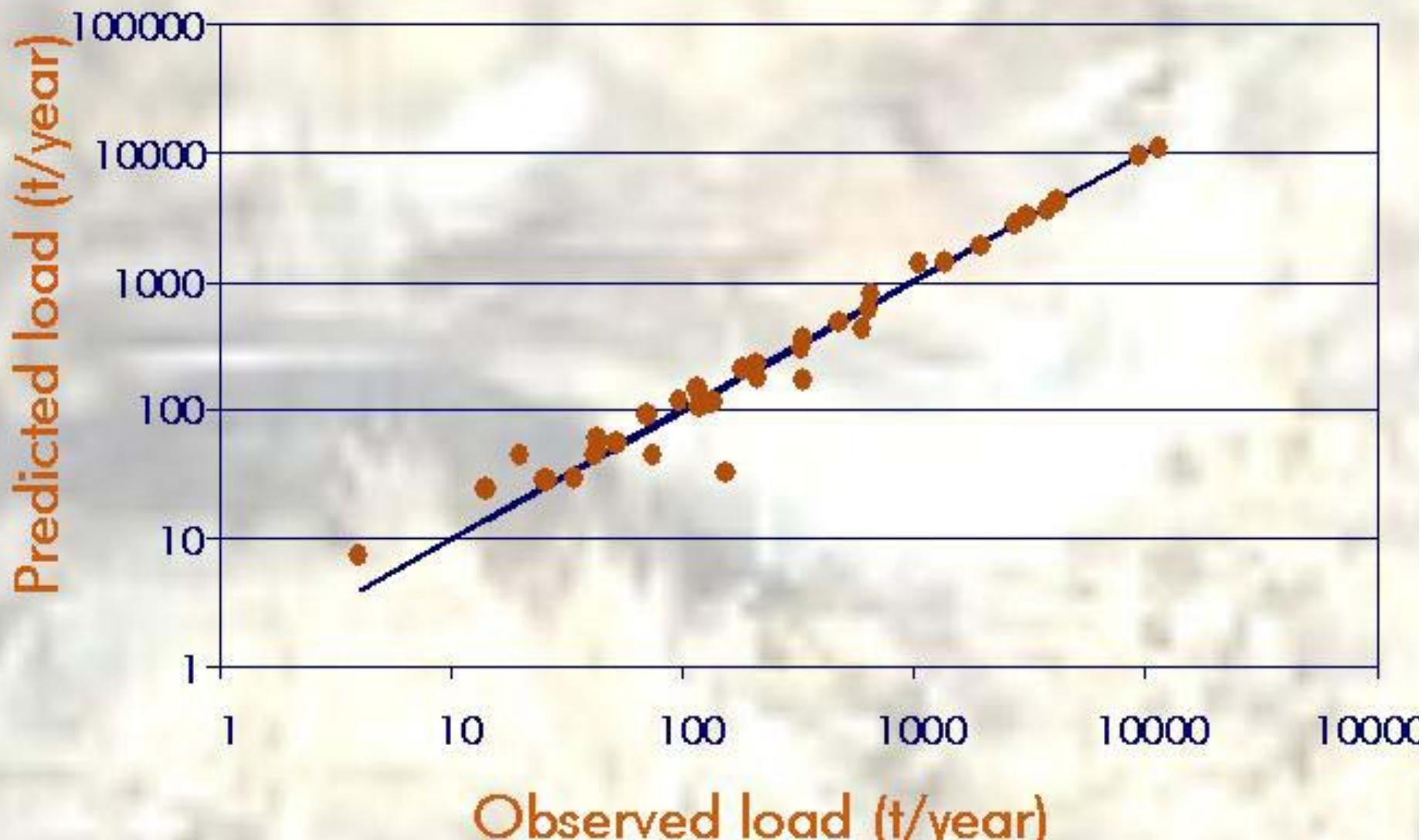
Available data

- ✓ water quality with flows
- ✓ stream network, topography
- ✓ landuse (from satellite)
- ✓ point sources
- ✓ soil, drainage, erosion classes
- ✓ rainfall, flow
- ✗ landuse details (stock, fertiliser)
- ✗ travel times in streams
- ✗ atmospheric deposition
- ✗ reservoir volume

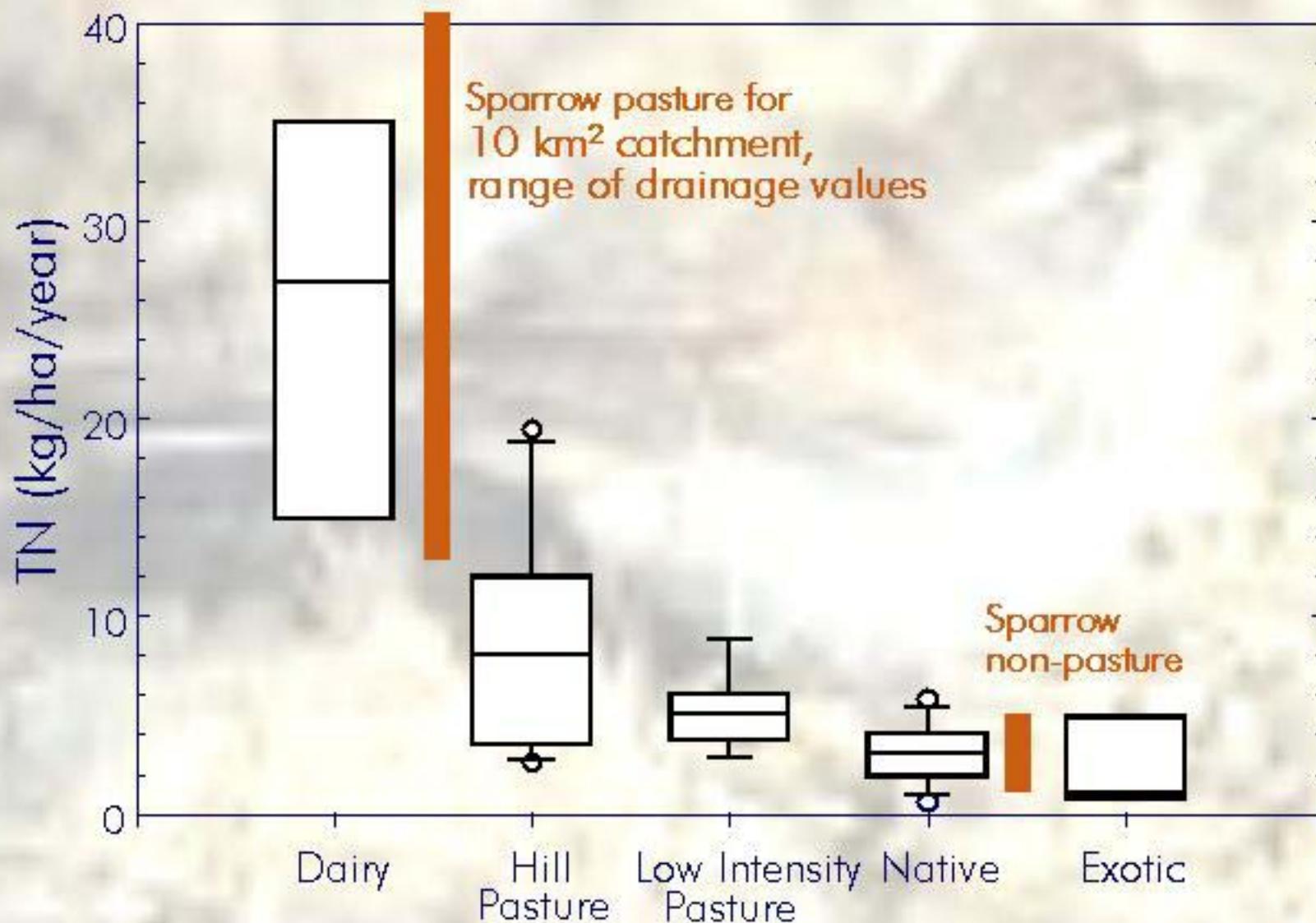
Tailored SPARROW model

- Landuse as a 'source' (yield)
- Land delivery factors:
 - slope
 - drainage
 - rain
 - erosion class
- Stream attenuation related to length, not travel time
- Reservoir attenuation from areal loading rate, not residence time

Excellent predictions for Nitrogen Load
 $R^2 = 0.97$ (similar for TP)



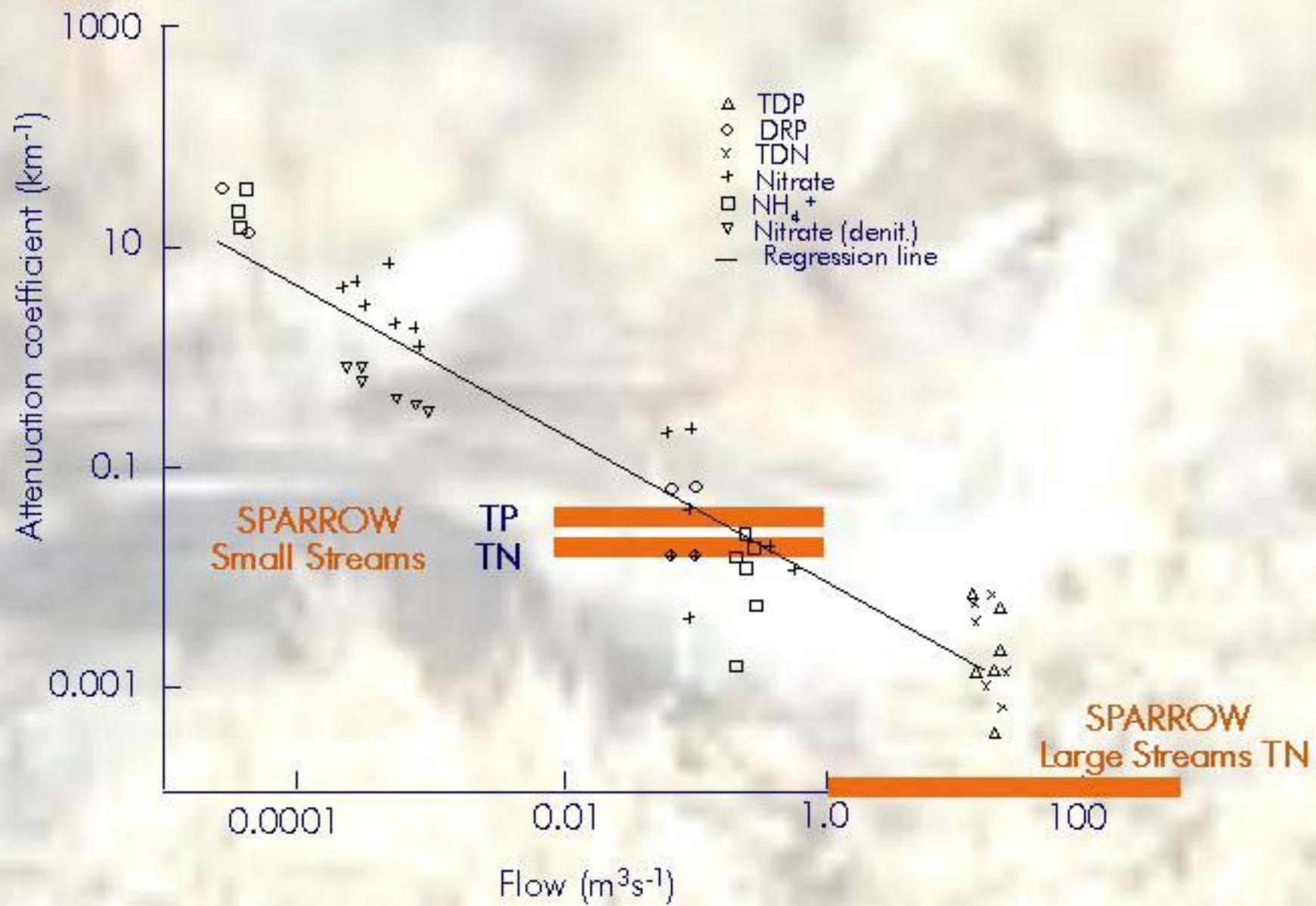
TN Export Coefficient Agrees with Literature Values

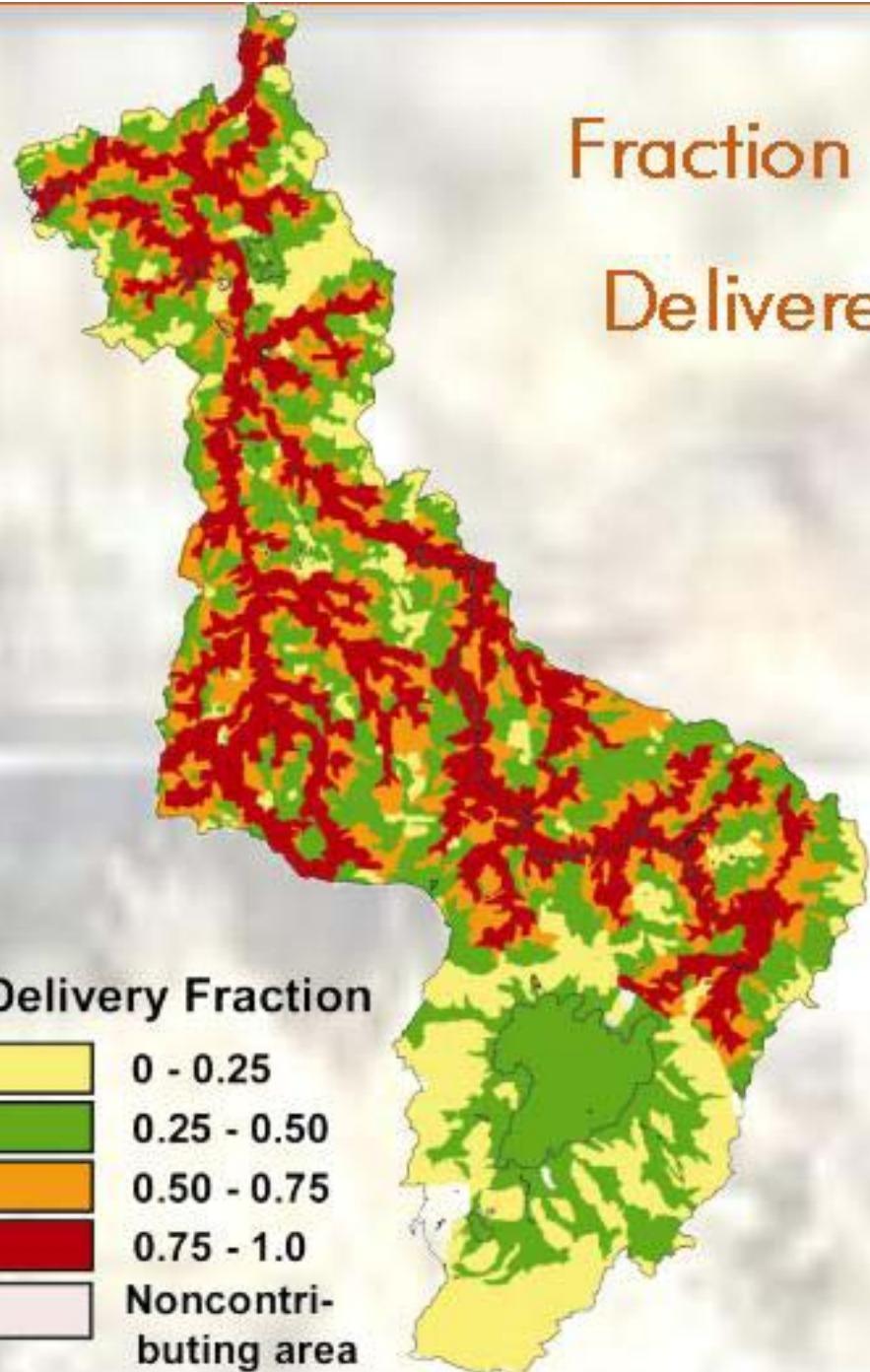


Source contributions at Waikato outlet

	TN	TP
Point	11% ($\pm 6\%$)	23%
Pasture	83%	66%
Non-pasture	5%	10%

In-Stream Attenuation Agrees with Literature Values

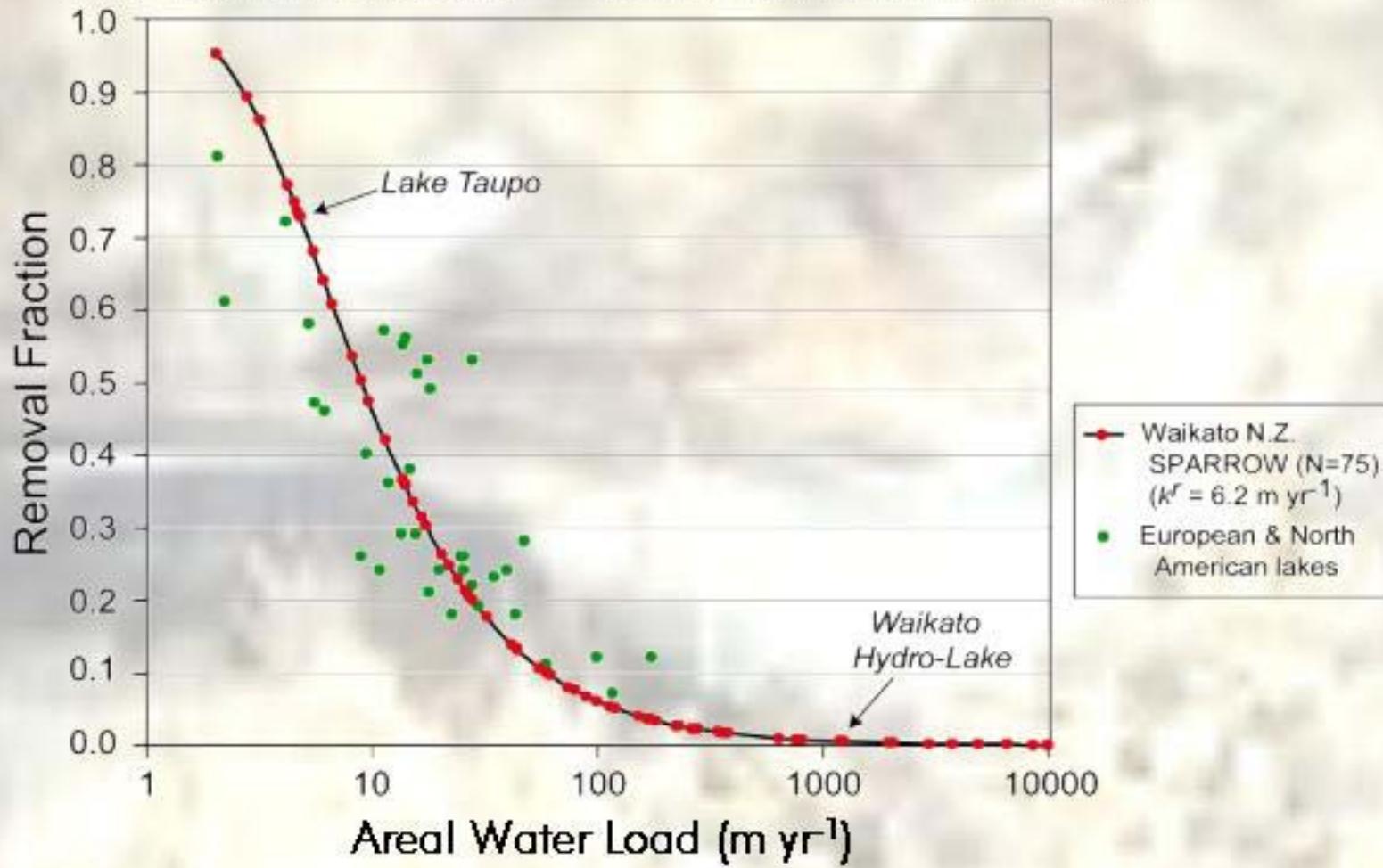




Fraction of Nitrogen Delivered to Outlet

Nutrient removal in lakes

Total Nitrogen Removal - Waikato Reservoirs and Lakes



- Lakes and streams combined remove 45% of TN and 57% of TP inputs

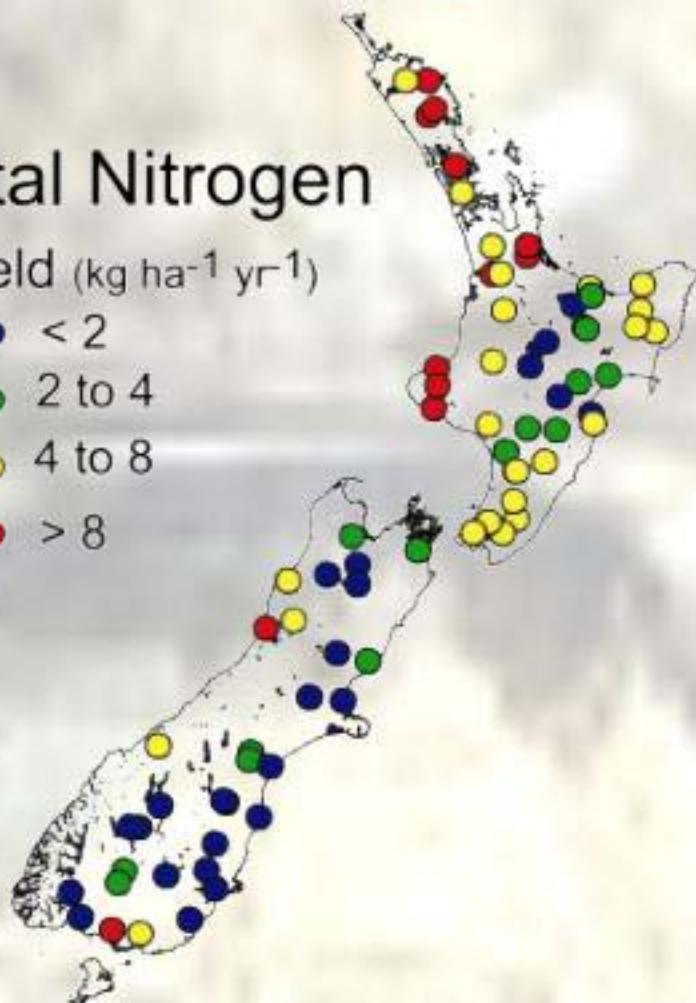
Application Nationally

76 monitoring sites 428,000 reaches, 438 lakes

Total Nitrogen

Yield ($\text{kg ha}^{-1} \text{ yr}^{-1}$)

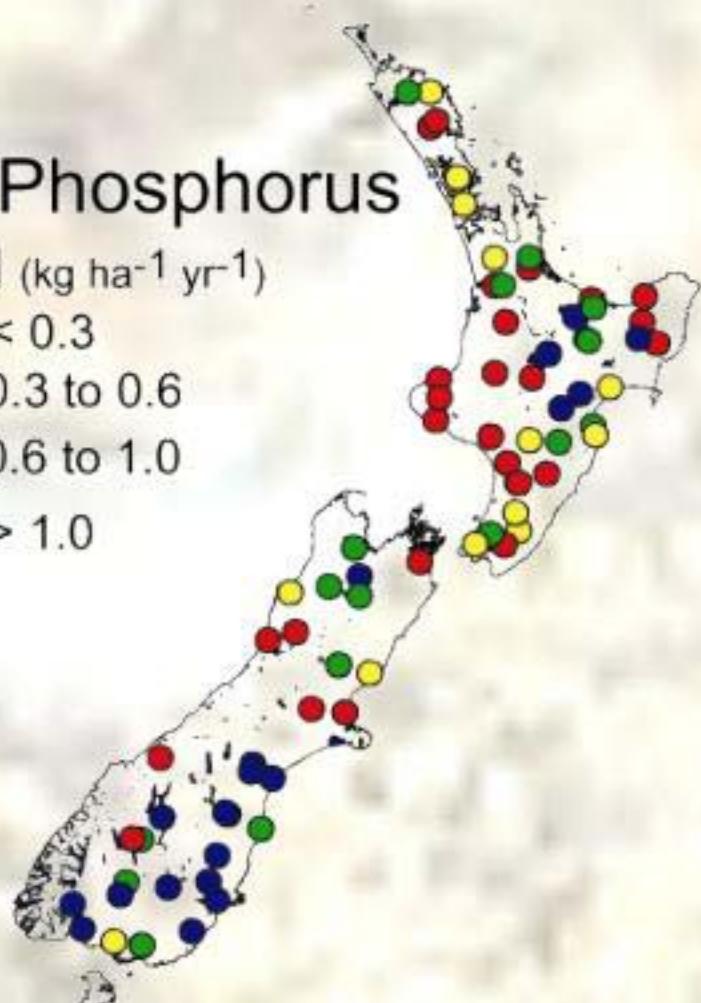
- < 2
- 2 to 4
- 4 to 8
- > 8



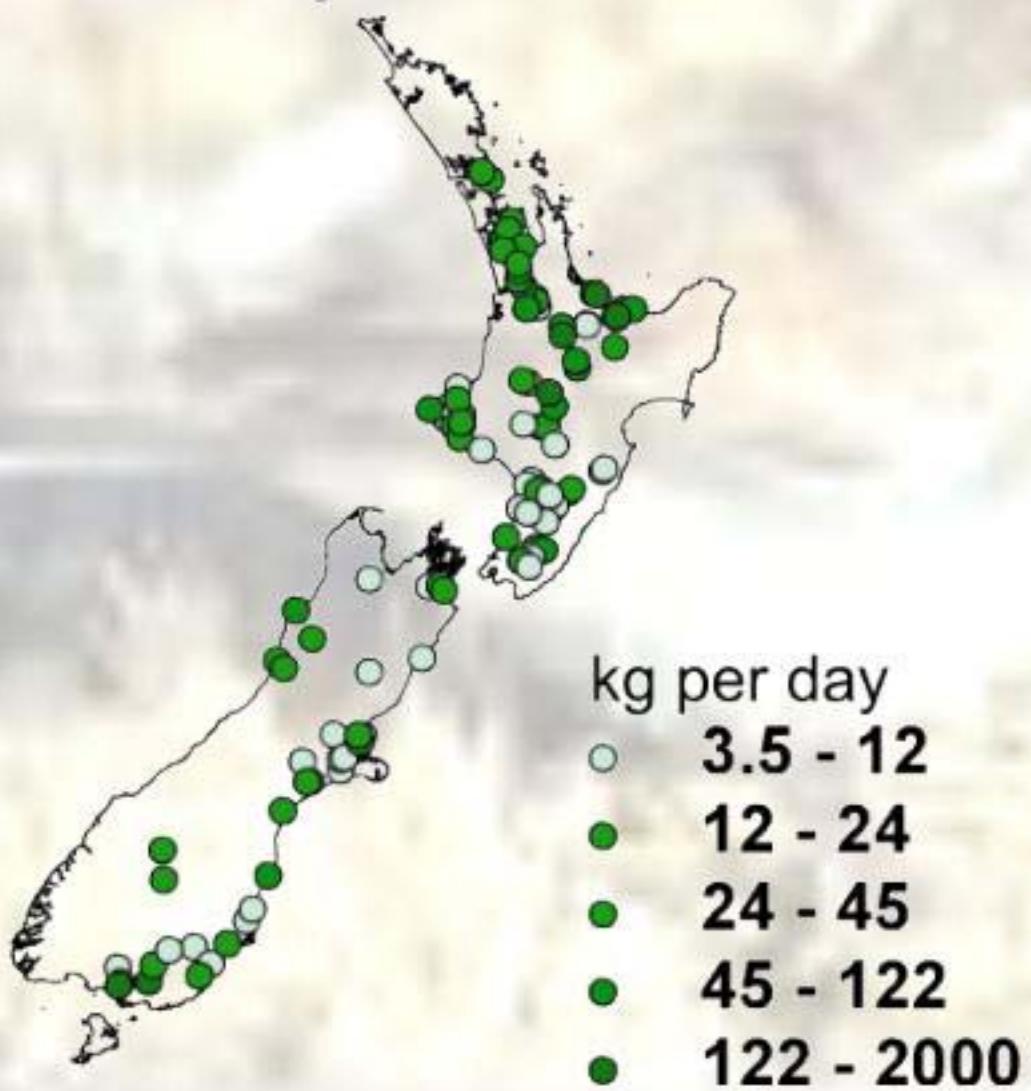
Total Phosphorus

Yield ($\text{kg ha}^{-1} \text{ yr}^{-1}$)

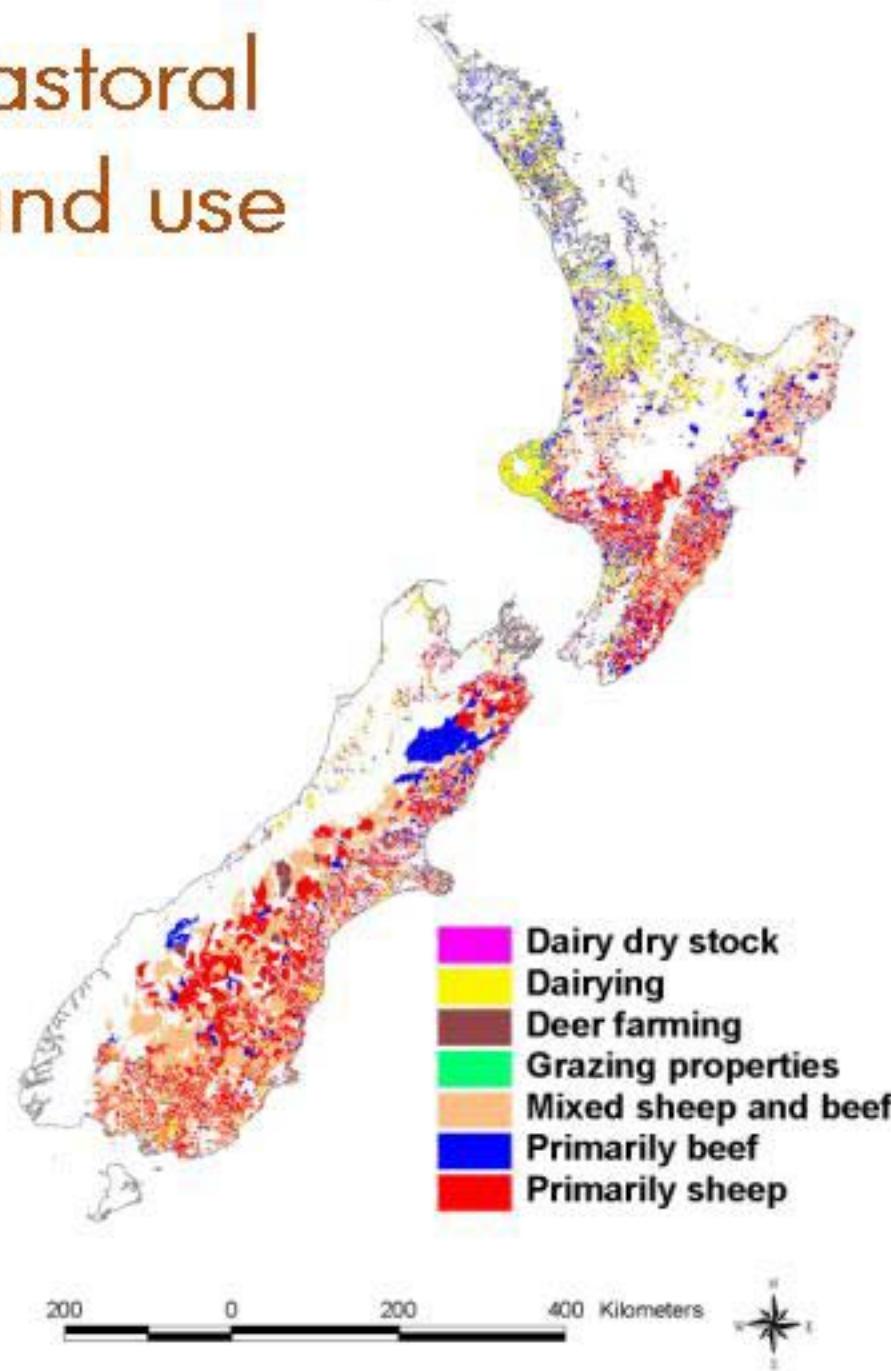
- < 0.3
- 0.3 to 0.6
- 0.6 to 1.0
- > 1.0



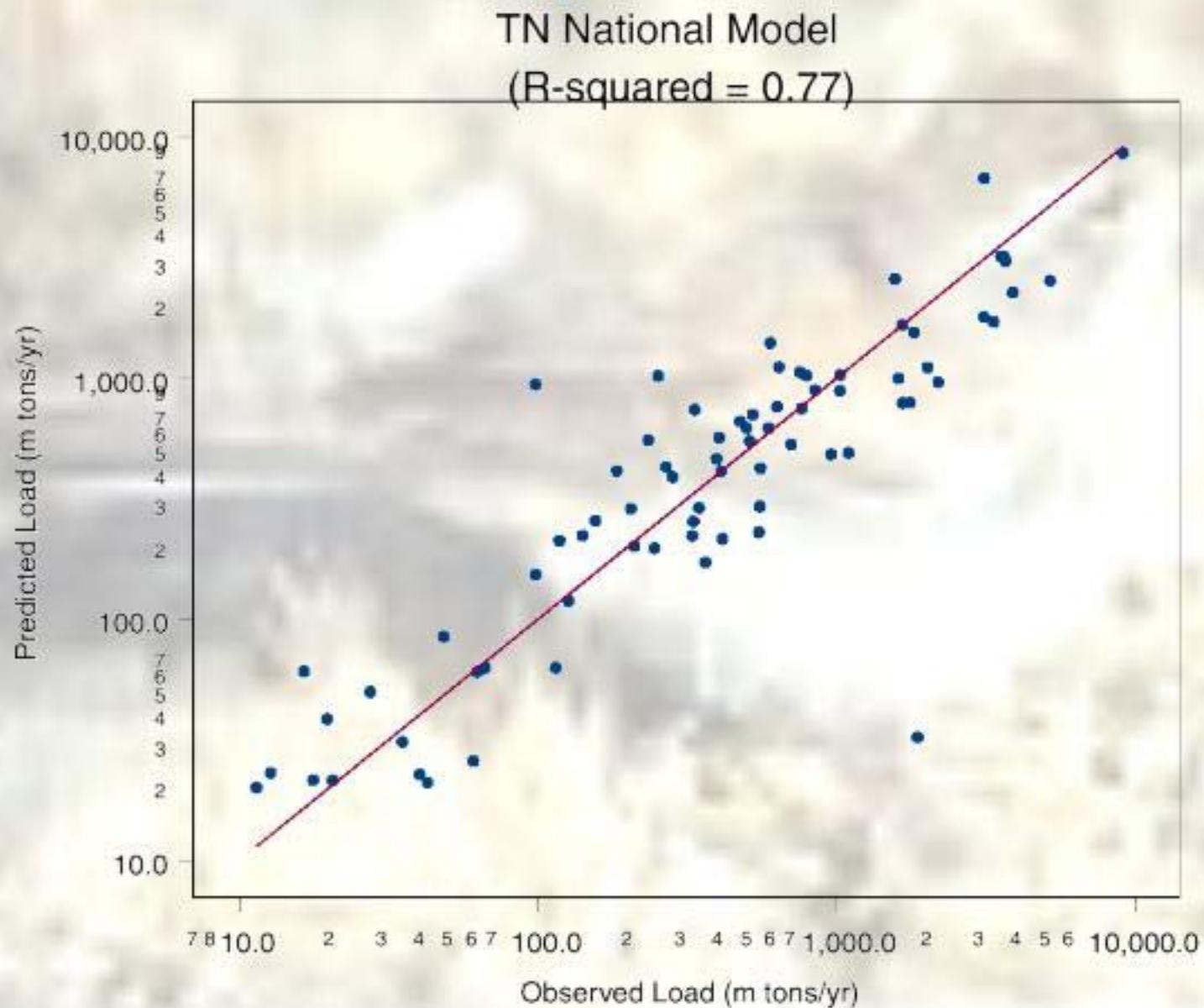
Point-Source Discharges to Water Total Nitrogen



Pastoral land use



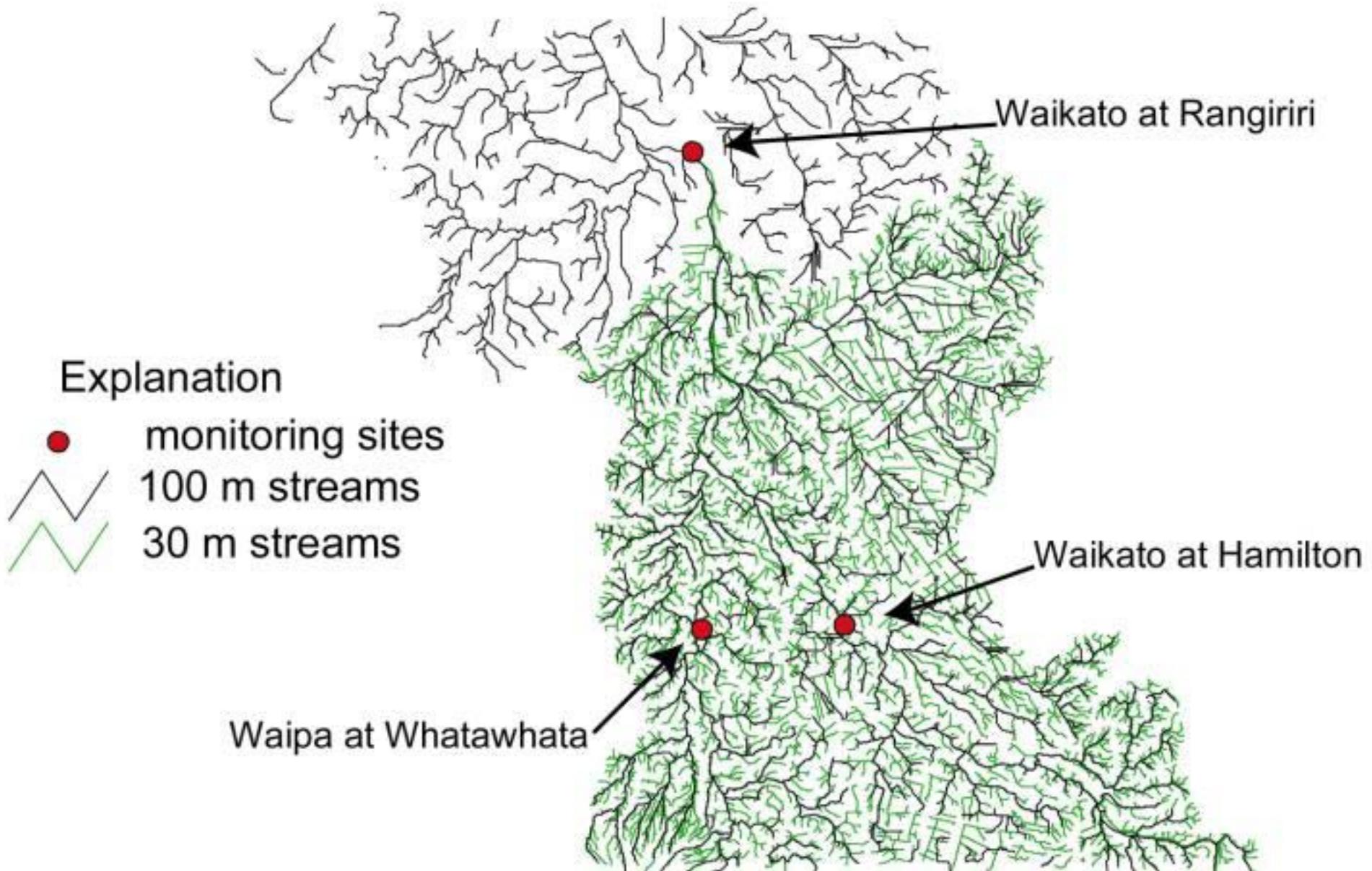
Observed vs predicted for TN



New work

- Complete national application
- Investigate resolution effect
- Faecals
- Make available on the web
- Superimpose land management
- Sediment?

Effect of resolution



Application to 'bad bugs'

- Successful regression study for E.Coli in the Waikato
- What is effect of attenuation?
- National database: 22 sites with flow for E.Coli and pathogens
- Birds a source of campylobacter?

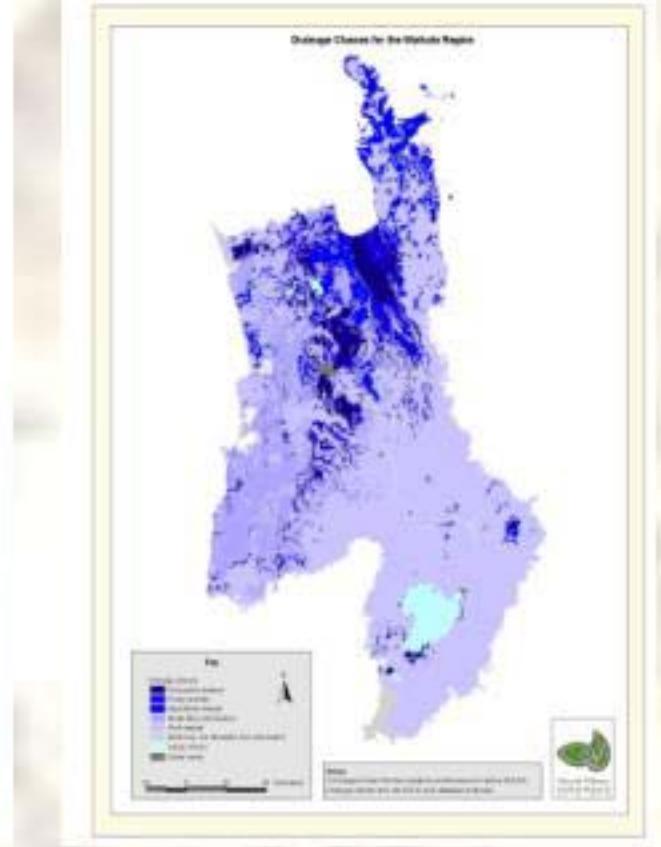
Land Cover



Stock Numbers



Soil Drainage



Multiple regression to derive a statistical model

$$\text{Median } E. \text{ coli} = 196 + (4.1 \times \% \text{PoorDrain}) + \\ (8.4 \times \text{TurbMedian}) + \\ (0.17 \times \text{Cattle}) - \\ (1.4 \times \% \text{WellDrain})$$

- Explains 70% of the observed variance in median *E. coli* across the region

Uses for SPARROW

- 'Makes sense' of national data
- State of Environment, National accounting
- Highlight main sources
- Assess effects of change in landuse or point source controls
- Complement other types of model

Summary

- Successful application to Waikato
- National application underway
- New bad bugs application