Healthy Rivers

Craig Depree

Scope of evidence

- asked to review large amount of peer-reviewed technical work by relevant experts, and comment on:
  - need to manage all 4 contaminants (including nitrogen)
  - ‘adequacy’ of water quality modelling
  - whole- (i.e. FMU) vs sub-catchment scale management
- Additional comments: (*addressed in expert conferencing?*)
  - water quality at upper FMU ‘node’ (Karapiro)
  - application of lake trophic state attributes to the mainstem
  - E.coli attribute
  - inconsistent use of ‘band-testing’ (removed)

Managing all 4 contaminants

- V&S Obj. k – …safe to swim in and take food from…
- N, P, sediment & *E.coli* relevant to the values in Obj.k
- Need to manage N despite P being ‘more important’
  - trophic state effects – phytoplankton / periphyton / MCI
  - best practice = dual nutrient management (US EPA 2015)
  - nitrogen shown to limit maximum biomass in summer
  - toxicity (NPS-FM)
  - mainstem- ‘A’ toxicity; tributaries - several ‘C’ (20% effects)
  - *load to come* – of significant trends, 80% of TN increasing

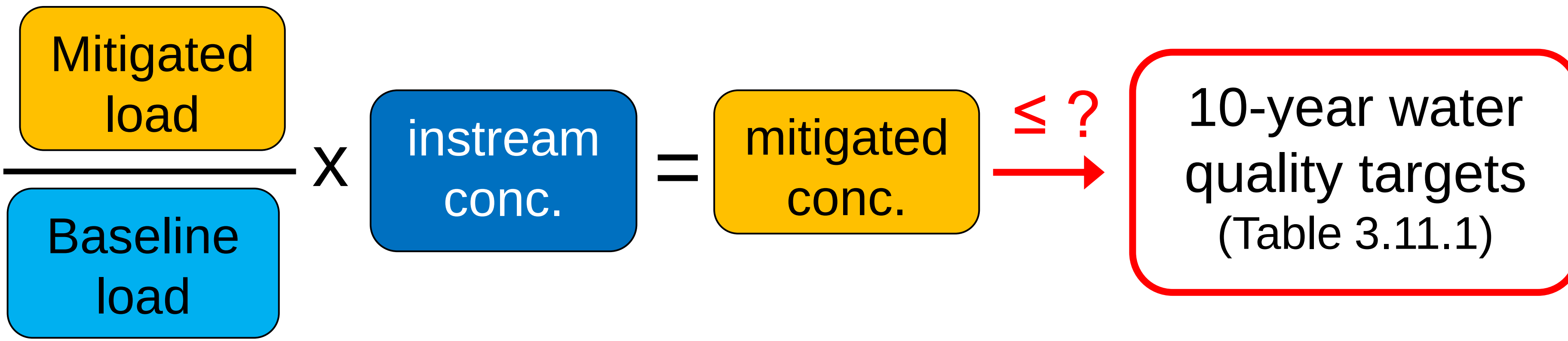
DairyNZ

‘Adequacy’ of water quality models

- not a water quality modelling expert, but recognizing...
  - done by experts, established models, and peer-reviewed
- to review ‘water quality’ aspects of PC1, it was necessary to understand how the models were used
- requirements:
  - converting subcatchment loads into instream loads/conc.
    - current state (“baseline”) and “mitigation” scenarios
  - estimating concentrations for subcatchment with no data
  - estimating clarity from changes in nutrient / sediment loads
- my understanding is that the modelling achieves these

Application of modelling for PC1

- from a water quality perspective in PC1…
- model instream concs. from applying policy mix
  - Doc #6551310, Doole et al. 2016



- compare these with PC1 10-year targets

Catchment (FMU) vs subcatchment

- largely irrelevant (if justification are 80y targets met)
- ‘Community’ set water quality targets (concs.)
- PC1 needs to make ≥10% progress against these
- PC1 proposes set of mitigations to achieve this
- tested via modelling (Doc #6551310, Doole et al. 2016)
  - done at subcatchment-scale (routed downstream)
- results indicated ‘policy mix’ achieved *magnitude* and *rate of change* required by PC1

Catchment (FMU) vs subcatchment

- PC1 requires 10% progress toward 80-yr targets
- Doc #6551310 (Doole et al. 2016; Table 5, p. 30)

Attribute	median improvement (%) rel. to 80-yr target
Chla (median)	72
TN (median)	33
TP (median)	31
Nitrate (median)	68
E.coli (95th%ile)	69

- PC1 policy mix meets10-yr target for all contaminants

Comments to improve 'logic'

(1) absence of water quality site at Karapiro

- Downstream boundary (node) of *upper FMU*
- Narrows argued as a proxy site for *upper FMU*
- If not, what is the water quality leaving the upper FMU?

(2) 'disconnect' between chla and clarity (upper FMU)

- Chla accounts for >50% of 'light attenuation' in upper lakes
- median Chla in upper FMU already compliant (≤5 mg/m^3)
- By contrast, clarity much lower than 80-yr target of 3 m
  - Waiapa = 2.1 m; Narrows (Karapiro proxy) = 1.8 m

Comments to improve 'logic'

(3) Use of NPS-FM lake trophic state to mainstem

- justified for *upper FMU* - c. 35 day residence time
- potential issues:
  - 'B'-band chla and TP, but 'A'-band TN - rationale?
  - *'seasonally stratified'* vs '*polymictic*' lake classification

- NPS-FM lake attribute numeric objective
  - *seasonally stratified*: **"A" = 160 mg/m^3; "B" = 350 mg/m^3**
  - *polymictic*: **"A" = 300 mg/m^3; "B" = 500 mg/m^3**

(3) Use of NPS-FM lake attribute to mainstem (cont.)

- little justification for applying to lower/middle FMU
  - uncertainty around the potential for lake TN/TP attributes to control chla in the mainstem (internal vs external sources)
  - How do nutrient targets in mainstem relate to chla / clarity ?