Stream crossings

Rob Davies-Colley
NIWA, Hamilton

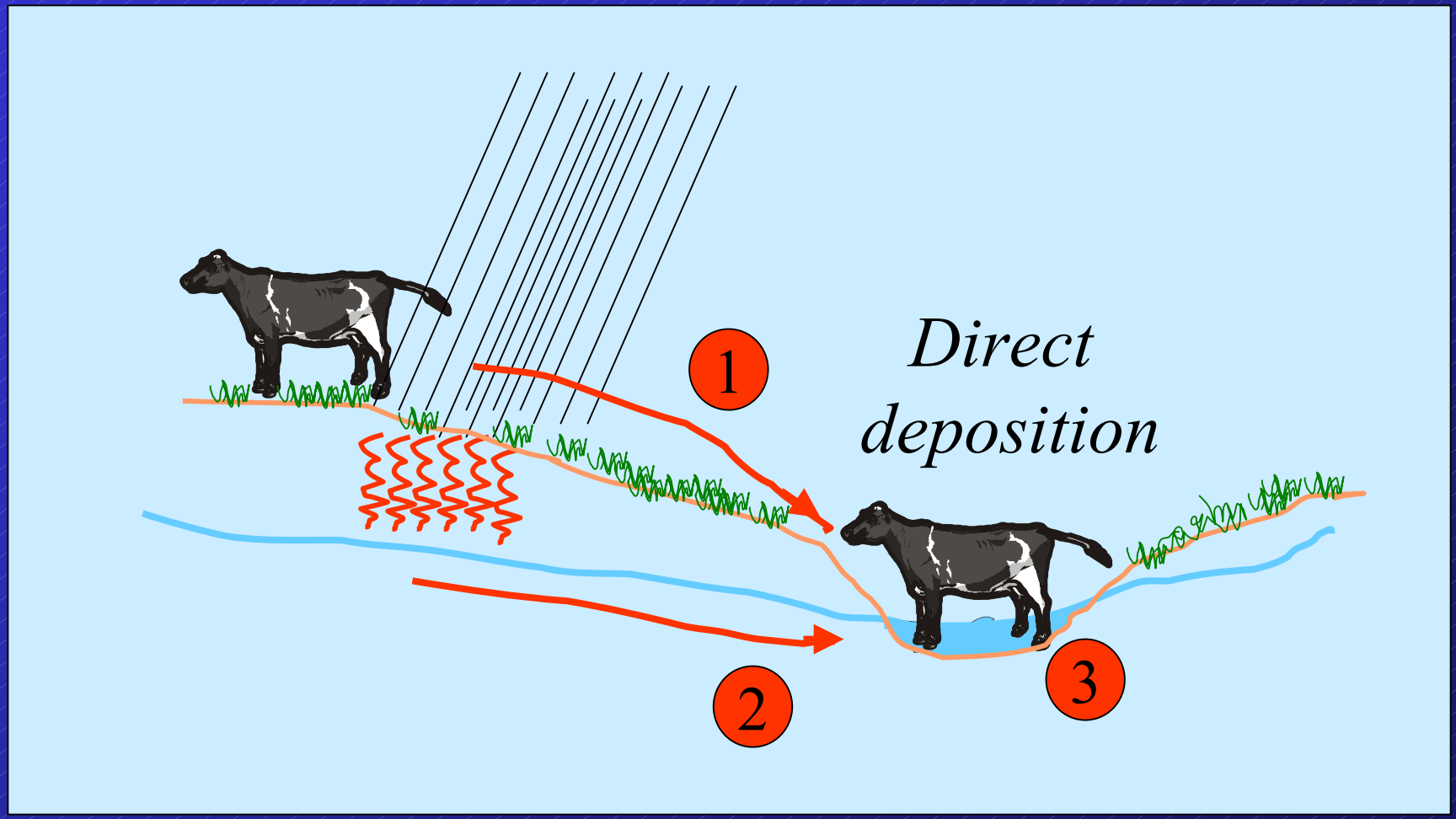
NIWA
Taihoro Nukurangi

Background

- **Interest in water quality & riparian**
- **Traditional diffuse pollution concern – mainly with nutrients (also sediment)**
- **Faecal pollution by livestock also important**
  - Zoonotic diseases (*Campylobacter, Cryptosporidium*)
  - Relative significance of animal vs human contamination?

Today's talk emphasises faecal pollution

Pathways of faecal pollution

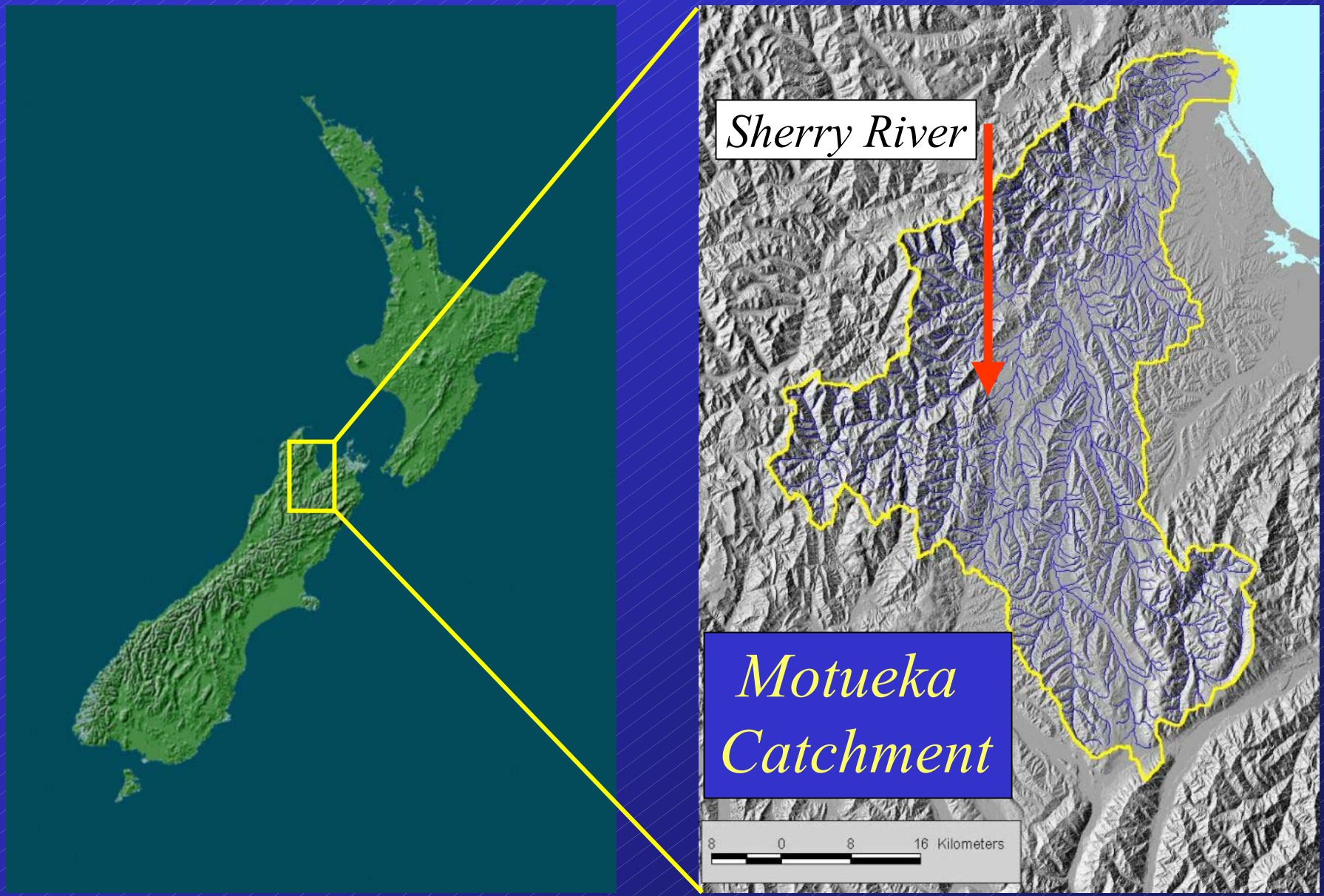


More background

- Motueka icm programme (LCR sub to NIWA)
  http://icm.landcareresearch.co.nz
- Objective on riparian aspects
- TDC asked us to collect data on cow Xings – to support policy initiatives
- Field site = Sherry River (Motueka catchment)

Previous work on cow crossings in NZ

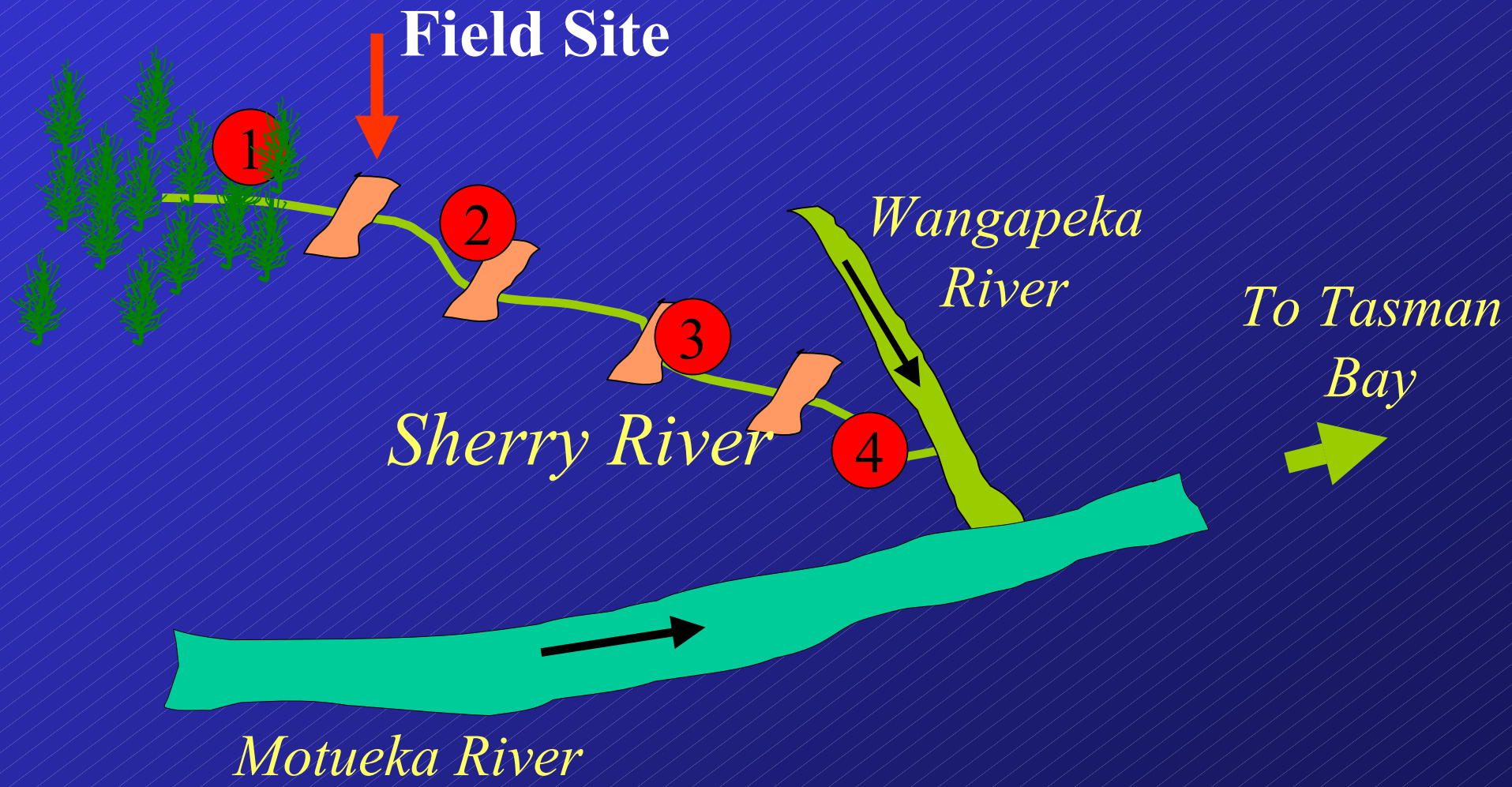
- **Adrian Meredith's (ECan) – pioneering work**
- ***E. coli* in streams up to 100,000 cfu/100 mL**
  - 300-1000 X guidelines!
- **SS and turbidity also increased markedly**


Sherry River
Motueka Catchment
8 0 8 16 Kilometers

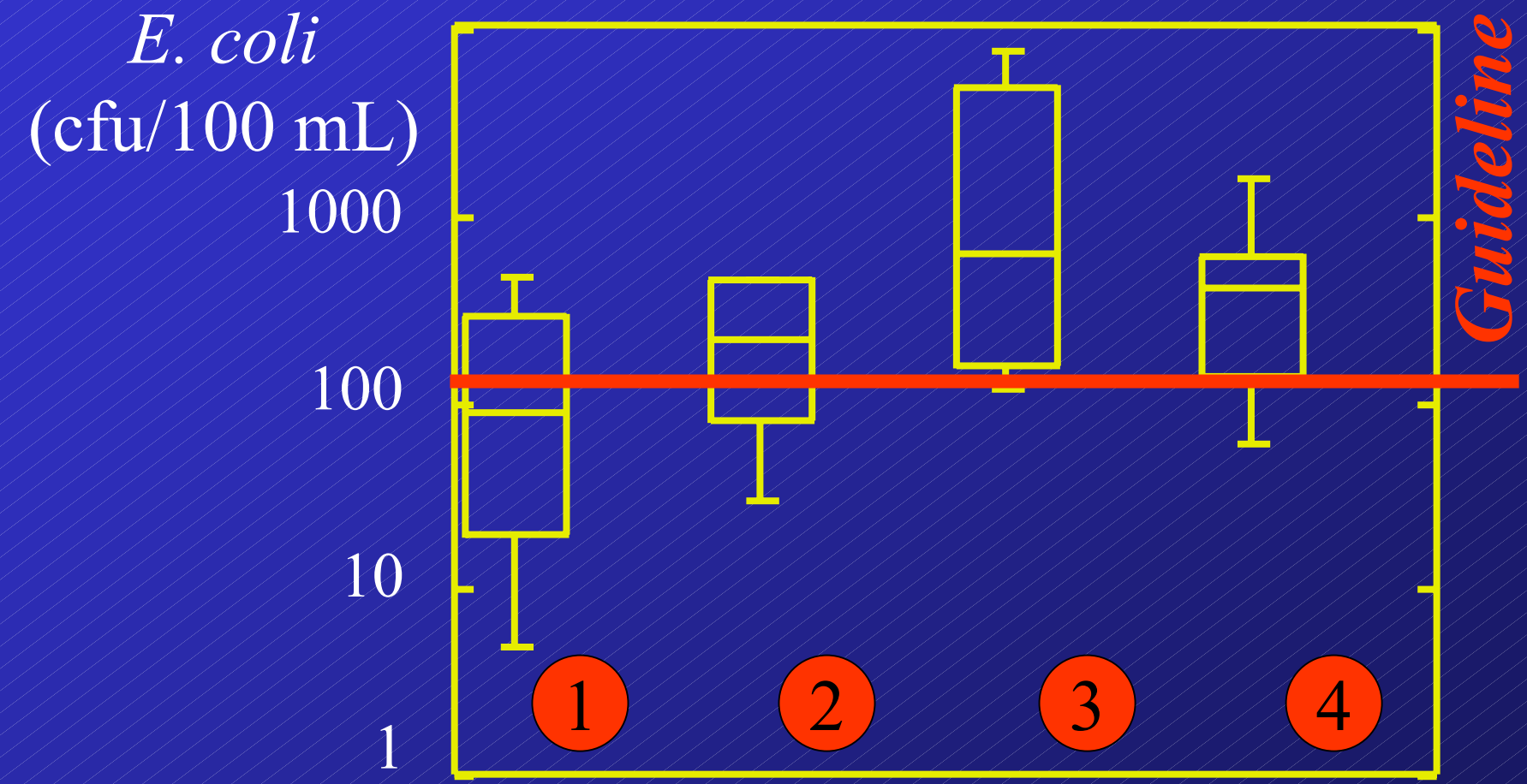
Sherry River Valley

- 4 dairy farms along the river
- All had crossings on raceways *(in late 2001)*
- 4 water quality monitoring sites (Cawthron)

Schematic – *Sherry River*



E. Coli data – *Sherry River*

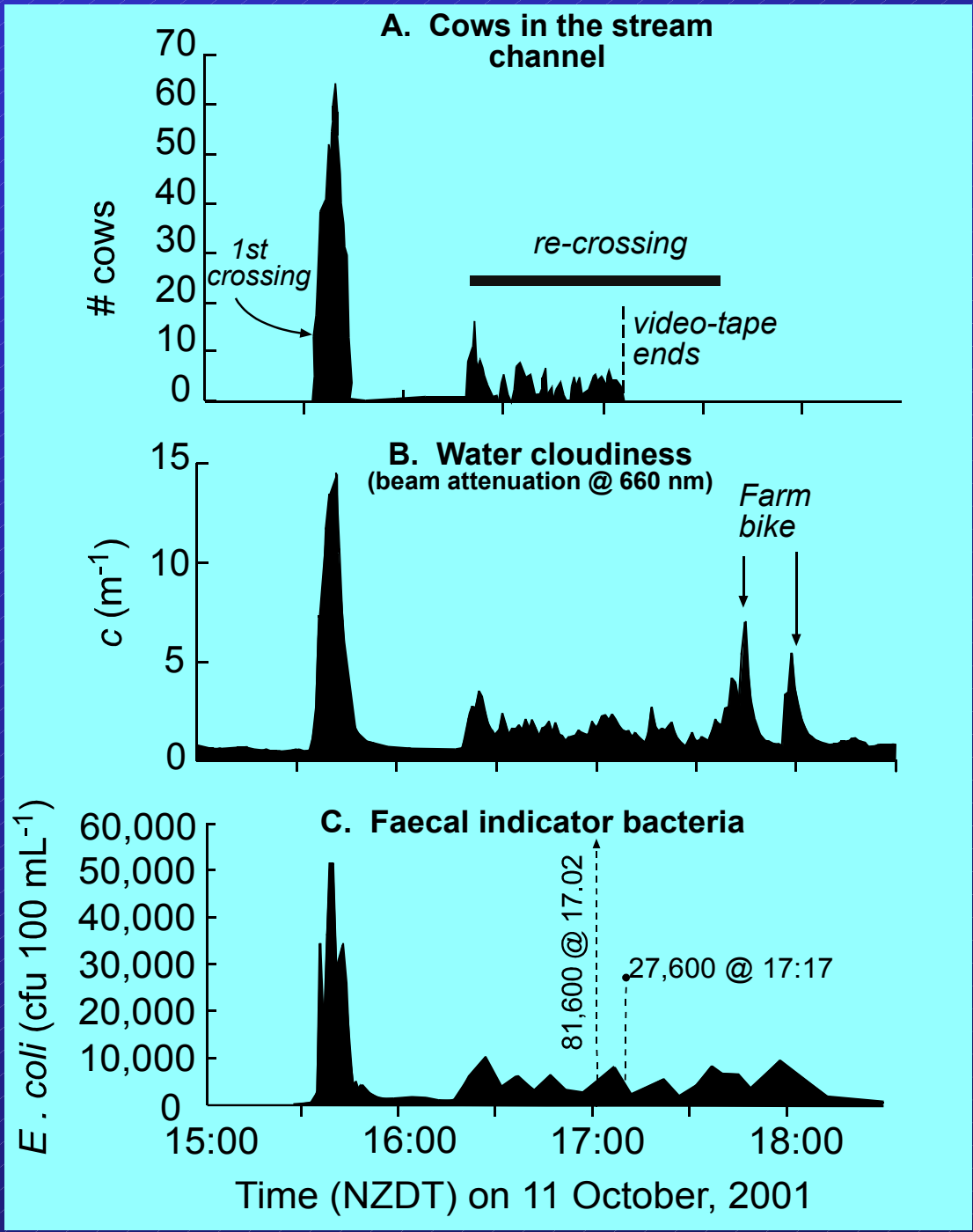


Study design

- Field site – highest dairy farm on Sherry R.
- 256 cow herd
- Video camera (count of cows)
- Water clarity - continuously monitored
- Sampling for TN, TSS, *E. coli*.
- Pats on the raceway sampled for *E. coli*.

Time series - crossing experiment

Pollutant concentrations correlate with cow count



Other findings

- 25 faecal ‘events’ counted on return crossing
- 10% of herd defecated
- 17.5 Kg of faeces
- 50 X as many faecal events in stream as elsewhere on raceway

Q – do cows poo more in water?

50 X slower speed in water?

- **Actually about 10X slower in stream**
- **Implies 5 X higher intrinsic rate of defaecation in stream**

Inference – cows DO crap more in water!

Contribution of crossings to total pollution load

- *E. coli* concentration quadrupled
- Cloudiness of water doubled –
  visual clarity halved
- Total Nitrogen increased 10%

Pollution from Xings more severe at low flow

Other crossing studies

- ***Puremahia Stream*** *(Golden Bay)*
  - Rob Smith (TDC)

- ***Tutaki River*** *(Upper Buller Catchment)*
  - John Nagels, Rob Smith

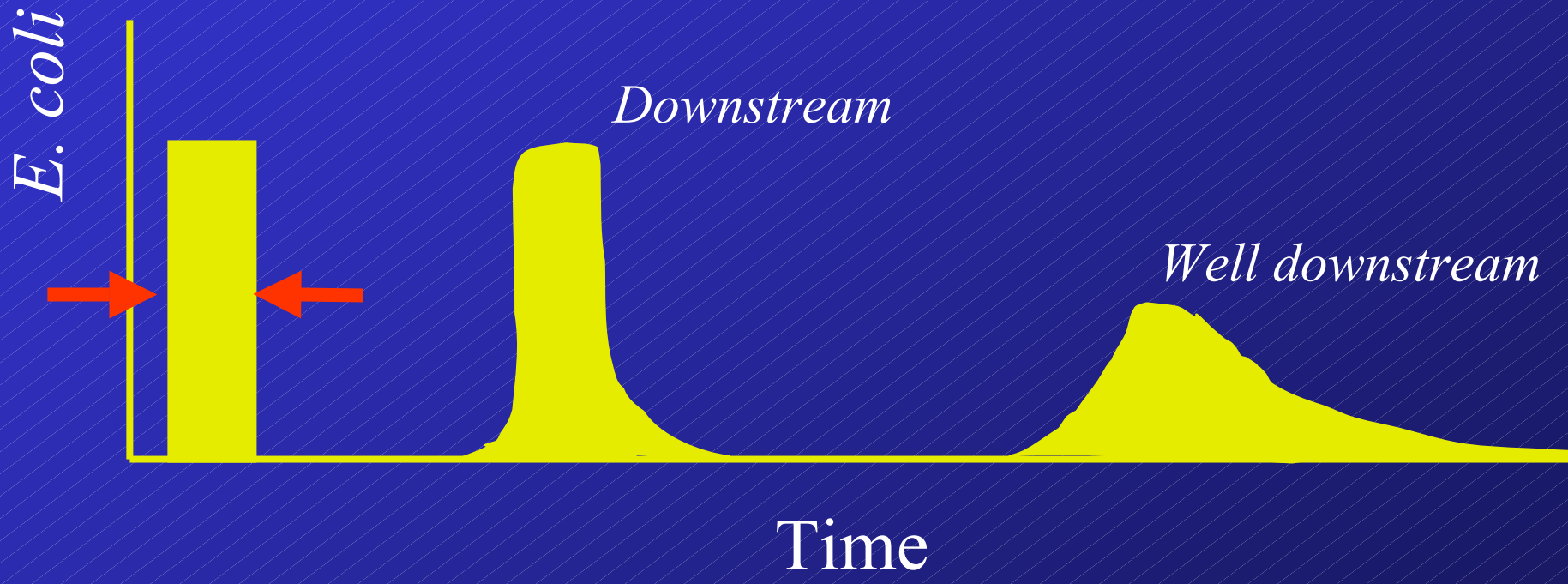
Comparable results,

except *E. coli* cfu/g faeces highly variable (100-fold)

Modelling (Cow Xing 'calculator')

- Developed for ECan/MfE
- Parameters:
  - Dispersion in stream
  - Herd size and crossing time
  - Assumes 8% of cows crap
  - *E. coli* /g faeces can be varied by user
  - Ignores settling to bed
    (and resuspension by hoof stirring)

Schematic of cow Xing calculator



Model ramifications

Difficult to have cows in streams without breaching guidelines for *E. coli*

Need -

- ***Small herds*** *(small input of faeces)*
- ***Slow crossings*** *(to dilute faeces)*
- ***Large streams*** *(to dilute faeces)*

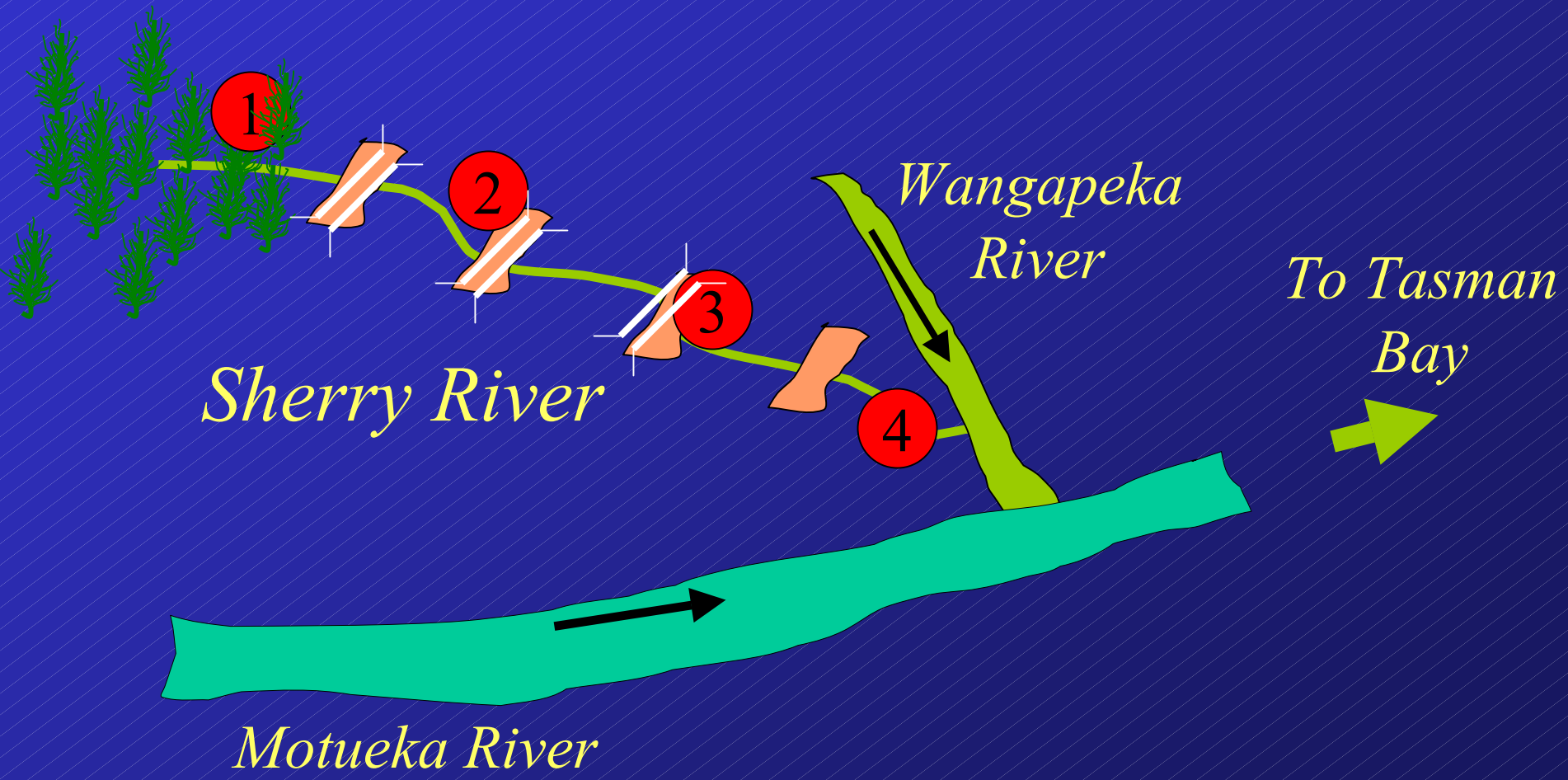
Calculation example

- 1 crap produces 10 Billion cfu of *E. coli*
- To dilute to 400 cfu/100 mL of *E. coli*, requires
  10^{10} /(4 X 10^{3}) = 2.5 X 10^{6} L = 2500 m^3 water
- A (large) 1 m^3/s stream takes 2500 s or 40 min to deliver that volume
- 8% of cows crap (or 1/12), so you can cross 12 cows every 40 minutes
  (or 1 every 3 minutes) – *VERY SLOW!*

Further work – *Sherry River* (the good news story)

- Since the Sherry crossing study - bridges have been built on raceways
- Monitoring is underway to document the expected improvement in water quality
- 4 sites monitored monthly
- Future experiments/Intensive studies

Schematic – *Sherry River*



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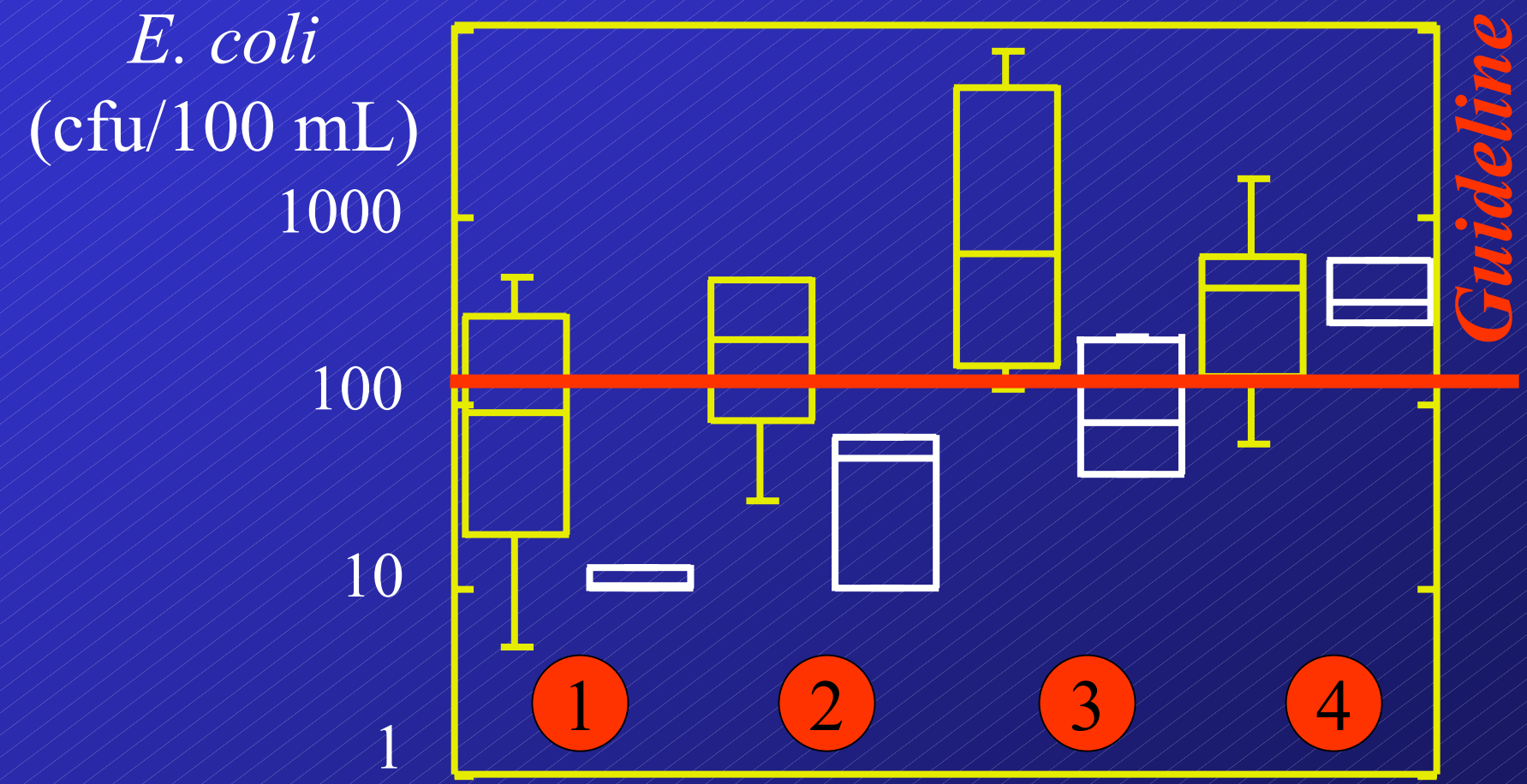

Conclusions

- **Cow crossings are significantly polluting**
  (May dominate faecal pollution of ag. streams)

- **Crossings will usually breach guidelines**
  (except 'unlikely' combinations….)

- **Bridging of crossings greatly reduces faecal pollution**

***Logical corollary* -** Cattle access to un-fenced streams has a high pollution potential