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Ecosystem Health – science, policy, and protecting and enhancing

DairyNZ

Overview

- What is ecosystem health
- How is it measured
- Complexity
- Proposed nutrient attributes (DIN/DRP)
- Relationship with nutrients
- Management through the NPS-FM
- Improving outcomes
- FEPs as an integrated tool
- Conclusions & take homes

What is ecosystem health?

- Universal term
- Many components
  - Aquatic life
  - Physical habitat
  - Water quality
  - Water quantity
  - Ecological processes
- Not a scientifically defined measure, rather is assessed on a range of physical, biological and chemical measures
- No universally accepted benchmark

How is ecosystem health measured?

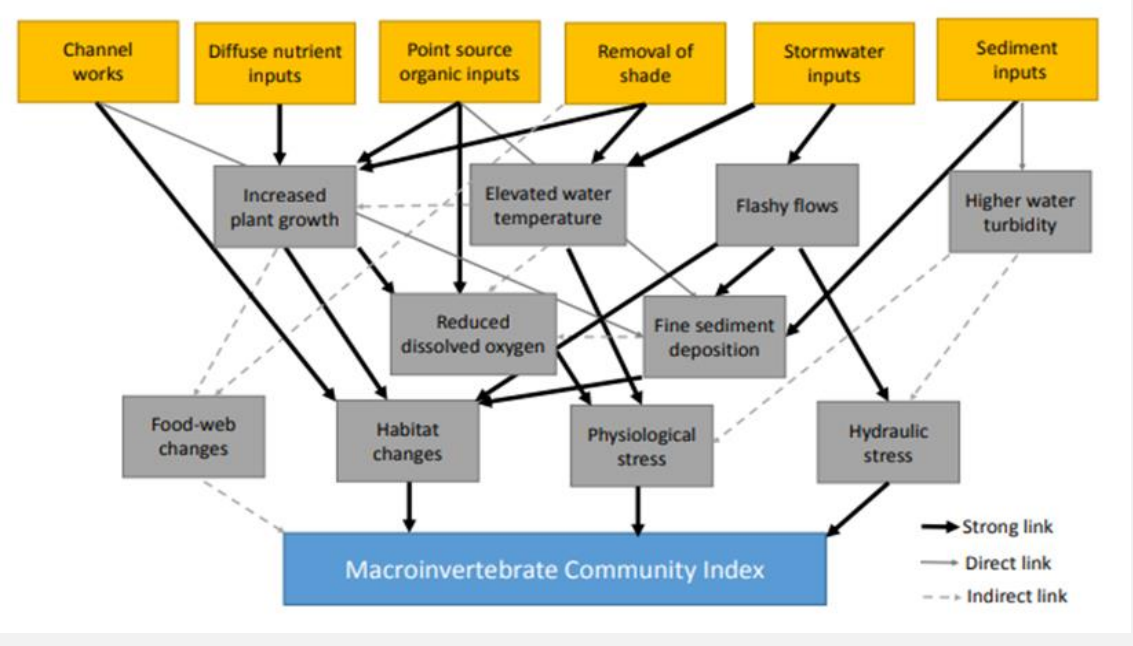
- Biological measures of EH (i.e., aquatic life) are important as WQ is not always a good indicator of aquatic organism health
- Generally assessed on the presence, absence and diversity of aquatic organisms
- In NZ
  - Macroinvertebrate Community Index (MCI)
  - Fish
  - Periphyton

Protecting ecosystem health is highly complex

- Ecological responses of streams to landuse in their catchments can be highly complex
- Nutrients can have adverse effects on EH directly (e.g., nitrate toxicity)
- Indirect effects generally have greater impact
  - Trophic effects (stimulating plant growth/production)
  - Habitat
  - Shade
  - Other physical processes

Protecting ecosystem health is highly complex

- Oversimplistic to assume that managing for single factors will deliver EH outcomes



Proposed ecosystem health nutrient attributes (DIN, DRP)

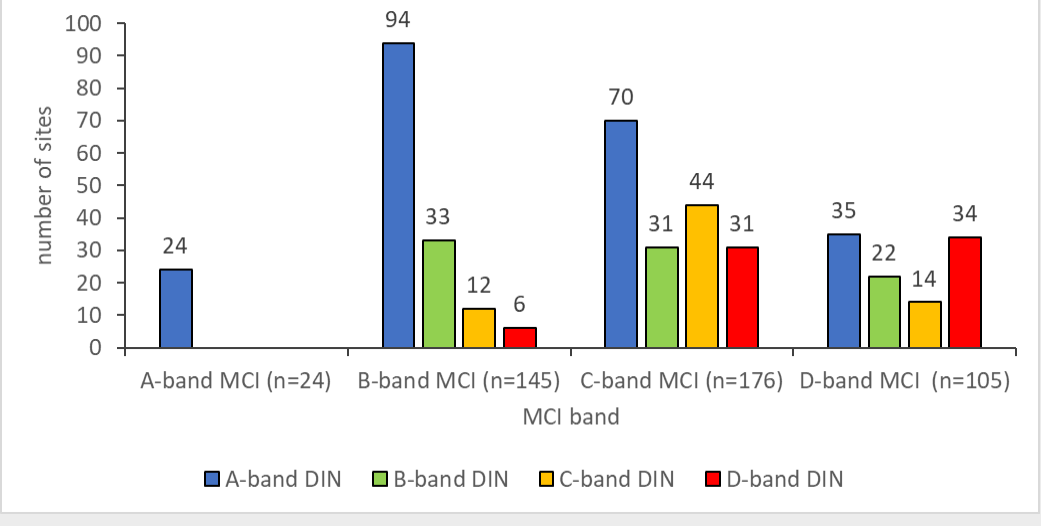
- EH already compulsory value in NPS-FM
- Nutrients are a driver of periphyton biomass…but for a given nutrient concentration…
- DIN and DRP largely superfluous
- Periphyton already considers downstream receiving environments
- If DIN/DRP national bottom lines introduced, sensible caveats/exemptions

Relationship between nutrients and ecosystem health

- Pingram et al. (2019): *Monitoring of ecological responses to human pressures, and subsequent mitigation interventions, is essential for sustainable environmental management. However, identifying causal pathways and mechanisms in multi-stressor settings remains challenging.'*
- Leps et al. (2015): *'It is broadly acknowledged that freshwater ecosystems are affected by multiple stressors, but the relative importance of individual stressors in impairing riverine communities remains unclear.'*
- Clapcott and Goodwin (2014): *'Overall results suggest that site MCI scores are related to land use through a complex chain of causality, which makes isolating the role of specific variables difficult.'*
- Graham et al. (2019): *'… no single driver was clearly dominant; the analyses conducted demonstrate that there are multiple drivers influencing each metric and the drivers likely interact with each other.'*

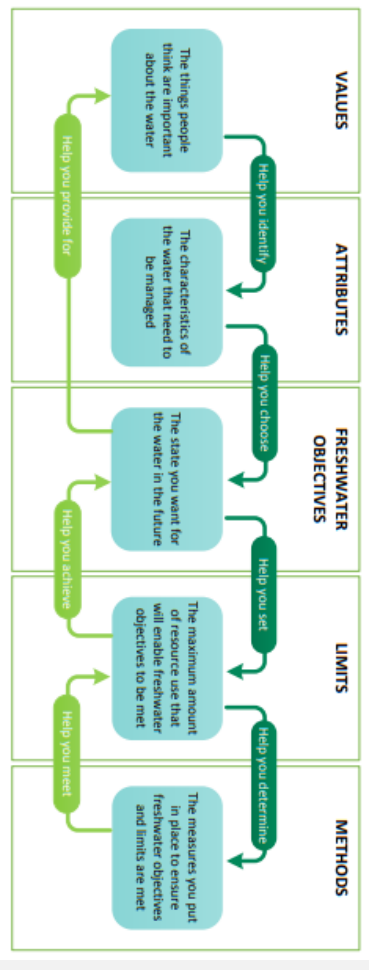
Relationship between nutrients and ecosystem health

- DIN (450 SoE sites 2013-2017)
- Comparing current MCI status and proposed nutrient bottom lines



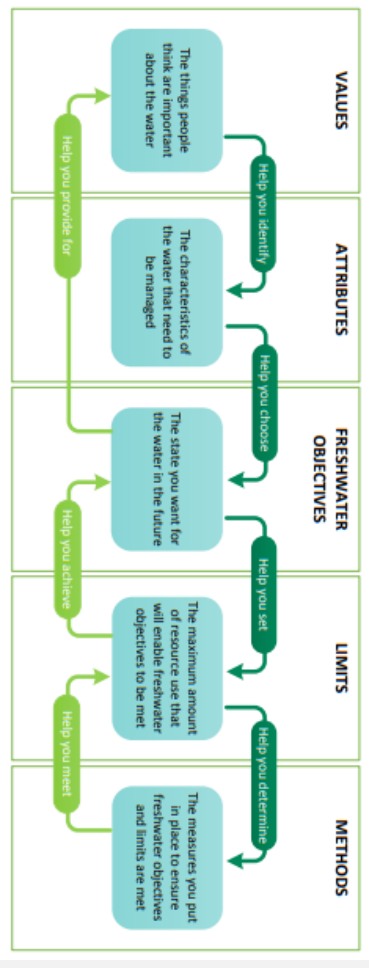
How is ecosystem health managed through the NPS-FM?

- Nitrate and ammonia toxicity – Attributes requiring limits on resource use
- Macroinvertebrate Community Indices (MCI, QMCI, ASPM) – Action Plan
- Periphyton attribute – Attribute requiring limits on resource use
- Both have bottom lines that set minimum levels of stream health
- If not met, councils to establish Action Plans or limit resource use to improve stream health
- Action plans are catchment specific and address all factors, not just nutrients



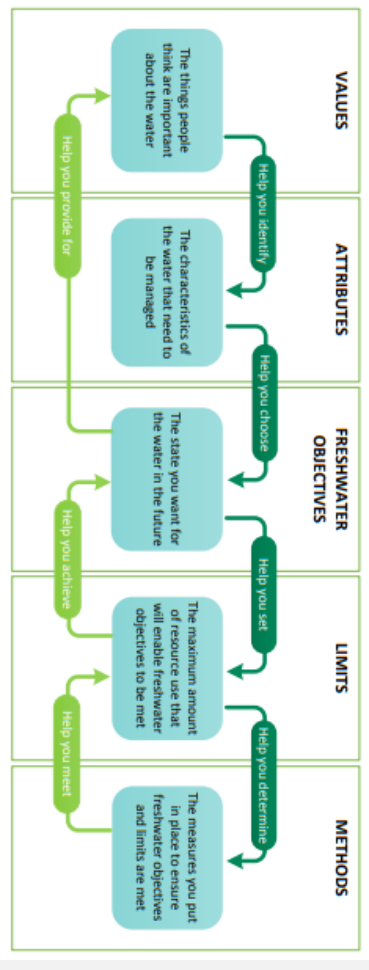
How is ecosystem health managed through the NPS-FM?

- Action Plan (MCI)
  - prepared for whole, part or multiple FMUs
  - set out a phased approach to achieving enviro outcomes
  - may be composed of regulatory and non-regulatory measures
  - set out how regional council will achieve the target attribute state
  - can be part of a regional plan, or separate
  - consultative approach with communities and tangata whenua
  - must be reviewed within 5 years



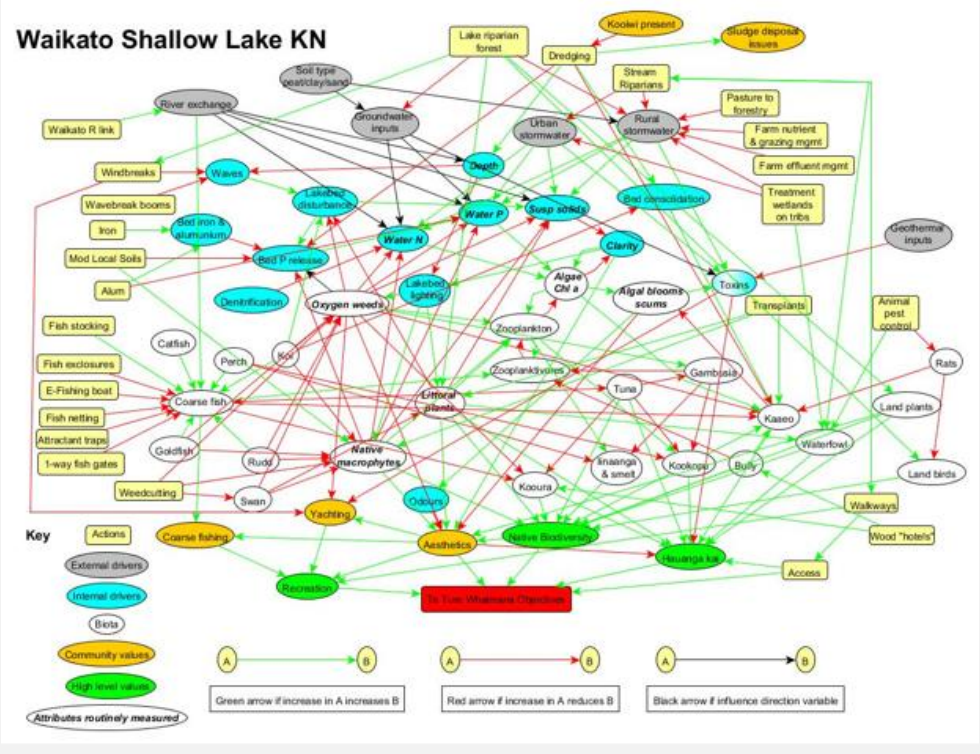
How is ecosystem health managed through the NPS-FM?

- Setting limits on resource use (periphyton)
  - Limits on resources may apply to activity or landuse
  - Apply at any scale
  - Control resources through land-use control; input control; output control
  - Ensure that instream concentrations and exceedance criteria are achieved



Improving ecosystem health outcomes

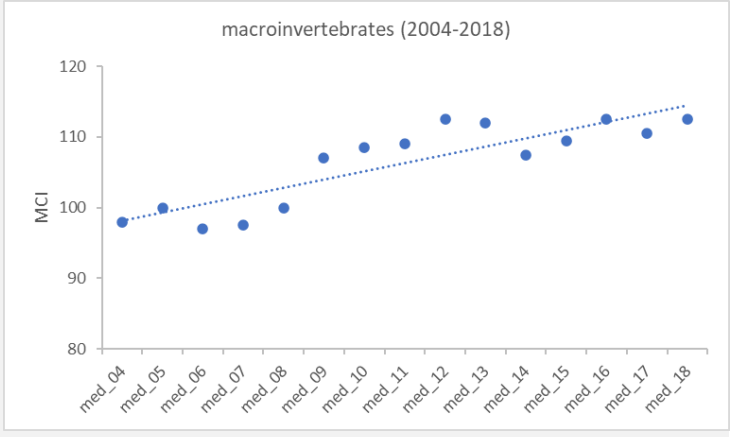
- Protecting ecosystem health is highly complex
- Changes in landuse generally associated with changes in EH
- Implement changes that mimic unmodified landscapes



Improving ecosystem health outcomes

- Vegetate stream margins
  - Decrease amount of light reaching the water
  - Decrease stream temperatures
  - Create habitat for adult aquatic insects
  - Decrease deposited and suspended fine sediment
  - Create terrestrial food sources
  - Increase instream habitat complexity and flow complexity
- Keep stock out of waterways
  - Decrease stock trampling of banks
  - Decrease direct defecation
- Protect smaller waterways and wetlands
  - Disproportionate contribution of contaminants

Improving ecosystem health outcomes



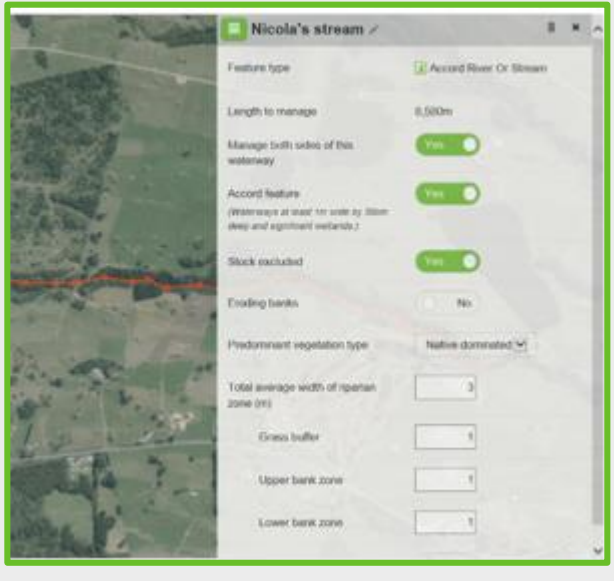
Taranaki case-study

- 1996
- 2019 - 99.5% of dairy farmers had riparian planting plans
- 14,000km fencing, 9,000km streambank planted
- >5.6 million native plants

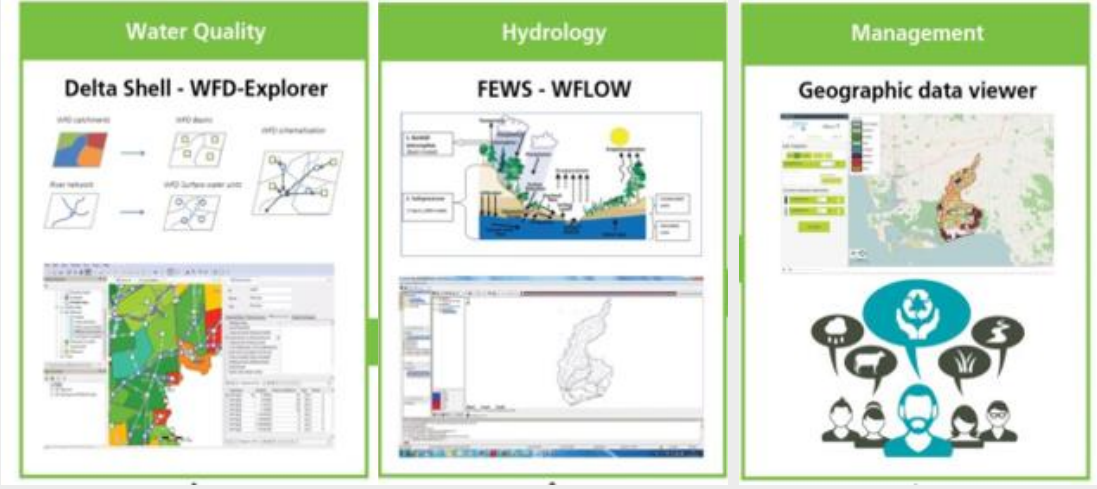
- Waiokoura – 1200 ha. WQ in 2001 – high turbidity, elevated nutrients and very high levels of faecal pathogens
- Key mitigations – irrigation of FDE, stock exclusion, riparian planting
- Between 2001 and 2008, 25-40% reduction in phosphorus and suspended sediment
- Marked improvement in biological measures of stream ecosystem health

Farm Environment Plans – linking prioritised action to outcomes

- FEPs represent an opportunity to focus and prioritise efforts on the most pressing issues
- Gives individual farm context within its catchment
- An approach for linking actions to outcomes based on WQ issues and typographical landscape features



Farm Environment Plans – linking prioritised action to outcomes



Conclusions and take home messages

- Ecosystem health needs to be managed
- Means accepting complex relationships
- MCI integrators of water quality and habitat
- Nutrients shouldn't be main lever to address ecosystem
- EH managed through toxicity, macroinvertebrate, periphyton attributes (both limit setting and action plan)
- Improving outcomes requires multiple management approaches
- FEPs to identify key catchment issues, key options based on the physical and environmental attributes of the farm