



Wai Ora
HE RAUTAKI WHAKAPAIPAI



RAUKAWA CHARITABLE TRUST
TE POARI MANAAKI O RAUKAWA



TŪWHARETOA
MĀORI TRUST BOARD



Population of a Waikato Objective Framework

Report back from TLG on defining attributes for Human Health, Ecosystem Health and Mahinga Kai

CSG7 – Reporoa 31 Oct 2014

Mike Scarsbrook & Antoine Coffin - TLG

Expert Panel Workshop

- Purpose:
 - To populate a Waikato Objectives Framework with appropriate attributes relating to
 - Human Health ('Swimmability')
 - Ecosystem Health ('Healthy Biodiversity')
 - Mahinga Kai ('Fishable')
- Why?
 - Give effect to values within Vision & Strategy
 - Attributes will provide an objective measure of current state – where do we have problems?
 - Attributes are basis for setting objectives, limits and targets

Expert Panel Workshop (30/9/14)

- **Panel members**

- Bill Vant (WRC) – Water quality
- Bruno David (WRC) – Native fish
- Chris Hickey (NIWA) - Ecotoxicology
- Chris Koroheke (AgResearch) – Matauranga Maori
- David Hamilton (University of Waikato) – Lake ecosystems
- John Te Maru (Waikato-Tainui College for R&D) – Matauranga Maori
- Kevin Collier (University of Waikato) – Stream ecosystems
- Ngaire Phillips (Streamlined Environmental) – Stream ecosystems & Matauranga Maori

Expert Panel Workshop

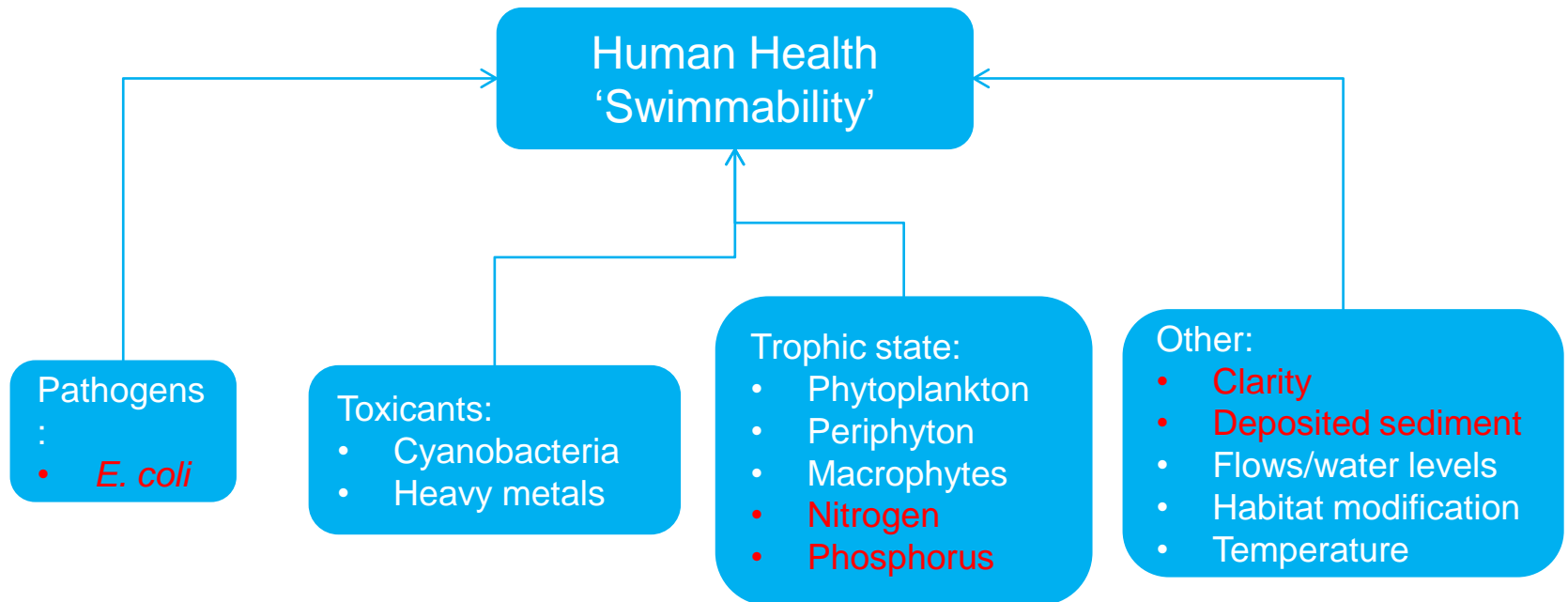
- **Process:**

1. For each value, the Panel reviewed existing attributes contained in the NPS-FM (2014) and assessed applicability to the Waikato-Waipā
2. Where appropriate the attributes were modified to improve relevance to Waikato-Waipā lake and river habitats
3. The Panel also provided advice on additional attributes relevant to the three values
4. Draft reviewed and approved by TLG

Expert Panel Workshop

- Assumptions adopted for workshop process:
 1. 'Swimmability' is a value applied to all waterways, at all times of the year, and under all flow conditions
 2. Wetlands and groundwaters were out of scope of this work
 3. Attributes should relate to four main contaminants (N, P, sediment & faecal contaminants)

Human Health



Human Health

Recommendations to CSG:

- Apply *E. coli* attribute as per NPS-FM
- Apply Planktonic Cyanobacteria attribute, but extend to include sections of some lowland rivers
- Develop and apply a Water Clarity attribute to lakes and rivers in the Waikato-Waipā catchment
- Develop narrative statements relating to physical safety and aesthetics (based on Tikanga and Mātauranga Māori)

Value	Human health for recreation		
Freshwater Body Type	Lakes and rivers		
Attribute	<i>E. coli</i> *		
Attribute Unit	<i>E. coli</i> /100 mL (number of <i>E. coli</i> per hundred millilitres)		
Attribute State	Numeric Attribute State	Sampling Statistic	Narrative Attribute State
A	≤260	Annual median	People are exposed to a very low risk of infection (less than 0.1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95 th percentile	People are exposed to a low risk of infection (up to 1% risk) when undertaking activities likely to involve full immersion.
B	>260 and ≤540	Annual median	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95 th percentile	People are exposed to a moderate risk of infection (less than 5% risk) when undertaking activities likely to involve full immersion. 540 / 100ml is the minimum acceptable state for activities likely to involve full immersion.
C	>540 and ≤1000	Annual median	People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating). People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities likely to involve immersion.
National Bottom Line	1000	Annual median	
D	>1000	Annual median	People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).

E. coli

Existing NPS-FM attribute

Apply to all Waikato lakes and rivers

Seek clarification from MfE on sampling regime

Acceptable for swimming

Unacceptable for swimming

**Escherichia coli*

Value	Human health for recreation	
Freshwater Body Type	Lakes and lake fed rivers	
Attribute	Cyanobacteria - Planktonic	
Attribute Unit	Biovolume - mm^3/L (cubic millimetres per litre) OR Cell Count - cells/mL (cells per millilitre)	
Attribute State	Numeric Attribute State	Narrative Attribute State
	80 th percentile*	
A	$\leq 0.5 \text{ mm}^3/\text{L}$ biovolume equivalent for the combined total of all cyanobacteria OR ≤ 500 cells/mL of total cyanobacteria	Risk exposure from cyanobacteria is no different to that in natural conditions (from any contact with fresh water).
B	N/A	
C	> 0.5 and $\leq 1.8 \text{ mm}^3/\text{L}$ biovolume equivalent of potentially toxic cyanobacteria OR > 0.5 and $\leq 10 \text{ mm}^3/\text{L}$ total biovolume of all cyanobacteria	Low risk of health effects from exposure to cyanobacteria (from any contact with fresh water).
National Bottom Line	$1.8 \text{ mm}^3/\text{L}$ Biovolume equivalent of potentially toxic cyanobacteria OR $10 \text{ mm}^3/\text{L}$ total biovolume of all cyanobacteria	
D	Biovolume equivalent of $> 1.8 \text{ mm}^3/\text{L}$ of potentially toxic cyanobacteria OR $> 10 \text{ mm}^3/\text{L}$ total biovolume of all cyanobacteria	Potential health risks (eg. respiratory, irritation and allergy symptoms) exist from exposure to cyanobacteria (from any contact with fresh water).

* The 80th percentile must be calculated using a minimum of 12 samples collected over 3 years. 30 samples collected over 3 years is recommended.

Cyanobacteria

Existing NPS-FM attribute

Apply to Lakes and lake-fed rivers

Extend to some lowland rivers above Waikato River junction



'Swimmability' – Water clarity (NEW)

Value	'Swimmability'	
Freshwater Body Type	Lakes & rivers	
Attribute	Water clarity	
Attribute Unit	m (measured using agreed methods e.g. horizontal Black disc in rivers)	
Attribute State	Numeric Attribute State	Narrative Attribute State
	Median of samples (excluding flood flows*)	Lakes with naturally low clarity (e.g. peat-stained) will need to be treated separately
A	≥4	Water clarity is deemed excellent for swimming (WRISS)
B	≥1.6 and <4	Water clarity is deemed suitable for swimming**
C	≥1.0 and <1.6	Water clarity is deemed marginally suitable for swimming**
Minimum acceptable state	1.0	
D	<1.0	Water clarity is deemed unsuitable for swimming

* WRC analysis of water clarity excludes the top 10% of flows

** Smith, D. G. & Davies-Colley, R. J. 1992. Perception of water clarity and colour in terms of suitability for recreational use. Journal of Environmental Management 36: 225-235.

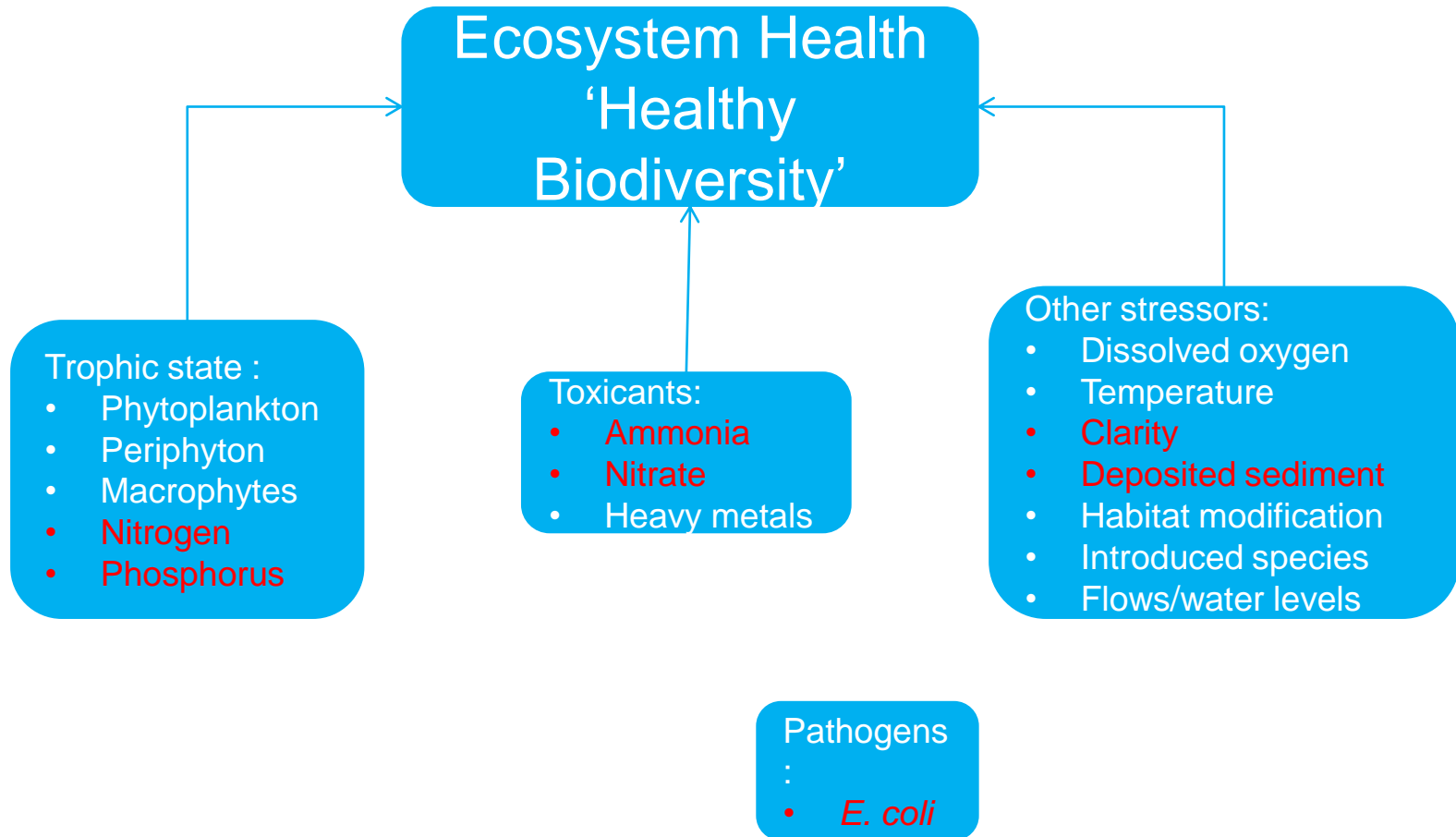
‘Swimmability’ – ‘Choice’ attributes

- Colour/Odour
- Bed sediments
- Aquatic weeds/algae
- Debris/snags
- Bank condition
- Access
- Habitat (e.g. presence of trees for swings)

Further development needed – narrative rather than numeric

Strongly linked to cultural and social values

Ecosystem Health



Ecosystem Health

Recommendations to CSG:

- Apply Phytoplankton, TN and TP attribute as per NPS-FM, but extend the Freshwater Body Type to include sections of some lowland rivers
- Do not apply the Periphyton (attached algae) Attribute as per NPS-FM - limited relevance in the Waikato-Waipā catchment
- Develop a set of Nutrient indicators that could be applied to rivers that are not covered by TN or TP attributes
 - Could be used to identify 'hotspots' or high value areas within FMU

Ecosystem Health – Phytoplankton

- Apply to whole of Waikato River mainstem (including hydrolakes)
- Extend to some lowland rivers above Waikato River junction



Value	Ecosystem health		
Freshwater Body Type	Lakes		
Attribute	Phytoplankton (Trophic state)		
Attribute Unit	mg/m ³ (milligrams chlorophyll-a per cubic metre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	Annual Median	Annual Maximum	
A	≤2	≤10	Lake ecological communities are healthy and resilient, similar to natural reference conditions.
B	>2 and ≤5	>10 and ≤25	Lake ecological communities are slightly impacted by additional algal and plant growth arising from nutrients levels that are elevated above natural reference conditions.
C	>5 and ≤12	>25 and ≤60	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrients levels that are elevated well above natural reference conditions.
National Bottom Line	12	60	
D	>12	>60	Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state, due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.

Value	Ecosystem health		
Freshwater Body Type	Lakes		
Attribute	Total Nitrogen (Trophic state)		
Attribute Unit	mg/m ³ (milligrams per cubic metre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	Annual Median	Annual Median	
	Seasonally Stratified and Brackish*	Polyoictic	
A	≤160	≤300	Lake ecological communities are healthy and resilient, similar to natural reference conditions.
B	>160 and ≤350	>300 and ≤500	Lake ecological communities are slightly impacted by additional algal and plant growth arising from nutrients levels that are elevated above natural reference conditions.
C	>350 and ≤750	>500 and ≤800	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrients levels that are elevated well above natural reference conditions
National Bottom Line	750	800	
D	>750	>800	Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state, due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.

* Intermittently closing and opening lagoons (ICOLs) are not included in brackish lakes.

Ecosystem Health – TN

- Apply to whole of Waikato River mainstem (including hydrolakes)
- Extend to some lowland rivers above Waikato River junction
- Use numbers for ‘Seasonally Stratified’

Ecosystem Health - TP

Value	Ecosystem health	
Freshwater Body Type	Lakes	
Attribute	Total Phosphorus (Trophic state)	
Attribute Unit	mg/m ³ (milligrams per cubic metre)	
Attribute State	Numeric Attribute State	Narrative Attribute State
	Annual Median	
A	≤10	Lake ecological communities are healthy and resilient, similar to natural reference conditions.
B	>10 and ≤20	Lake ecological communities are slightly impacted by additional algal and plant growth arising from nutrients levels that are elevated above natural reference conditions.
C	>20 and ≤50	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrients levels that are elevated well above natural reference conditions.
National Bottom Line	50	
D	>50	Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state, due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.

- Apply to whole of Waikato River mainstem (including hydrolakes)
- Extend to some lowland rivers above Waikato River junction

Where do Waikato River sites sit?

	CHLA	TN	TP
Taupo Control Gates	A	A	A
Ohaaki Br	A	A	B
Ohakuri Tailrace Br	B	B	C
Whakamaru Tailrace	C	B	C
Waipapa Tailrace	B	B	C
Narrows Br	C	C	C
Horotiu Br	C	C	C
Huntly-Tainui Br	C	C	D
Mercer Br	C-D	C	D
Tuakau	C-D	C	D

Based on average of 5 annual medians (2008-2012)

May help with defining FMUs?

Ecosystem Health

Recommendations to CSG:

- Apply Nitrate & Ammonia (toxicity) attributes as per NPS-FM
- Apply Dissolved Oxygen attribute as per NPS-FM, but extend the Freshwater Body Type to include all rivers rather than just below point sources
- Develop a “Light Climate” attribute to lakes and large rivers in the Waikato-Waipā catchment (could be same as Clarity)
- Develop a Submerged Macrophyte attribute for rivers in the Waikato-Waipā catchment
- Develop a Deposited Sediment attribute for wadeable rivers
- Develop a Temperature attribute for rivers in the Waikato-Waipā catchment

Value	Ecosystem health		
Freshwater Body Type	Rivers (below point sources)		
Attribute	Dissolved Oxygen		
Attribute Unit	mg/L. (milligrams per litre)		
Attribute State	Numeric Attribute State	Narrative Attribute State	
	7-day mean minimum ¹ (Summer Period: 1 November to 30th April)	1-day minimum ² (Summer Period: 1 November to 30th April)	
A	≥8.0	≥7.5	No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites.
B	≥7.0 and <8.0	≥5.0 and <7.5	Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.
C	≥5.0 and <7.0	≥4.0 and <5.0	Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrate species being lost.
National Bottom Line	5.0	4.0	
D	<5.0	<4.0	Significant, persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.

1. The mean value of 7 consecutive daily minimum values.

2. The lowest daily minimum across the whole summer period.

Ecosystem Health Dissolved Oxygen

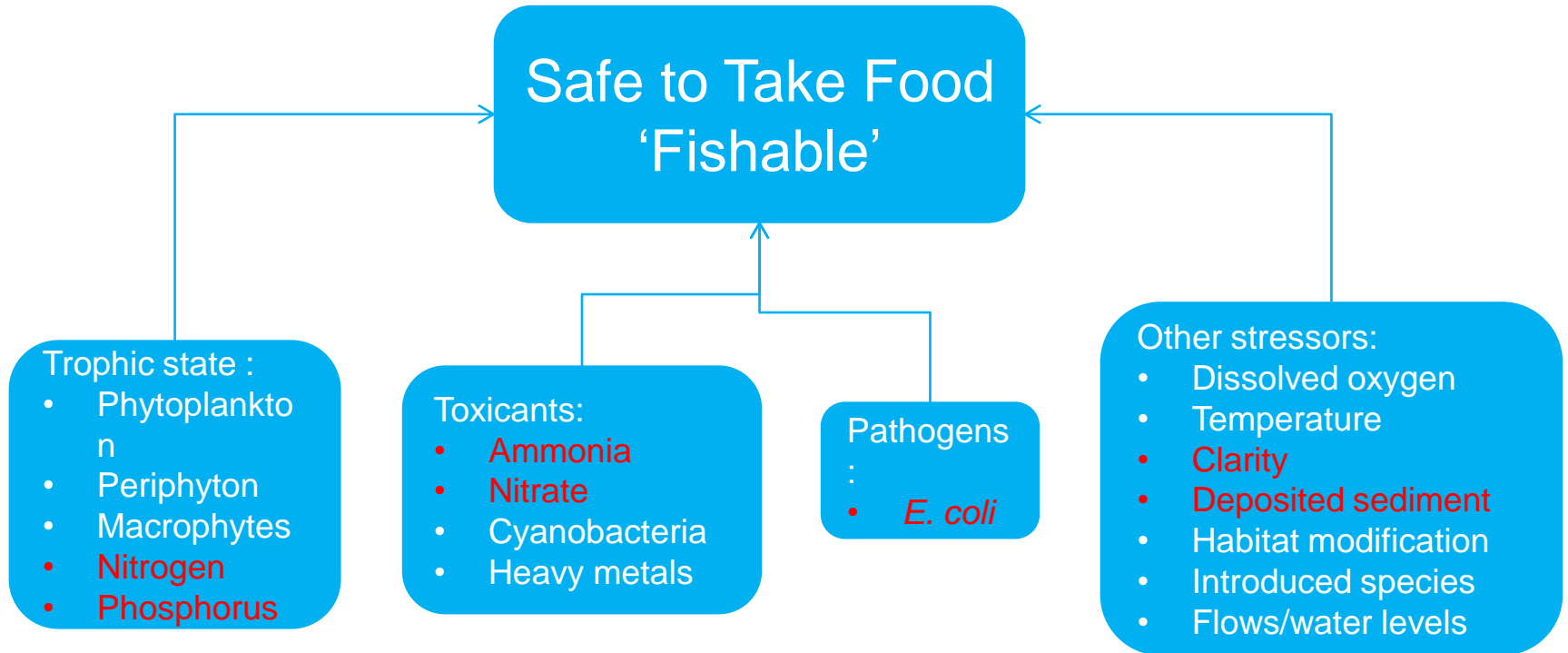
NPS-FM attribute, but applies only to below point sources

Recommend extending to all rivers

Important constraint on Ecosystem Health in lowland streams

Driven by macrophytes – difficult to control (4 contaminants)

Mahinga Kai



Mahinga Kai

Different aspects

1. Food is safe to eat
2. Food stocks are sufficient to be fit for purpose
3. Intergenerational supply
4. Access
5. Knowledge transfer

Mahinga Kai

Develop & apply attributes relating to:

- E. coli levels (likely to be more stringent than swimming)
- Cyanobacteria (shellfish)
- Heavy metals
- Catch-Per-Unit-Effort (bands could be linked to different purposes such as individual needs vs hui)

- Research programme already underway – University of Waikato + Waikato-Tainui College

Next Steps

- Use agreed Attributes to assess state of rivers and lakes
- Provide overall assessment of expression of values and hence where “problems” exist (Stakeholder Forum question)
- Timeframe for SoE report against Attributes – Aim to report back at CSG8 (December)
- Need support from CSG on choice of Attributes