Land use and water quality in Te Waikoropupū springs

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Golden Bay

- Land-use changes in Takaka catchment
- How water quality has changed
- Why water quality has changed
- Comments on options

Land-use changes

- Pre 1842
  - Small Maori cultivations
  - Tall podocarp hardwood forest in valley
  - Beech forests on hill
- Forests largely cleared by early 1900s
- 1912 Takaka County
  - 60% of stock units were sheep
- 2012 Tasman District
  - Dairy now 60% of stock units
  - Plus intensification of farming on lowland areas

Other impacts

- Clearing marble mountain (1900–1940)
  - 10 to 30 cm measured soil loss
  - Erosion on steep hills
- Sheep in upper Cobb/Waingaro to 1951
- Mining (ceased 1963)
- Cobb Dam finished 1955
  - Earth dam
  - Flooded 2.1 km^2

Dairy

- Dairy factory started 1894
- Early 1920s
  - milking machines
  - superphosphate fertilizer
- 1929 – factory expanded
- Mid 1960s further expansion
  - Milk tankers
- 1969 factory expanded again
- 2005 current factory - 560 m^3 of milk per day

Lowland recharge-area changes

Year	Cows in Golden Bay	Cows in recharge area	Typical herd size
Mid 1910s	4 300	400	10
Mid 1960s	9 000	2 000	60
Mid 1970s	10 700	2 500	100
Mid 2000s	21 500	5 500	250 2.3 cows/ha
2014	30 000	6 700	360 2.8 cows/ha

Leaching losses

- 2.8 cows/ha on gravel soils Takaka valley
  - often 80 kg N /ha per year
    - high rainfall, well-drained soils, N additions
- Sheep and cattle farms
  - 15 to 20 kg N/ha per year
- Indigenous forestry*
  - 0.5 kg N/ha per year
- *Estimated leaching losses for unconfined aquifer: in the order of 200 - 250 t/year*

*Published figure for podocarp/beech forest

Consented water use in recharge area (000s m^3 / wk)

Year	Pre 70	1982	1987	1992	1997	2002	2007	2012
Water supply[1]	3	6	9	9	7	7	10	10
Irrigated volume	0	0	32[2]	32	28	30	163	287
Total water consented	3	6	41	41	35	38	173	297
Irrigated area	0	0	91	91	181	196	655	1021

1. Domestic, stock and dairy washing
2. From 1983

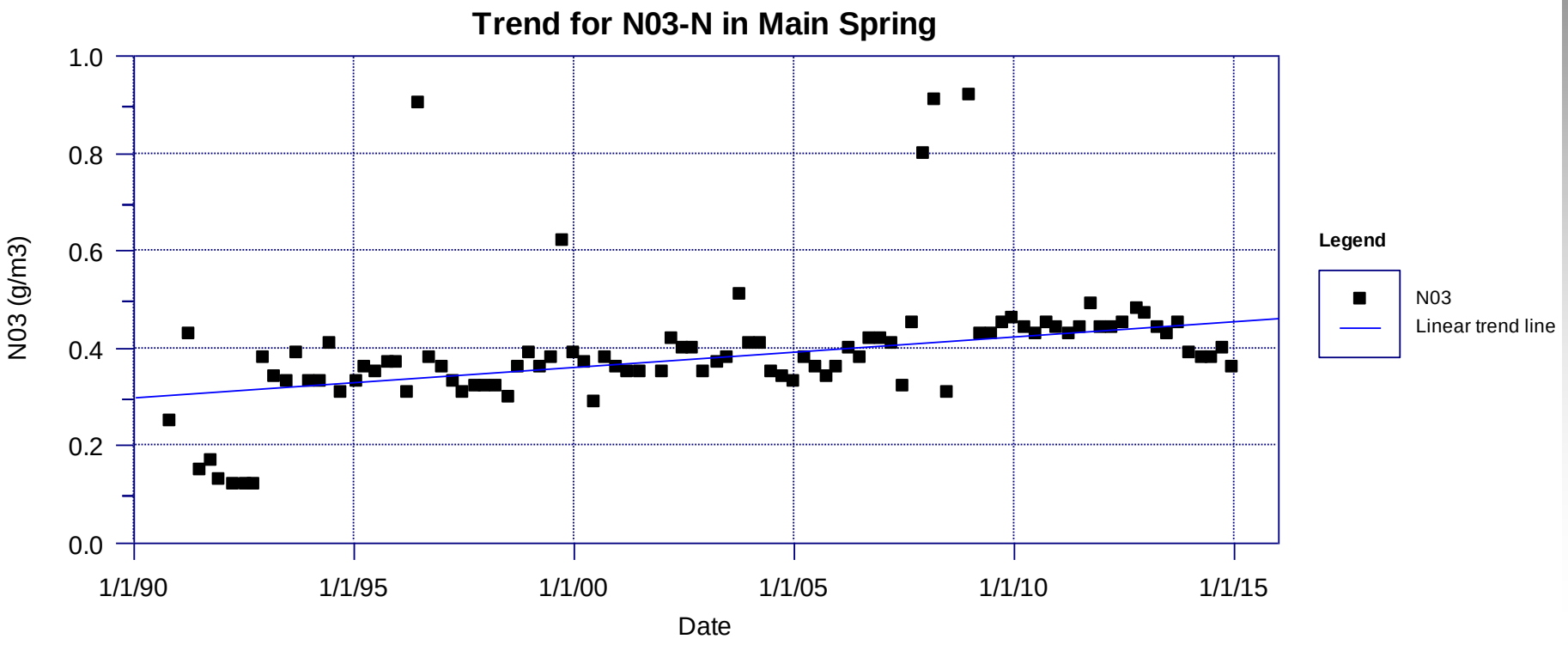
Actual metered irrigation use

- Irrigation usually mid-Nov to mid-April
  - 5 yr median use was 26% of allocated
- Highest in Feb – 40 to 80+% of approved

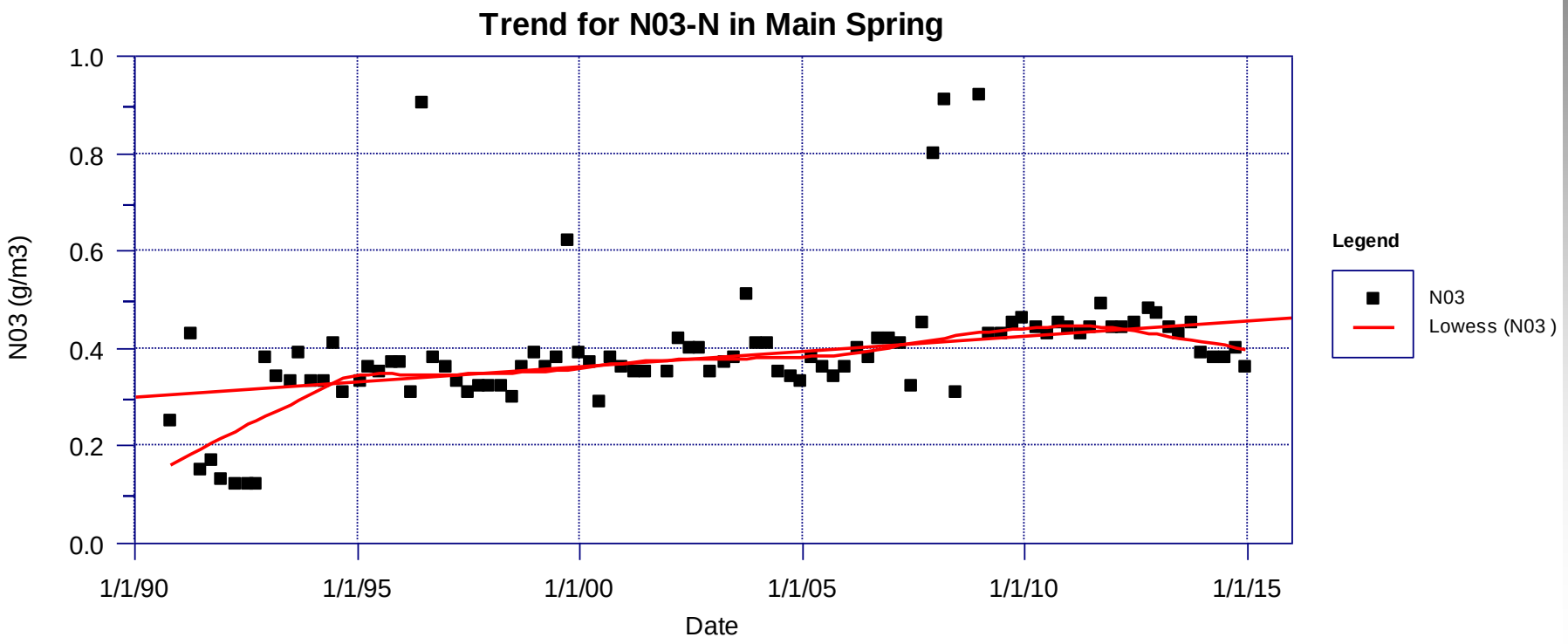
- In 2013-14 over 12 weeks
  - 2 million m^3 applied
    = 200 mm rainfall on the 1000 ha

What has happened?

1990 to 2014 Main spring



Median 0.38 g/m^3 **Rate of change 1.6% per year**



Lowess is locally weighted scatterplot smoothing

Indicates less increase in recent years

- Earliest water analyses 1970-71
  - Median NO_3-N was 0.31g/m^3
- Early 1990s nitrate was about half current level and *lower* than the 1970-71 results
- Reasons
  - **Improved farming practice**
  - Recovery from other disturbances
  - (Errors in analytical techniques?)

Fish Creek springs

- Very few analyses
- Flow-weighted nitrate concentration is about 23% higher than in the Main spring
  - Due to 75% of water in Fish Creek Spring coming from the shallow aquifer
- About 40% of nitrate moves in the shallow aquifer

Phosphate

- Less clear
  - Some high Total P concentrations in Main spring (limited data)
  - Most soluble P concentrations are low
  - However
    - Soluble P is higher in springs than the rivers
    - Total P can very high at Kotinga during floods

Takaka river

1. At the Harwood's nitrate has been decreasing by 13% per year since 1999
2. At Kotinga nitrate has remained stable
3. NO_3-N currently (base flow)
   - 0.005 g/m^3 at Harwood
   - 0.18 g/m^3 at Kotinga

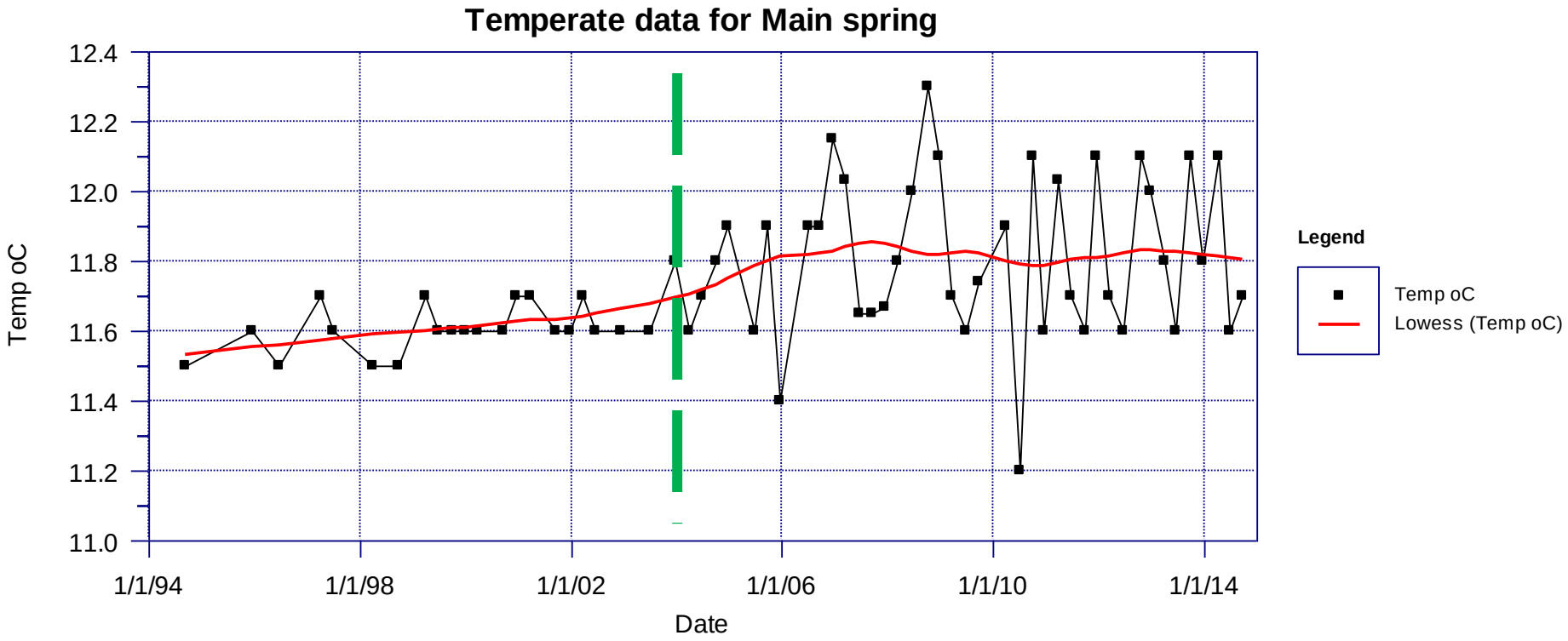
Nitrate-N discharges

- **Springs complex**
  - Pre farming – about 15 t/year
  - 1970 - about 100 t/year
  - 1990 - about 50 t/year
  - Current - about 200 t/year
- **Takaka river at Kotinga**
  - About 150 t/year (base flow)
- **Other losses from lower Takaka valley**

Water Temperature

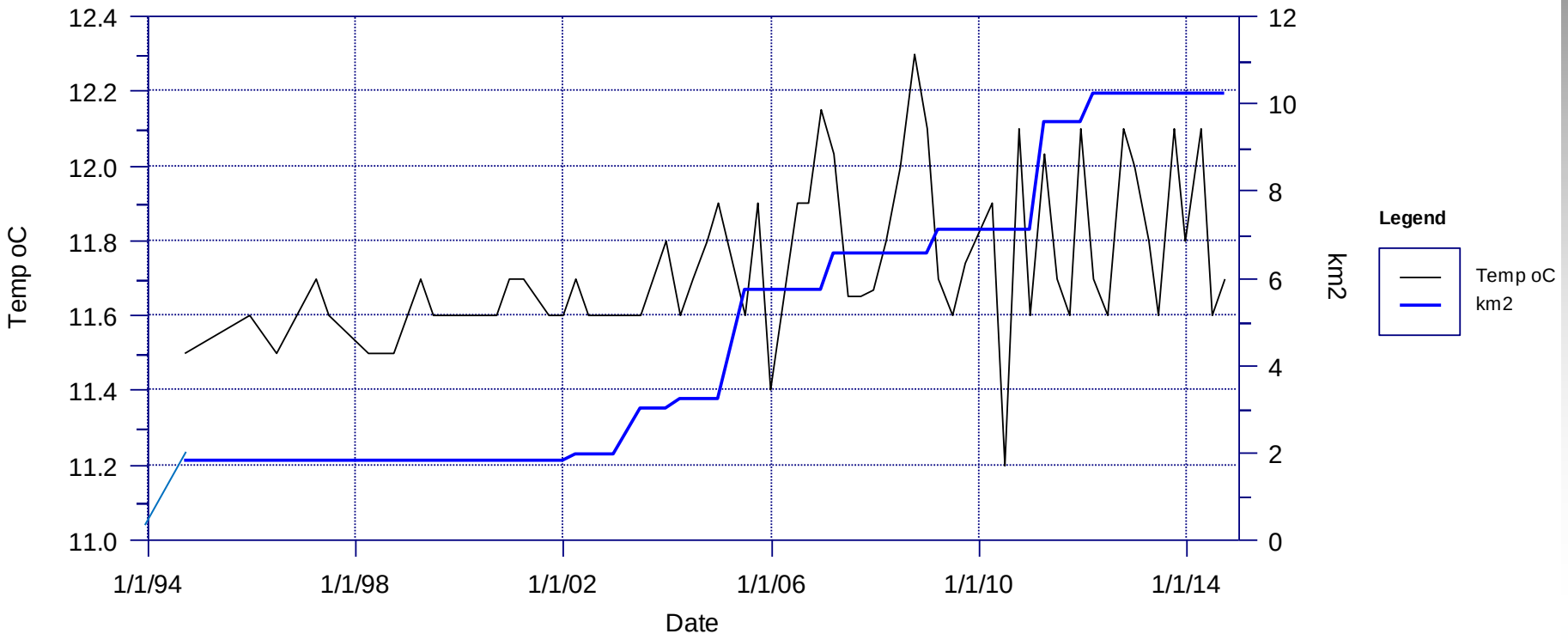
- **Water temperature influences**
  - Weed growth and biodiversity
- **Main spring**
  - 1970-71 constant 11.7 ^{o}C
  - 1975-76 11.5 ^{o}C
- **River temperatures**
  - large seasonal variation
  - but no significant trends with time

Water temperatures Main spring



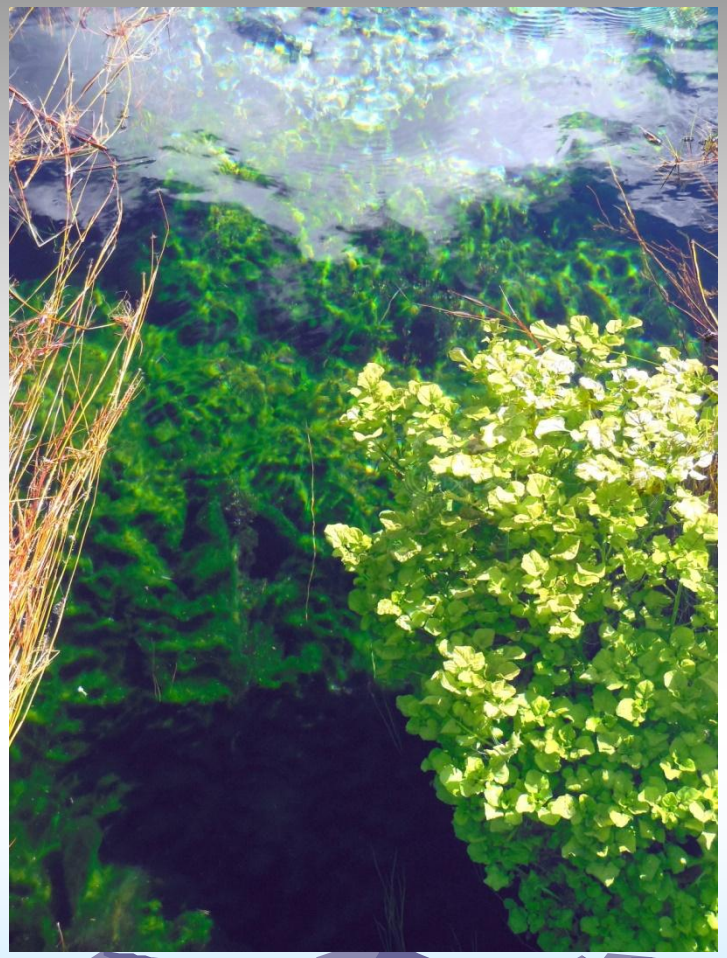
Pre 2004 median 11.6 ^{o}C stable – little variation
Post 2004 median 11.8 ^{o}C stable - greater variation
Winter temperatures 1994-2014 stable at 11.6 ^{o}C

Why?



Irrigated in dry, warm weather and high soil temperatures.
Illustrates sensitivity of system

Spring periphyton



- 4 studies between 1970 – 2012
  - Not fully analysed
  - Different methodologies

- Reduced weed-free area
- Several exotic weeds
  - Latest invasion detected 2005 and now covers 14% of spring.
  - Watercress is N responsive
- Periodically weeded by DOC

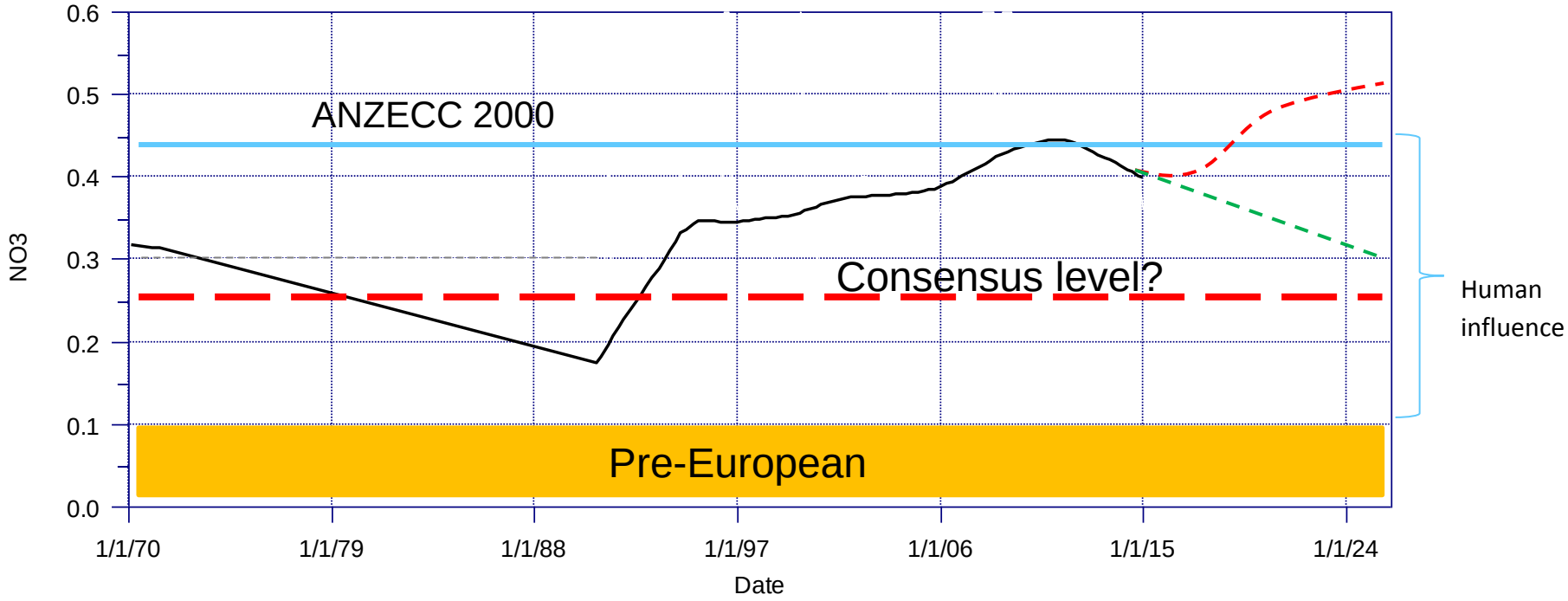
- Perhaps P limited (see Stark)
- Macro-invertebrates - no change

Comments on AMA management

- **Control by adaptive management**
  - Set goals
  - Select indicators
    - *Ideally these should be locally based*
    - Nitrate
    - Phosphate (the ‘critical’ P concentration is difficult for Springs periphyton)
    - Water clarity
    - Periphyton

Interpreting nitrate

1. ANZECC environmental guidelines
   - 0.44 g/m^3 lowland rivers - not karst systems
2. Nitrate levels in rivers above farming
   - About 0.01 g/m^3
3. Recent river natural estimates (2013)
   - 0.06 ± 0.03 g/m^3 for this climate, geology, topography
4. 2012 guidelines for natural groundwater
   - *up to* 0.25 g/m^3
5. National toxicity guidelines



Lowess trend for NO_3-N concentrations (1970 – 2014)

Dotted red and green lines illustrate possible future trends

What is the community's expectations for Te Waikoropupū springs and the AMA?

Thanks