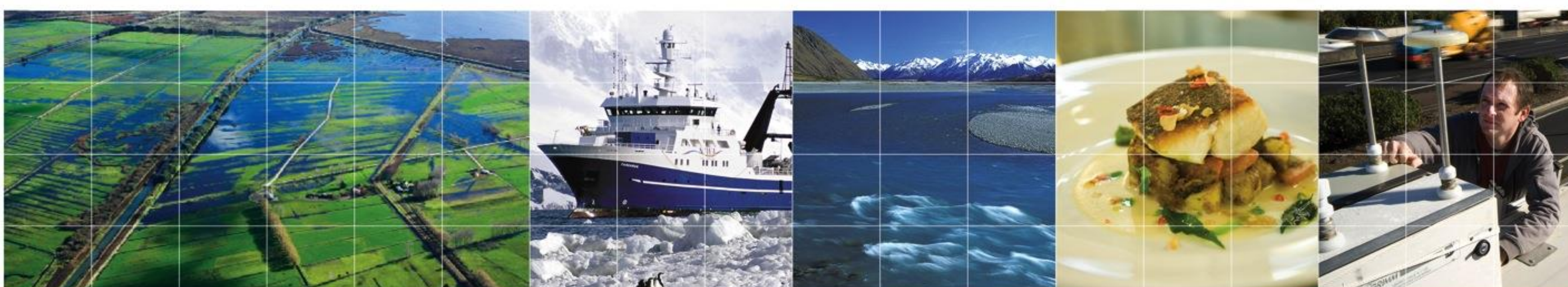
ROTAN-Annual

How does it compare with ROTAN-2011?

Kit Rutherford
Alastair MacCormick



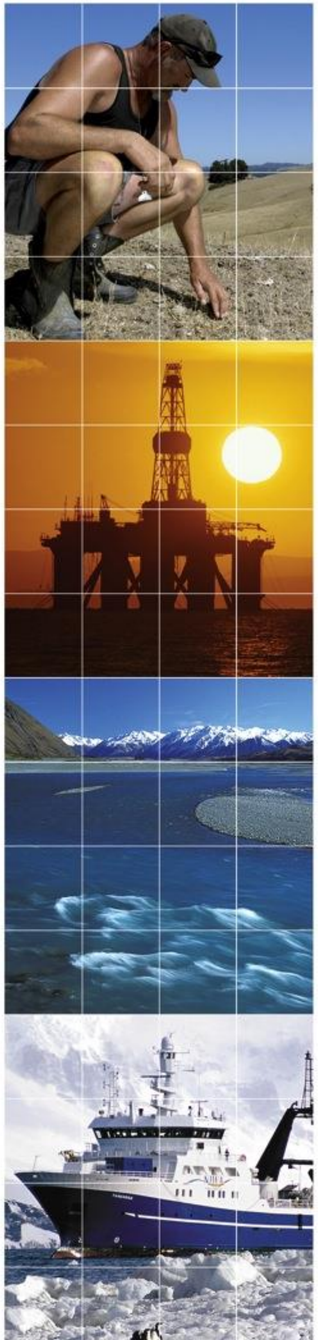
Differences

ROTAN-Annual

- Annual time-step
- 280 sub-catchments
- 280 aquifers
- MRT=f(distance)
- Uncertainty

ROTAN-2011

- Weekly time-step
- 25 sub-catchments
- 10 aquifers
- MRT=constant




Ngongotaha Rec
Hatchery Spr
TeAhipukahu Stm
Rainbow Spr
Paradise Spr
Utuhina Rec
Airport Rd
Lee Rd
Waingaehe Rec
Lynmore Stm
Waiohewa Rec
Waipa
Forest

Calibration 1

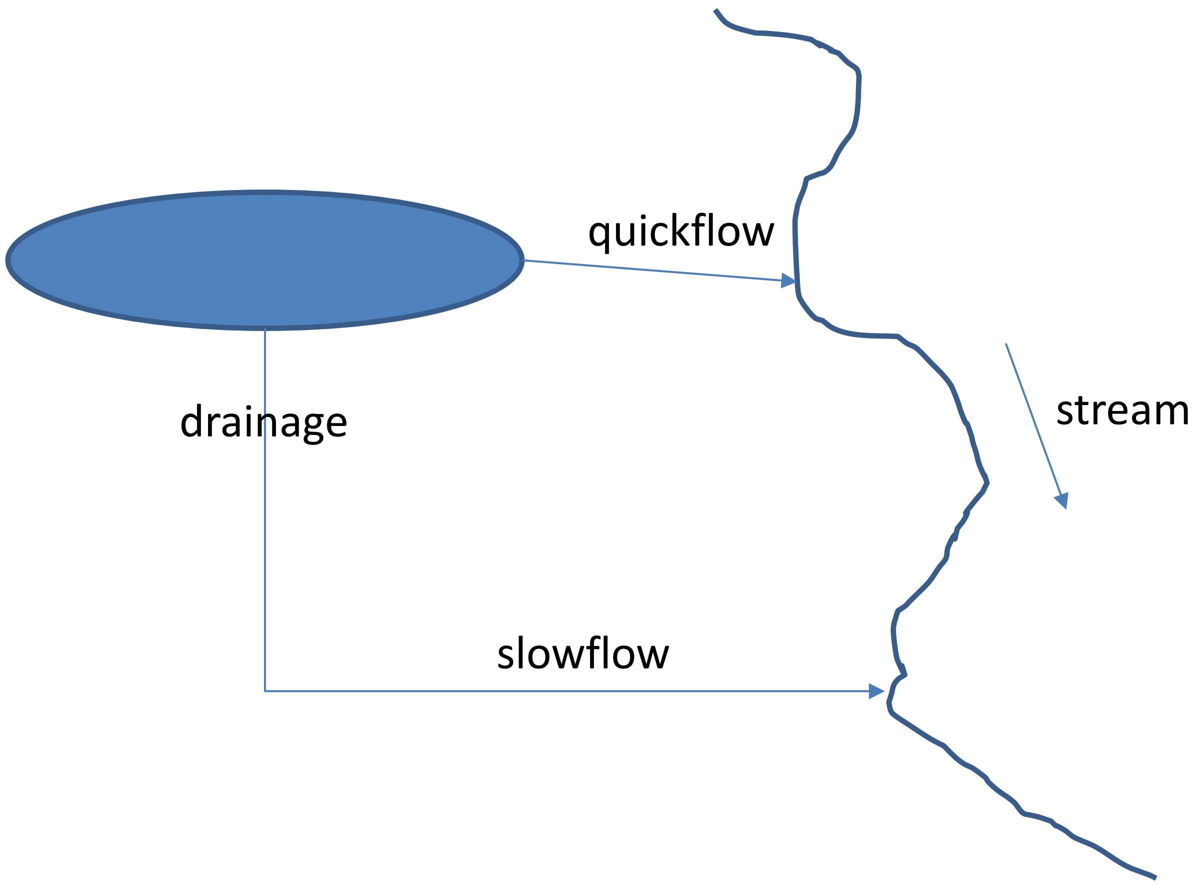
- Accounts for
  - Uncertainty in losses, flow pathways, MRTs
  - Distribution unknown (normal/uniform, limits etc)
  - Constraints imposed on attenuation coefficients
  - Assumed ‘normal’ distribution
  - 1000 realisations
- Approximate frequency distributions of steady-state loads
  - Current land use
  - Nitrogen loss reductions

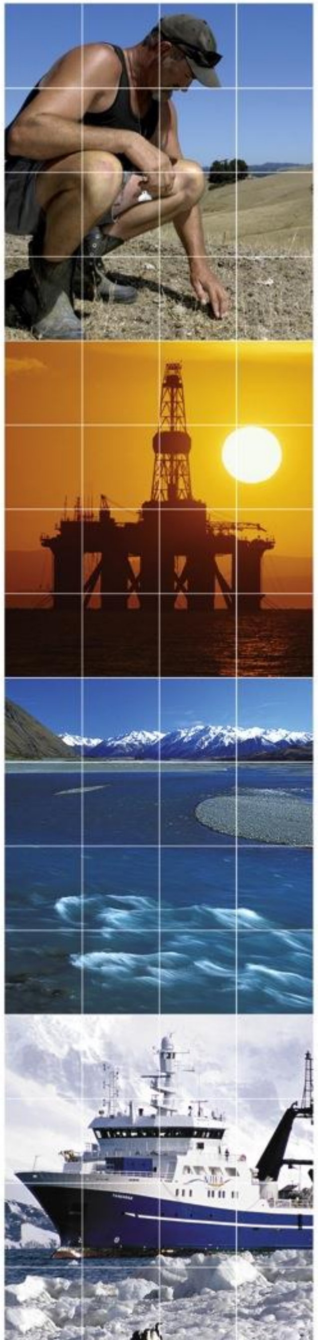
Calibration 2

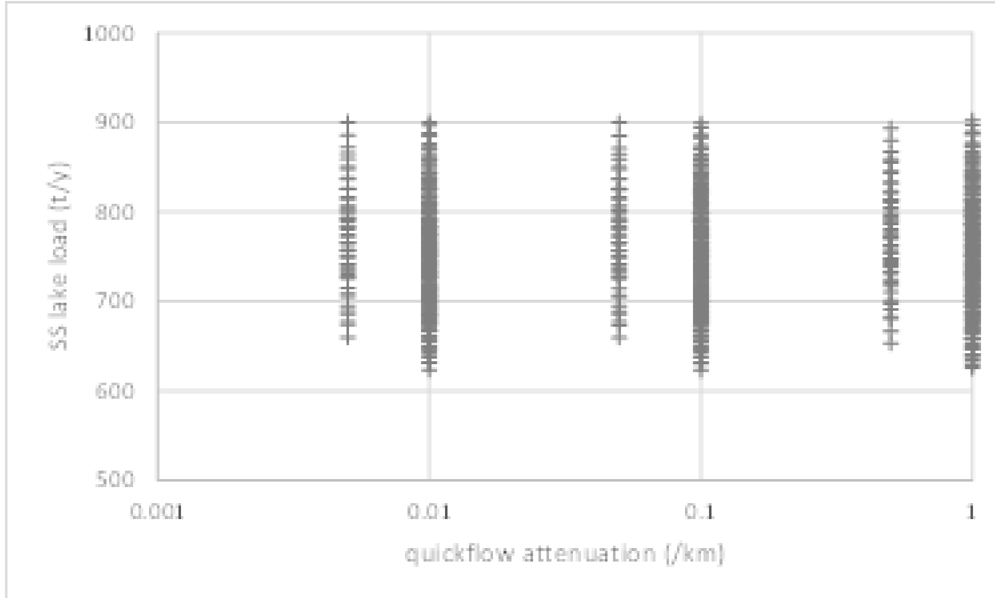
- Several combinations of attenuation coefficients gave equally 'good' fit
  - Over determined system
  - Can we estimate one or more *a priori*?

- Spatially homogeneous attenuation
  - Poor fit in some catchments – why?
- Spatially variable attenuation
  - Large differences between similar catchments – why?

  - Errors in losses, stream loads, flow pathways
  - Spatial variations in attenuation


quickflow
stream
drainage
slowflow

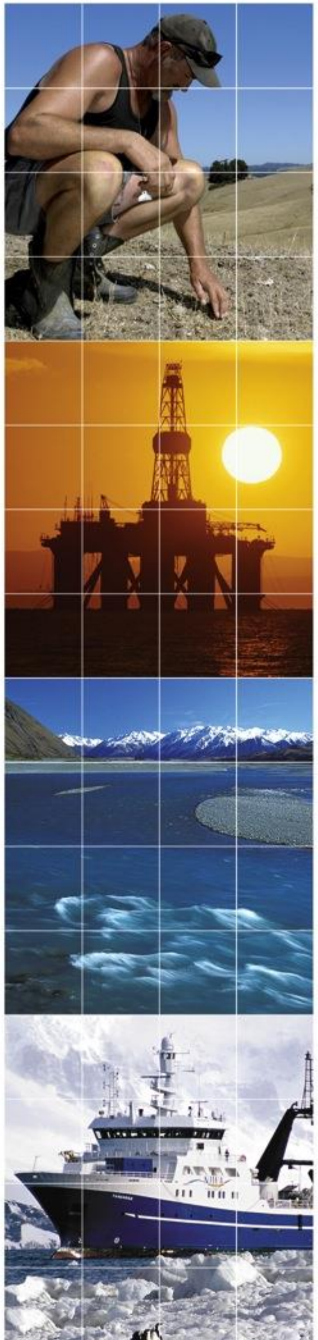


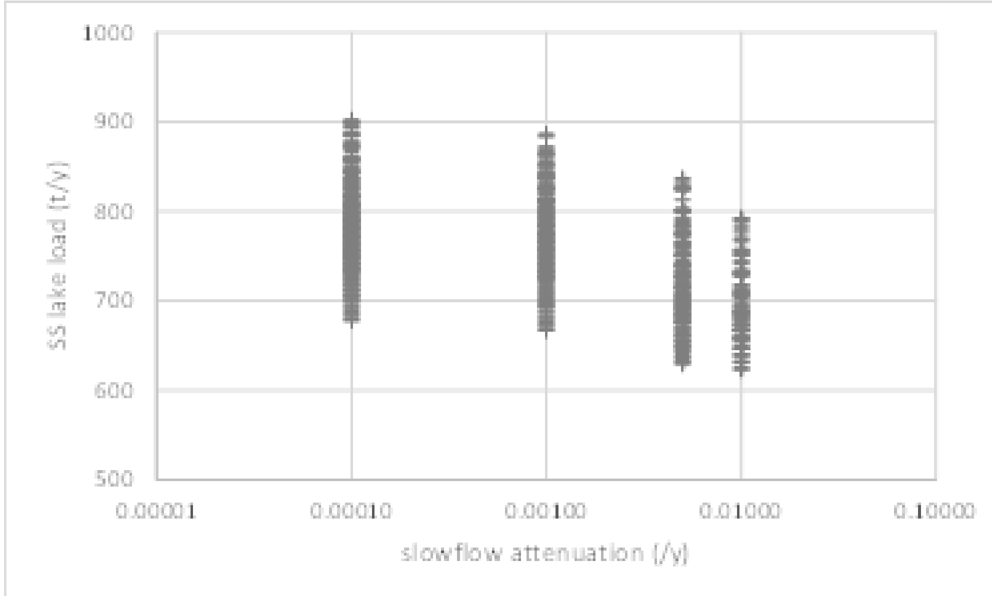


Stream nitrogen is not strongly influenced by quickflow attenuation.

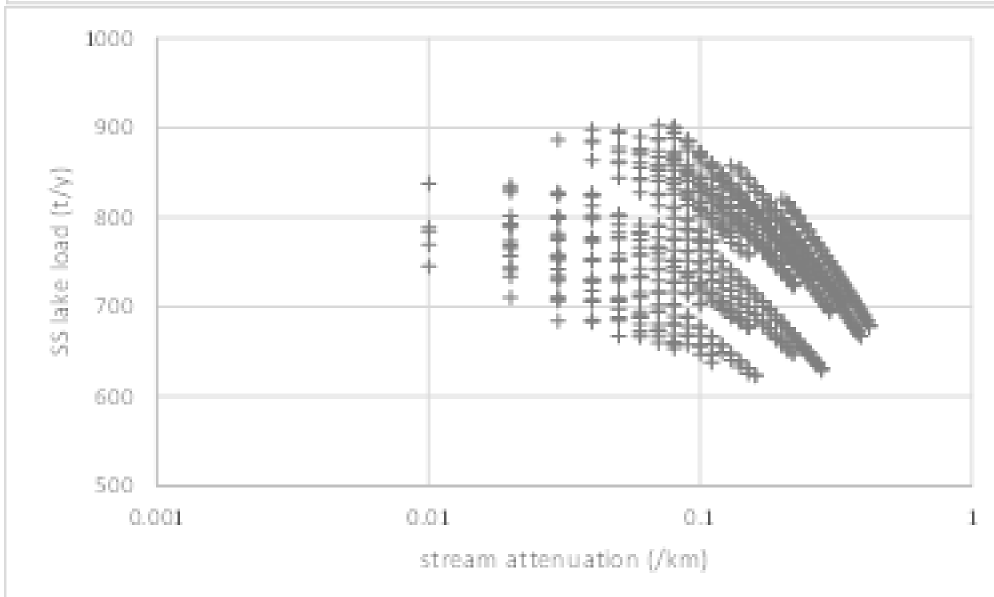
High drainage
Most runoff & nitrogen drains to groundwater

Slowflow & stream attenuation dominate

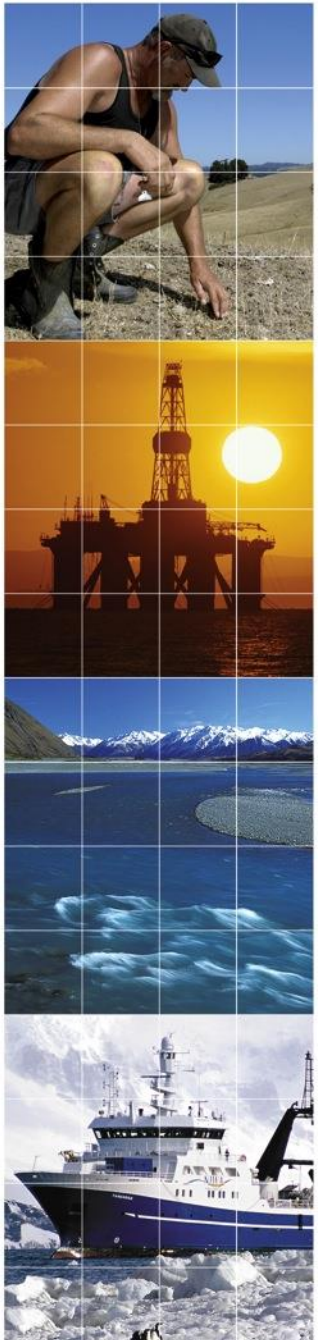




Slowflow & stream attenuation negatively correlated



Steady state lake load negatively correlated with slowflow & stream attenuation



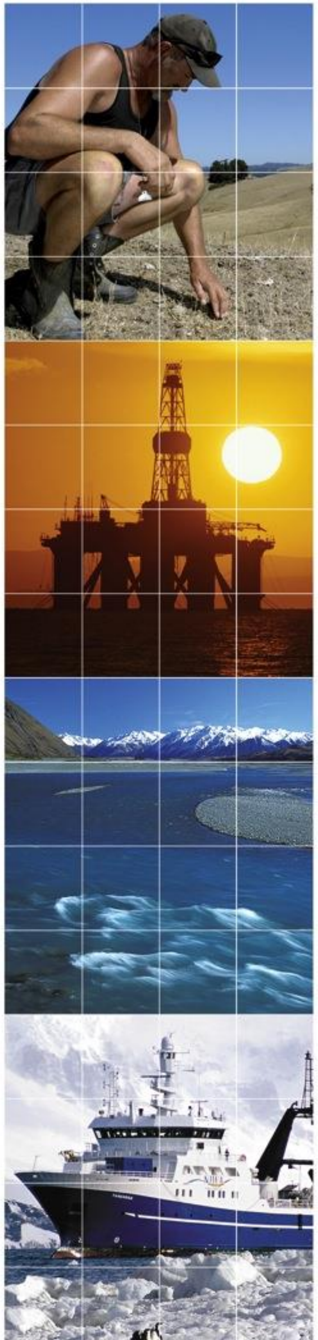
Slowflow attenuation

Initial: 0.0001 < slowflow attenuation < 0.1 /year
Calibrations all ‘converged’

660 < steady-state lake load current land use < 860 t/y
Median: 760 t/y

ROTAN-2011: 725 t/y (excluding rain on lake)

Final: 0.0030 < slowflow attenuation < 0.0082 /year
Based on synoptic groundwater sampling (Morgenstern et al. 2004)
670 < steady-state lake load current land use < 840 t/y
Median: 750 t/y



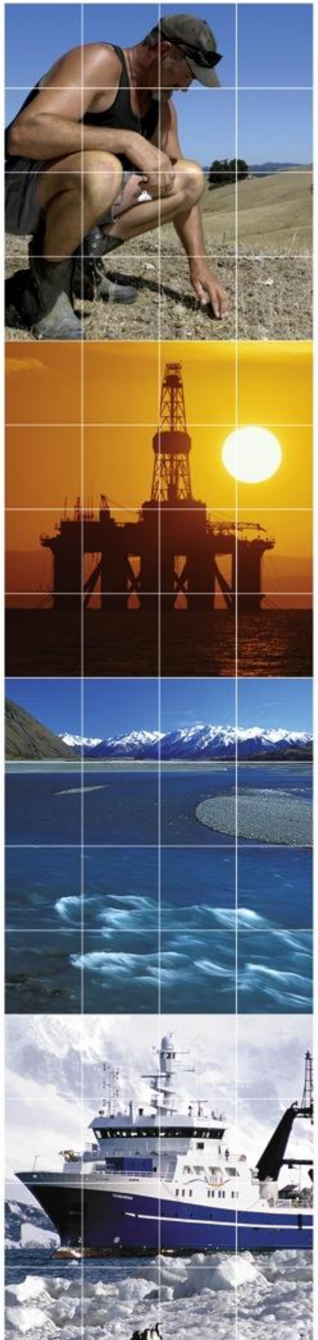
Loss reductions

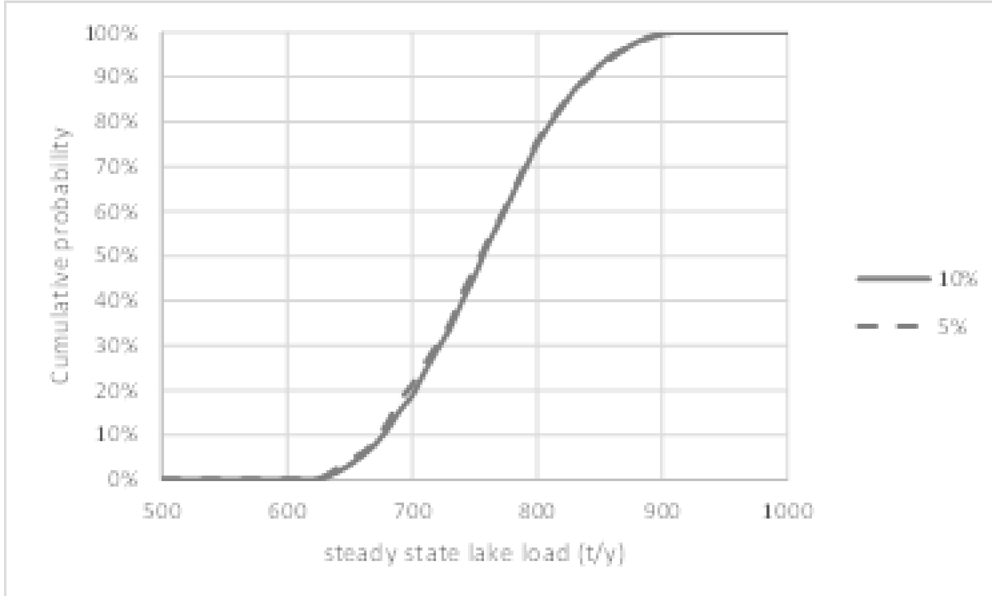
Initial:

390 < steady-state lake load reduced losses < 490 t/y
Median: 440 t/y

Target: 405 t/y (excluding rain on lake)

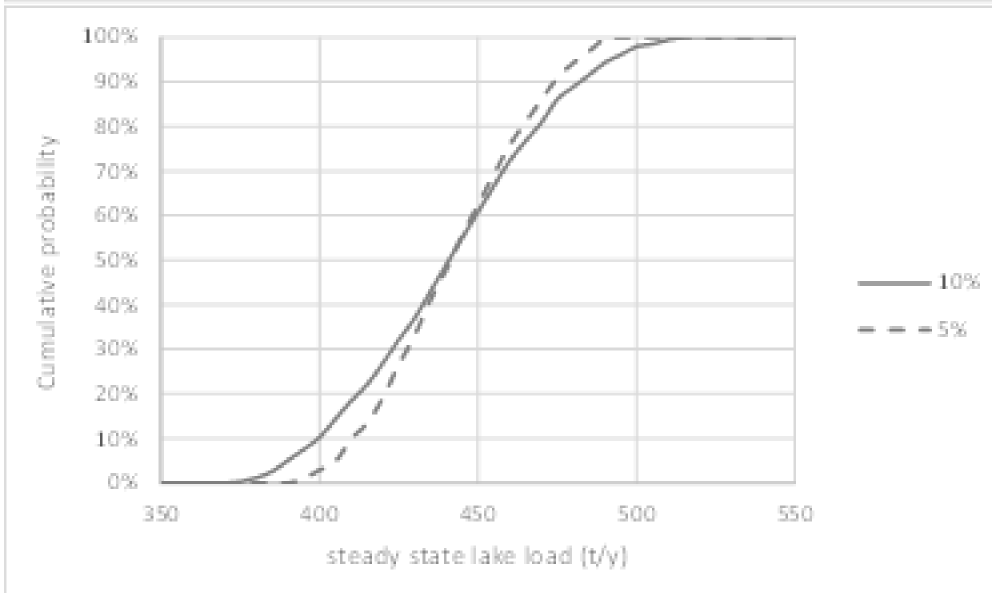
Final:
390 < steady-state lake load reduced losses < 460 t/y
Median: 420 t/y





Steady-state lake load – current land use

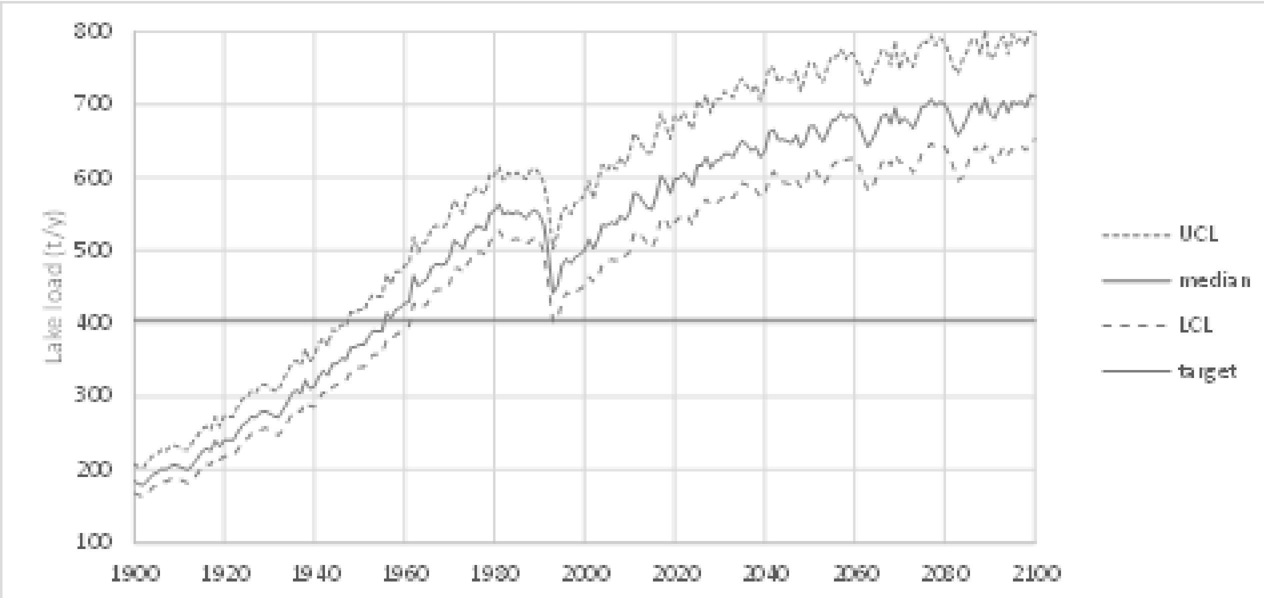
ROTAN-2011
725 t/y



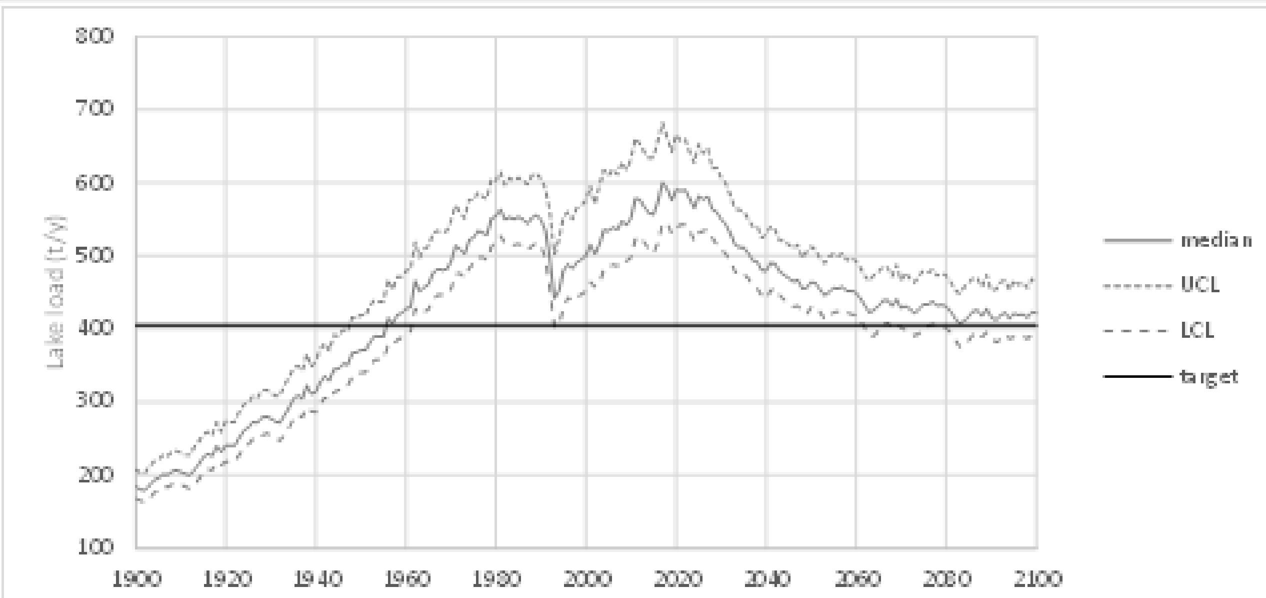
Steady-state lake load – loss reductions

Target
405 t/y

Predicted annual lake load

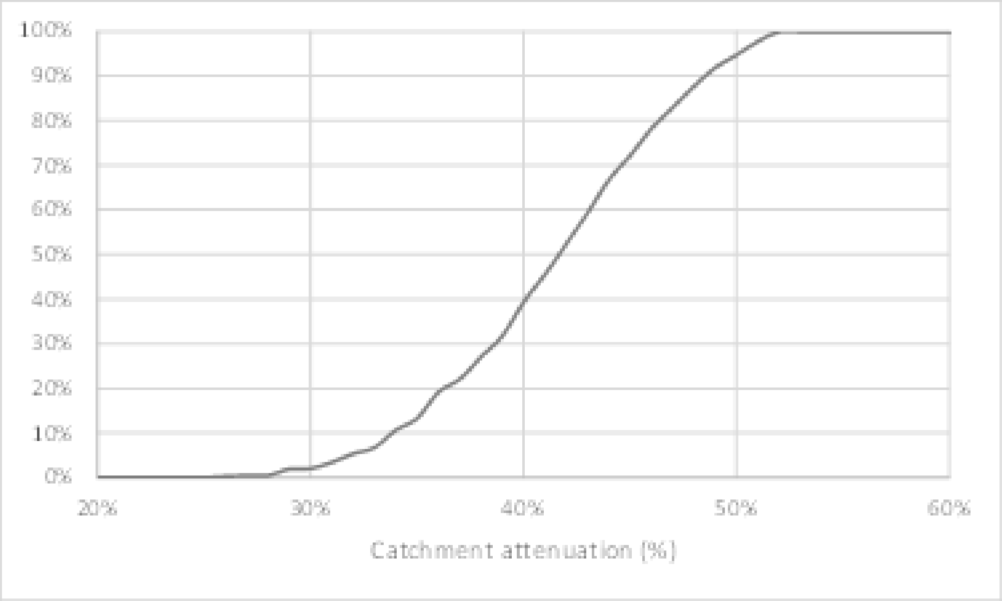


Current land use



Staged reductions

Frequency distribution of catchment-scale attenuation



Effect of OVERSEER changes

	OVERSEER v5		OVERSEER v6	
Total losses	725 t/y (no rain)		1261 t/y (1112-1419 t/y)	
SS lake load	725 t/y		750 t/y (670-840 t/y)	
Attenuation	c. zero		c. 40%	
Loss reductions (unattenuated)				
Rules	140 t/y		263 t/y	(scaled by 188%)
Incentives	100 t/y	(75%)	188 t/y	(85%)
Gorse	30 t/y		30 t/y	
Tikitere	22.5 t/y		22.5 t/y	
Sewage	10 t/y		10 t/y	
Other	17.5 t/y	(25%)	17.5 t/y	(15%)

Conclusions 1

- Several combinations of attenuation coefficients match stream concentrations
- The model is ‘over determined’
- Independent assessment of one or more attenuation coefficients would reduce uncertainty

Conclusions 2

- ROTAN-Annual gives a similar median steady-state lake load under current land use as ROTAN-2011
- ROTAN-Annual gives a steady-state lake load under reduced loads slightly higher than the target of 435 t/y
- One reason is that engineering and gorse ‘targets’ are now 19% of total reductions (cf 30% in 2011)