



Upper Mokau/Mangapehi & Upper Mangaokewa
Freshwater Monitoring Results
Merrin Whatley (PhD) – 25 July 2022

Overview

- Indicators of freshwater health
- Monitoring results
- On farm actions





Photo: Susan Stoddard

Indicators of Freshwater Health



Habitat



Flow




Wildlife



Energy & Nutrient
Dynamics



Water Quality



Identifying drivers of Health/Mauri of our Waterways



The key resources, attribute/indicator?



Where in the catchment are they coming from?



Are there seasonal changes or changes over time?



What are the underlying processes or practices contributing to contaminant loss?



Tailor catchment-based interventions to target resource loss over time and space.

Natural Influences


- Climate
- Topography
- Geology
- Soils
- Hydrology
- Land cover



Topography

-  Elevation & Slope
*LINZ, Regional Councils,
International Space Agencies*

Climate

-  Temperature & Precipitation
NIWA

Soils

-  Soil Maps SMap & Fundamental Soils
Manaaki Whenua
-  Soil Quality Data
Regional Councils
-  Soil Geochemistry
GNS Science
-  Soil Quality Data
Regional Councils

Land Cover

-  Land Cover Database
Manaaki Whenua, LCDBv5
-  Satellite Imagery
LINZ




Geology

-  Geological Map QMap
GNS Science
-  NZ Land Resource Inventory
Manaaki Whenua
-  Rock & Mineral Database
GNS Science



Land Use

-  Land Use Map LUCAS
Ministry for the Environment
-  Conservation Estate
DOC, LINZ, QEII
-  Land Use Data
Regional Councils



Hydrogeology

-  Aquifers
GNS Science, Regional Councils
-  Water Table Depth
GNS Science
-  Geothermal Inputs
GNS Science

Water Quality

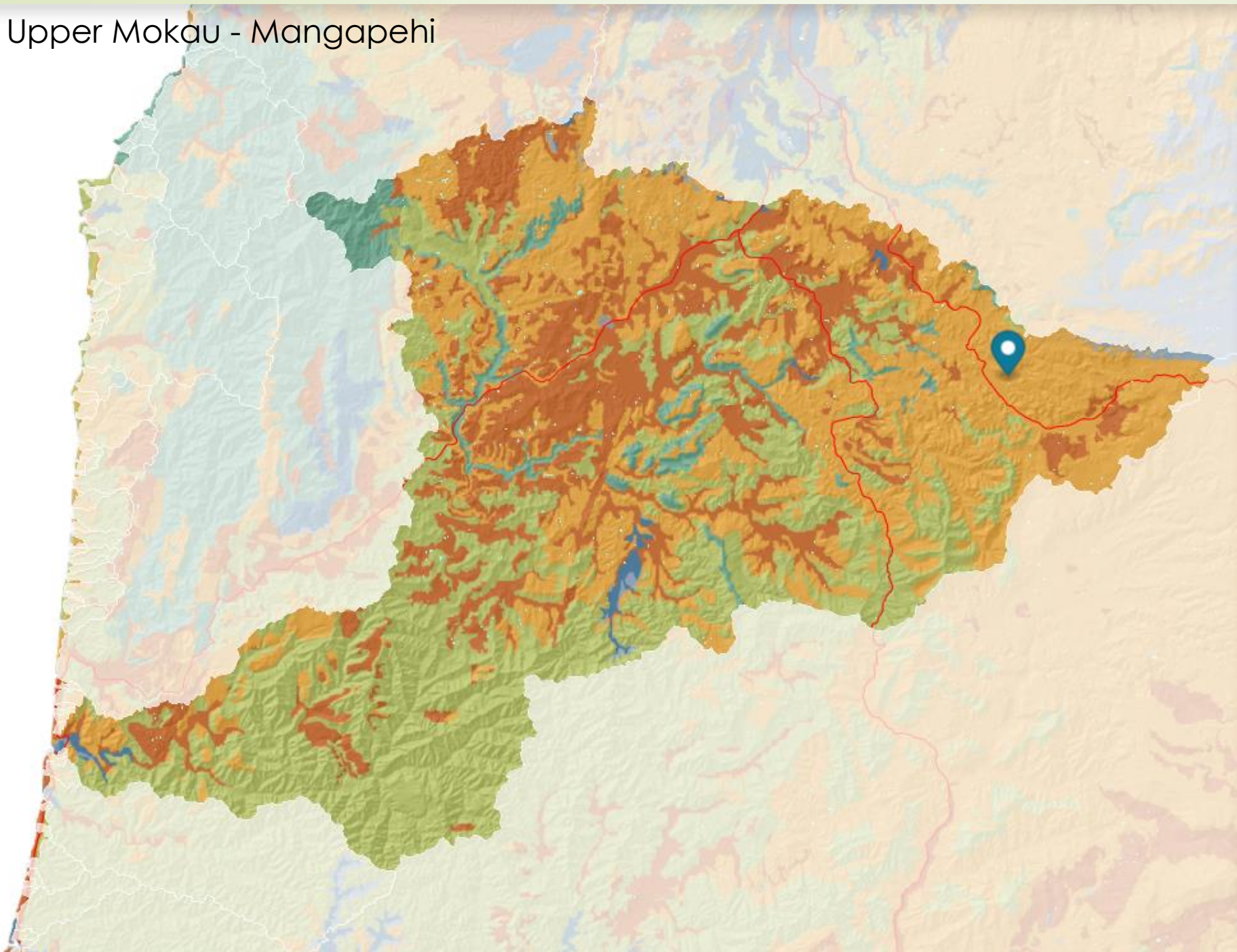
-  Surface water quality
Regional Councils, LAWA, NIWA
-  Groundwater Quality
Regional Councils, GNS Science

Hydrology

-  River Environment Classification
NIWA
-  Lakes and Rivers
LINZ



Upper Mokau - Mangapehi



Map Information ✕

■ Oxidising Soil & Aquifer

Variants

Overland flow	Not applicable
Artificial drainage	Not applicable
Natural soil bypass	Not applicable

Key Information

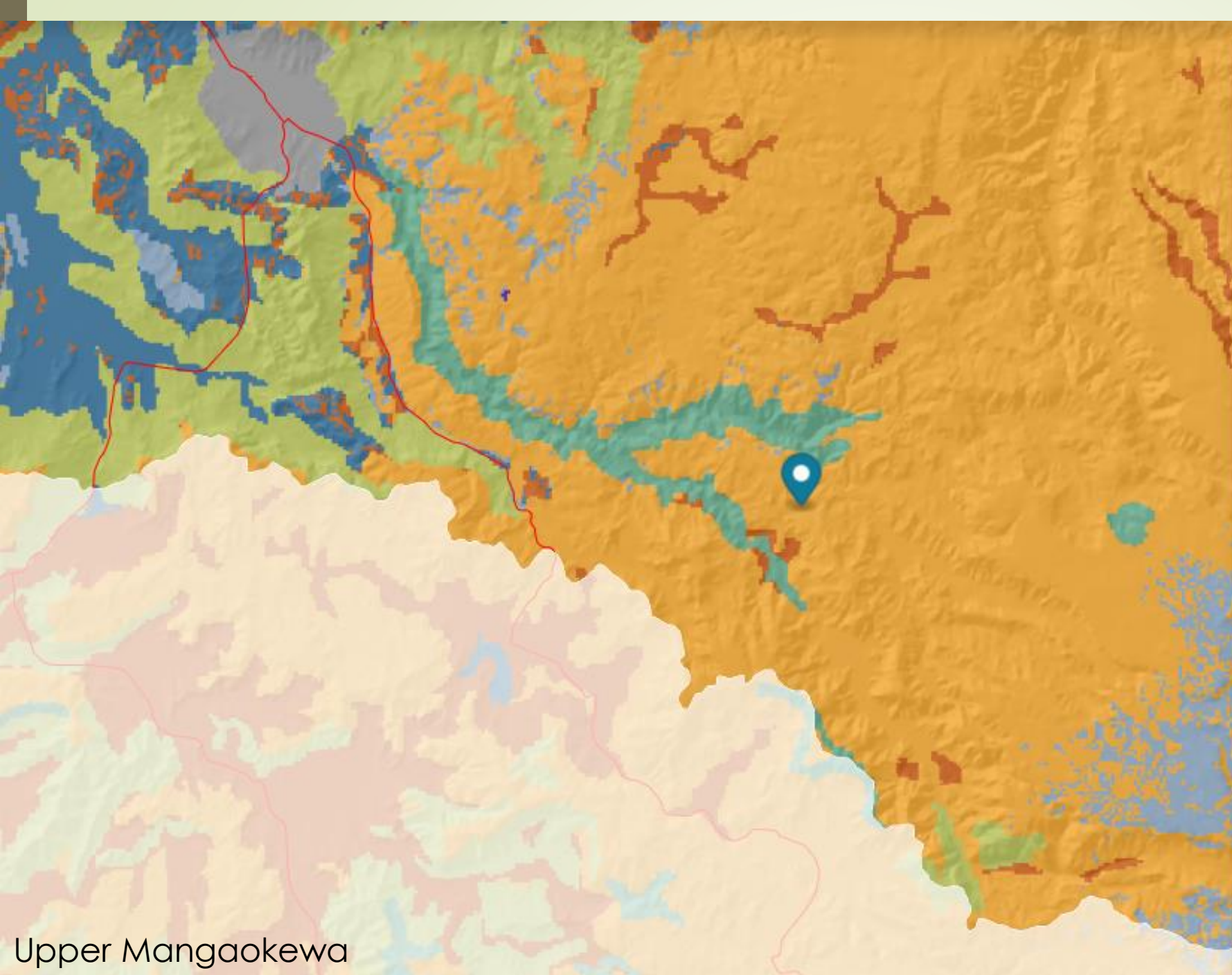
Hydrological Pathway	Deep drainage
Contaminant Risk	Nitrate nitrogen
Surface water catchment	Mokau River

Description

- Predominantly occurs in lowland, low relief areas where there are moderately-well to well drained soils and oxygen-rich (oxidising) underlying aquifers.
- Runoff risk is elevated in areas of sloping or slowly permeable soils.
- Environment is oxidising.
- Local rainfall is the main source of water.
- High ability to filter and adsorb contaminants and resist erosion.
- Deep drainage to the underlying aquifer is the dominant hydrological pathway.
- High risk of nitrate nitrogen leaching to shallow aquifer which can build up over time increasing the concentration in groundwater and in-stream.

More Information

- Sibling class: ■ [Over weak bedrock](#)
- [Science - Oxidising Soil & Aquifer](#)



Upper Mangaokewa

Map Information ✕

■ Oxidising Soil & Aquifer

Variants

Overland flow	Not applicable
Artificial drainage	Not applicable
Natural soil bypass	Not applicable

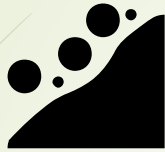
Key Information

Hydrological Pathway	Deep drainage
Contaminant Risk	Nitrate nitrogen
Surface water catchment	Waikato River

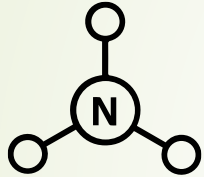
Description

- Predominantly occurs in lowland, low relief areas where there are moderately-well to well drained soils and oxygen-rich (oxidising) underlying aquifers.
- Runoff risk is elevated in areas of sloping or slowly permeable soils.
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- High risk of nitrate nitrogen leaching to shallow aquifer which can build up over time increasing the concentration in groundwater and in-stream.

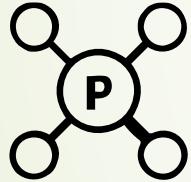
Attribute Descriptions



Water Clarity – Suspended Particles Including Sediment



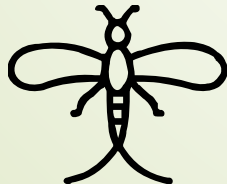
Nitrate



Dissolved Reactive Phosphorus (DRP)



Pathogens/E. coli (short for Escherichia coli)



Freshwater Macroinvertebrate Community Index (MCI)



Monitoring in Upper Mokau - Mangapehi

Waikato Regional Council Sites

- Upper Mokau-Mangapehi SC – 2 sites in total
 - 1 River Water Quality Sites
 - 1 Ecological Monitoring Sites
- Mokau River – 22 sites in total
 - 5 River Water Quality Sites
 - 16 Ecological Monitoring Sites
 - 1 River flow Site

Frequency of Measurements

- WQ collected by monthly grab sample
- Ecology site visited every 3 years
- Continuous river flow recorded every 15 minutes



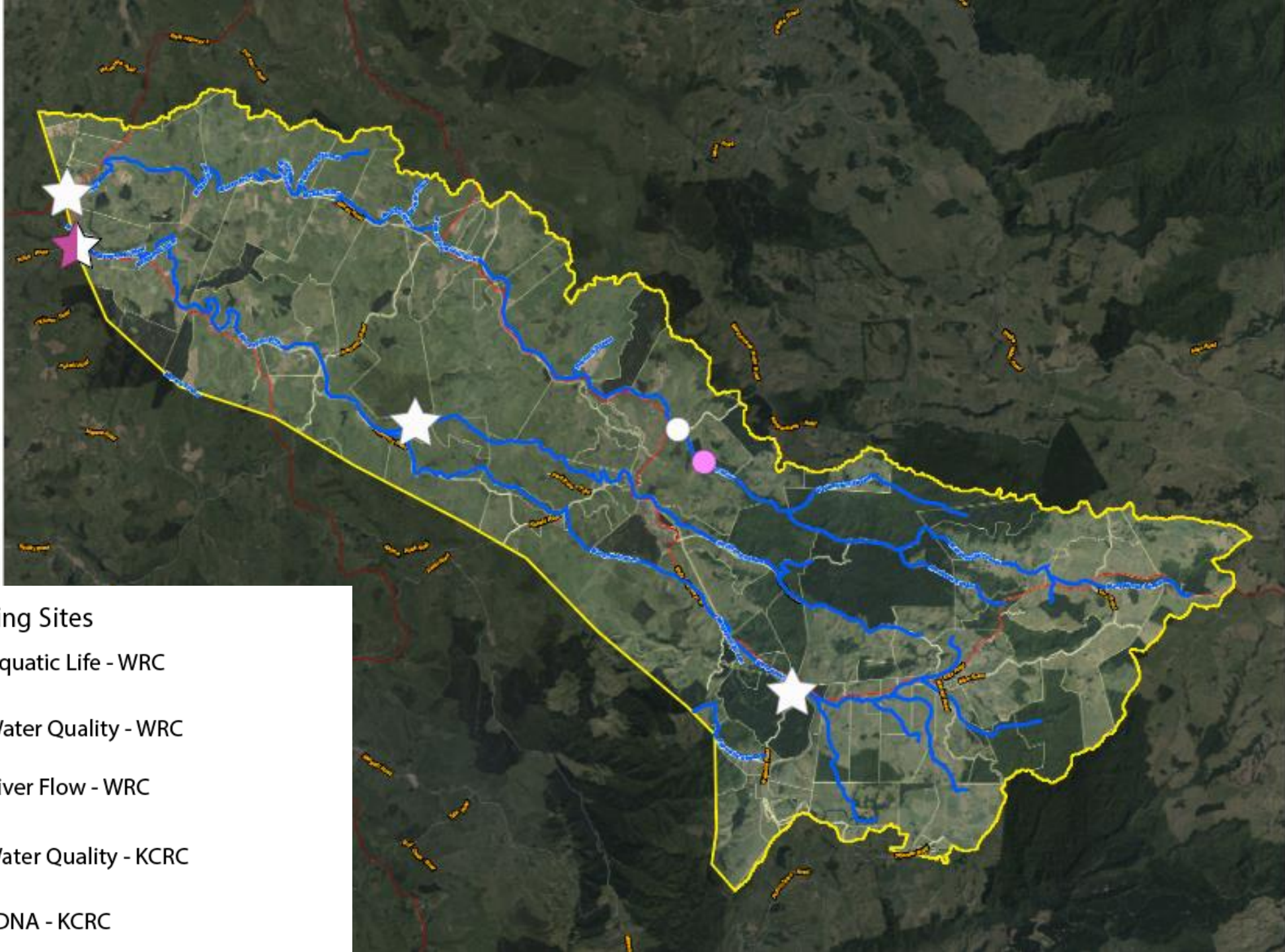
Monitoring in Upper Mokau - Mangapehi

KCRC Sites






- Upper Mokau-Mangapehi SC – 4 sites in total
- 4 Water Quality sites
- 1 eDNA site

Frequency of Measurements

- Water quality collected by grab sample 4 times a year
- eDNA collected twice, 25 Feb & 5 Dec 2021



Monitoring Sites

-  Aquatic Life - WRC
-  Water Quality - WRC
-  River Flow - WRC
-  Water Quality - KCRC
-  eDNA - KCRC

Upper Mokau-Mangapehi Annual Summary 2021 Labs: Hill/Analytica	Human Contact E. coli/100 ml	Ecosystem Health							
		Water Quality						Sediment	
		Nitrate Toxicity (TON mg N/L)		Ammonia Toxicity (mg N/L)		Dissolved Reactive Phosphorus (mg P/L)		Water Clarity Value ¹	National Bottom Line
KCRC WQ SITES	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	
13-Mokau R. HWY 4	167 ↓	0.26 ↓	0.72 ↓	0.007 ↓	0.010 ↓	0.003 ↓	0.005 ↓	1.58 ↑	1.34
14-Mangapehi R. HWY 4	313 ↓	0.39 ↓	0.63 ↓	0.006 ↓	0.026 ↓	0.005 ↓	0.007 ↓	1.35 ↑	1.34
17-Paritikona Stm	286 ↓	0.24 ↓	0.47 ↓	0.003 ↓	0.004 ↓	0.004 ↓	0.008 ↓	1.86 ↑	1.34
18-Mangapehi R.	1403 ↓	0.52 ↓	0.88 ↓	0.017 ↑	0.020 ↓	0.006 ↓	0.009 ↓	1.58 ↑	1.34
WRC WQ SITES									
Mangaokewa Rd (Off SH30)	1690 ↓	0.29 ↓	0.66 ↓	0.005 ↓	0.008 ↓	0.014 ↑	0.024 ↑	1.56 ↑	1.34
Mokau R. Baseline (Jan-2015 to Aug-2020)	5000	0.54	1.00	0.009	0.047	0.009	0.022	0.79	1.34

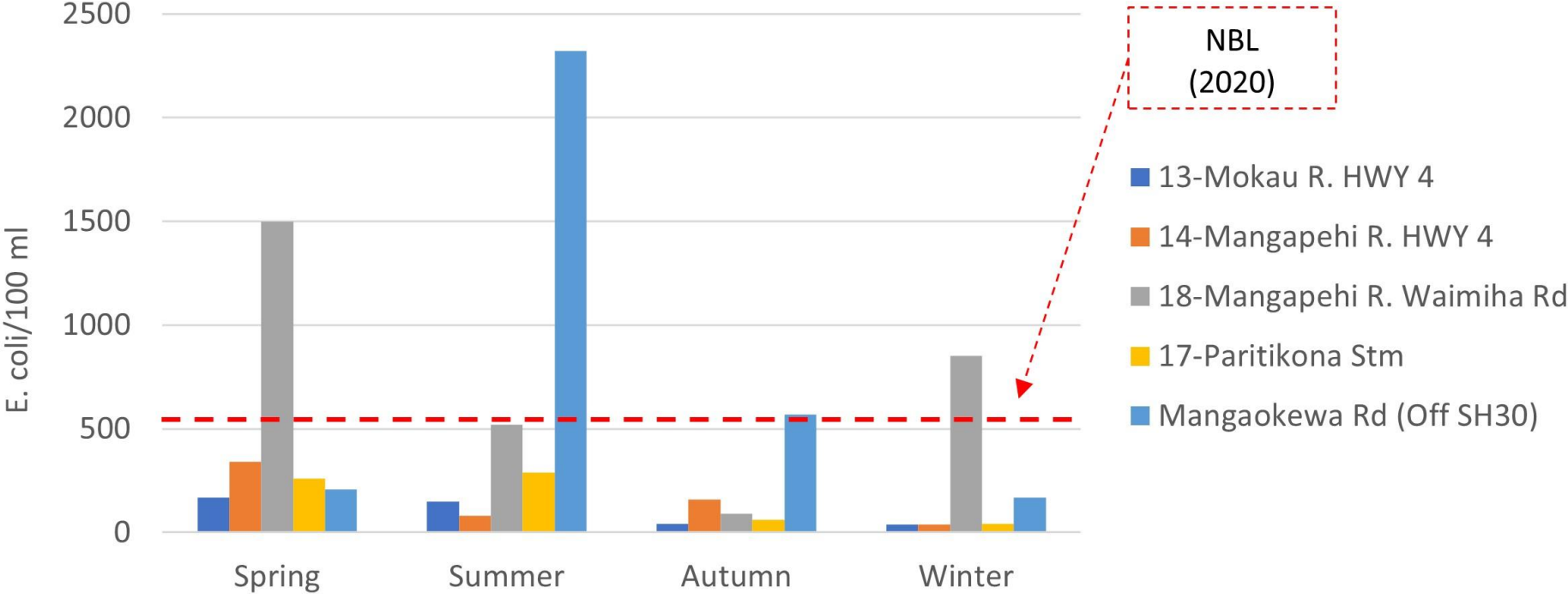
Annual Summary

Attribute Band - Current State

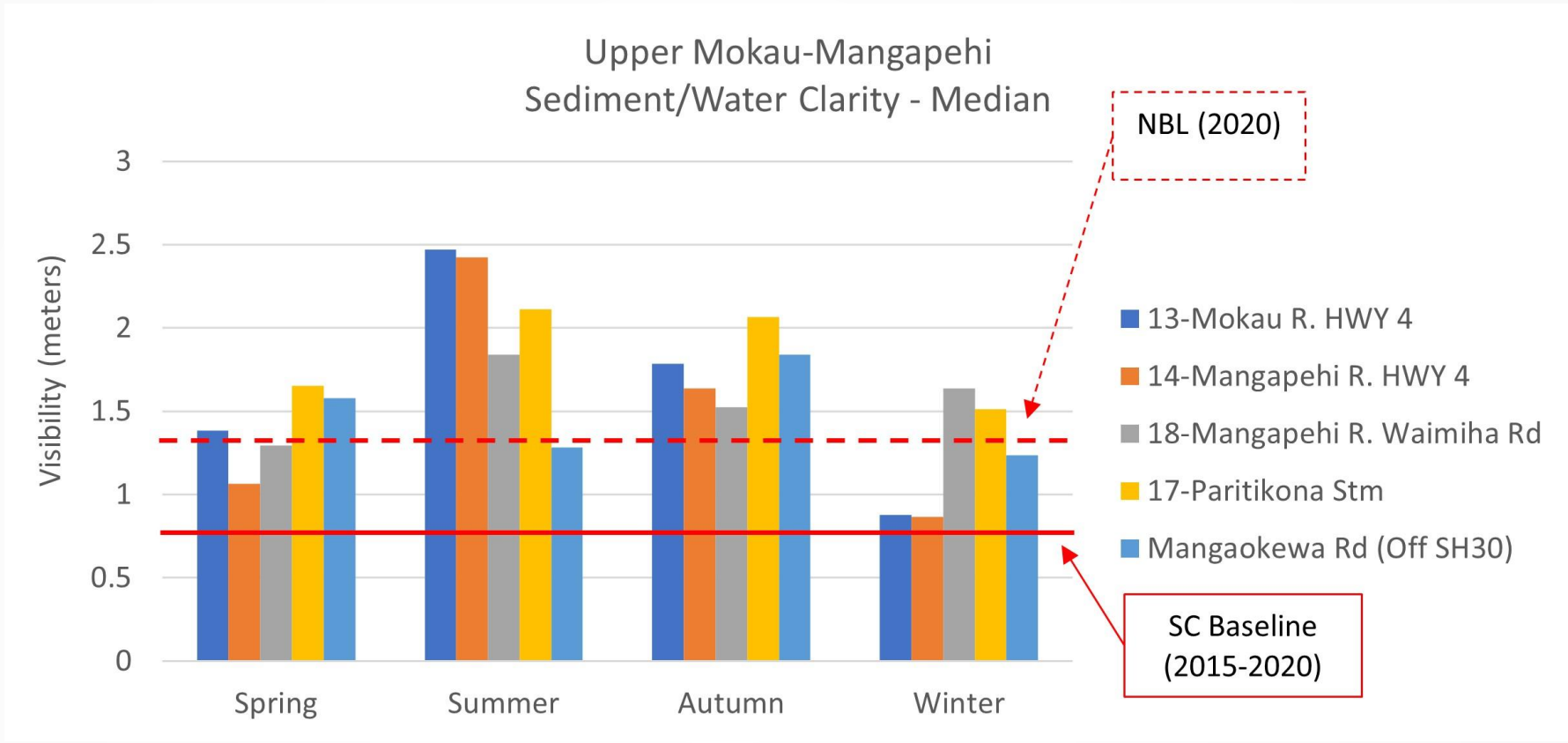


Upper Mokau-Mangapehi

E. coli - 95th Percentile

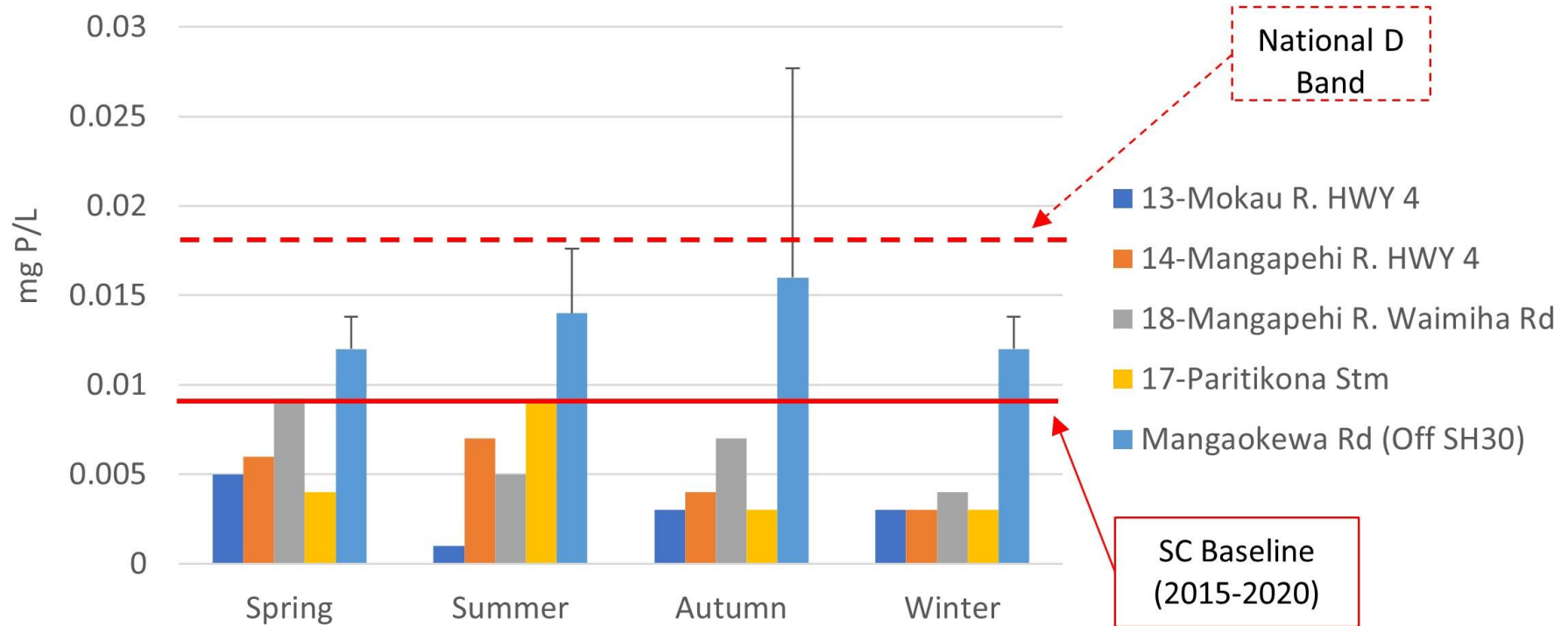


E. Coli – Seasonal Results

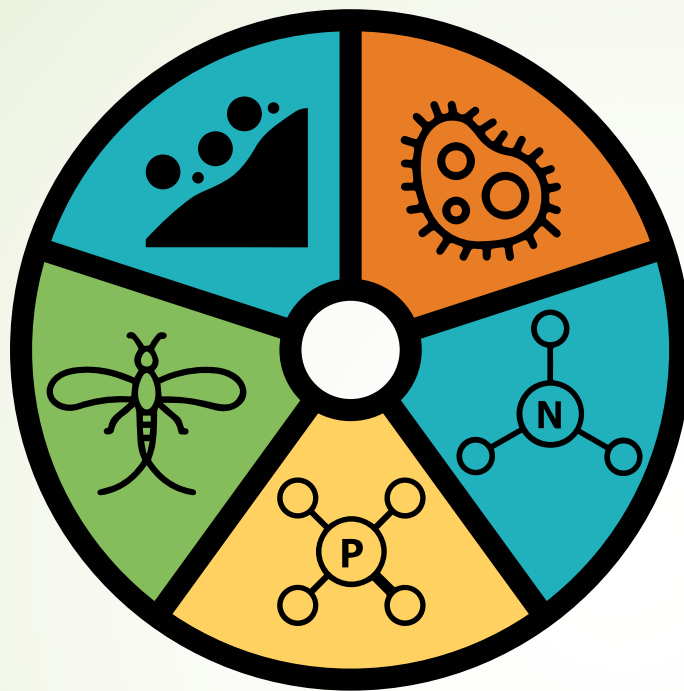


Water Clarity – Seasonal Results

Upper Mokau-Mangapehi Dissolved Reactive Phosphorus - Median



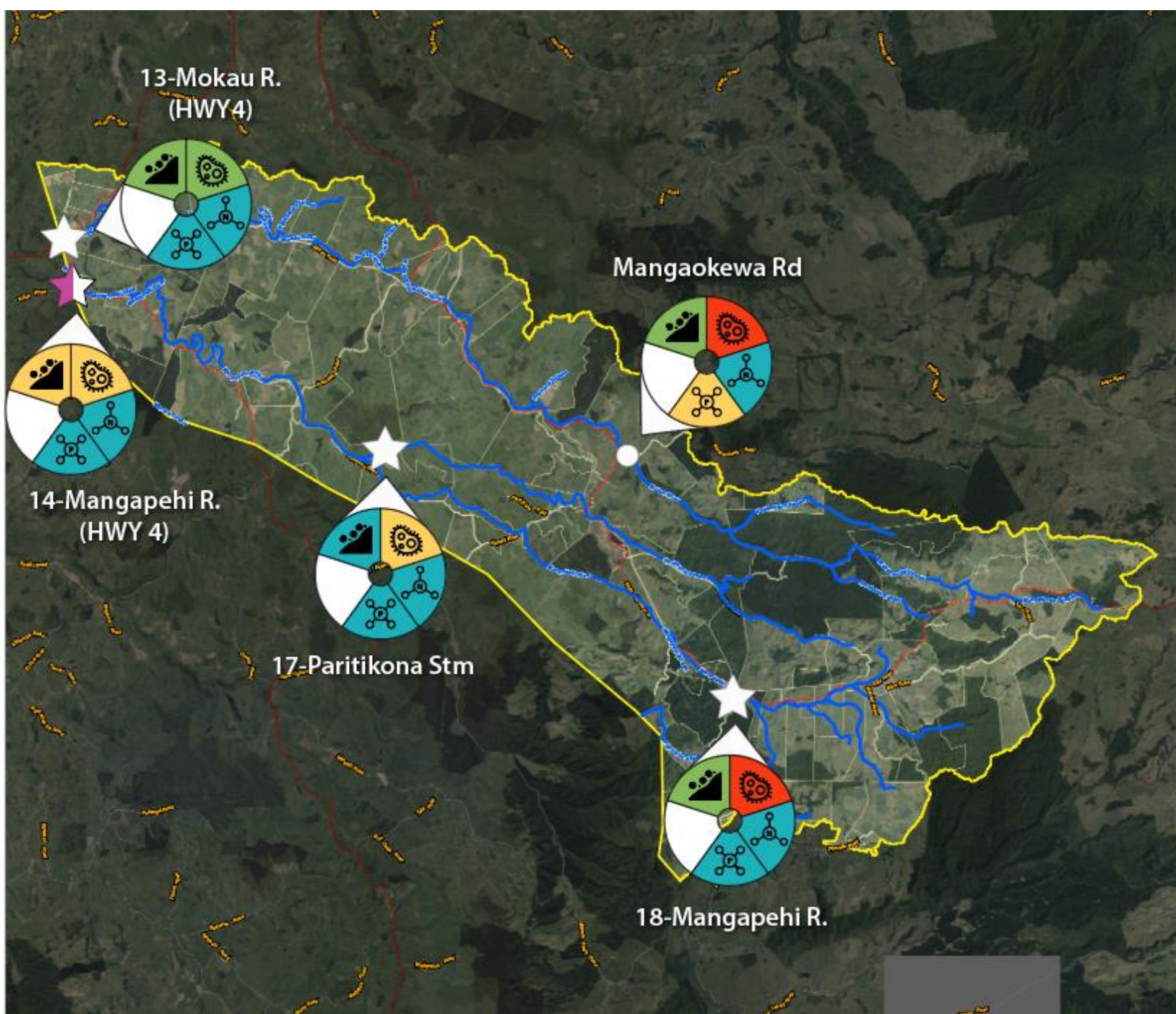
DRP – Seasonal Results



Attribute Band - Current State



Attribute Dials



Key Results

- E. coli and water clarity are the attributes to watch
- DRP is elevated at Mangaokewa Rd
- Water clarity is lowest at 14-Mangapehi R.
- Highest WQ at 13-Mokau R. & 17-Paritikona stm.
- Lowest WQ at Mangaokewa Rd



Monitoring in Upper Mangaokewa

Waikato Regional Council Sites

- Upper Mokau-Mangaphei SC – 1 site in total
 - 1 River Water Quality + River Flow Site

Frequency of Measurements

- WQ collected by monthly grab sample
- Ecology site visited every 3 years
- Continuous river flow recorded every 15 minutes



Monitoring in Upper Mangaokewa






KCRC Sites

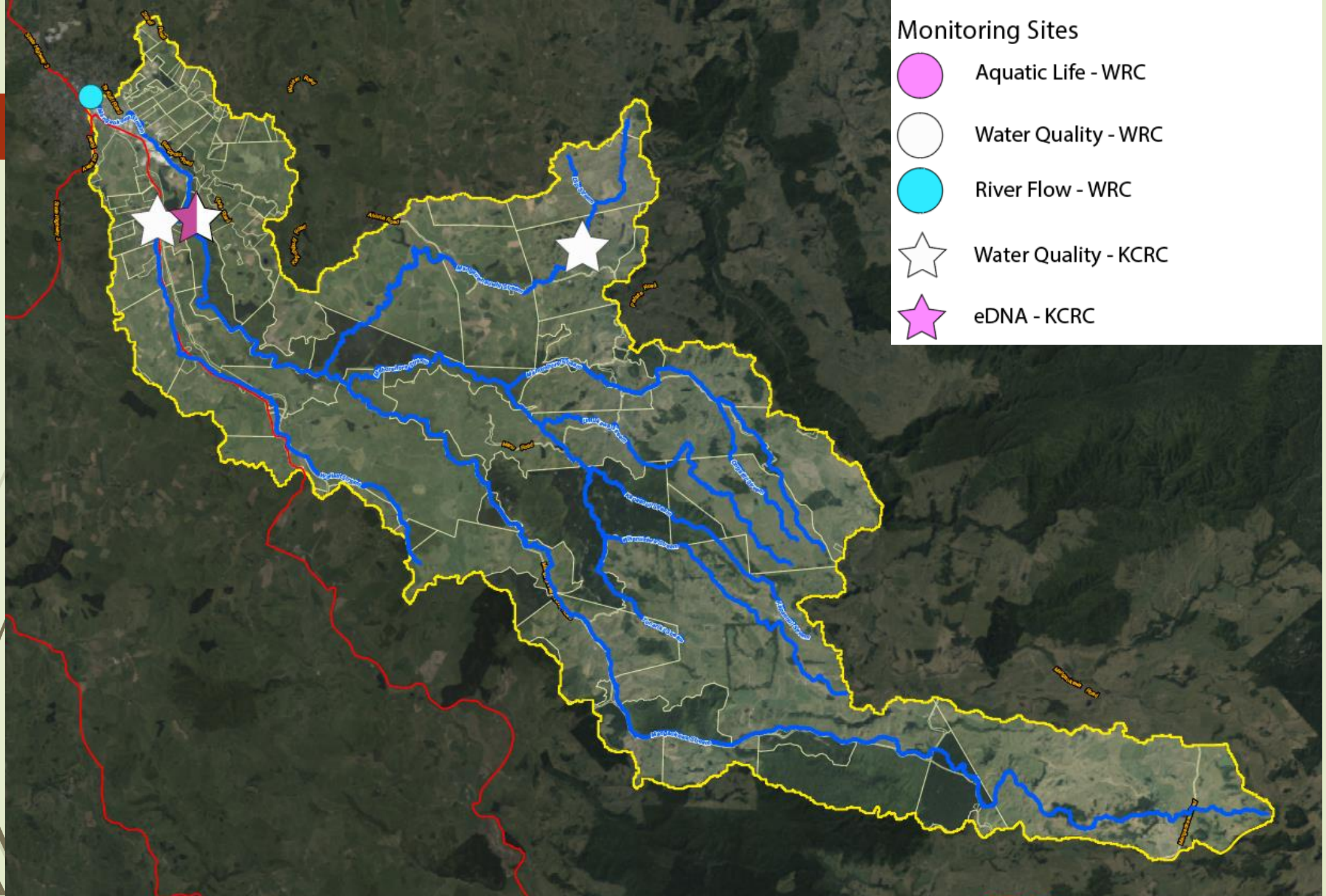
- Upper Mokau-Mangaphei SC – 3 sites in total
- 3 Water Quality sites
- 1 eDNA site

Frequency of Measurements

- Water quality collected by grab sample 4 times a year
- eDNA collected twice, 25 Feb & 5 Dec 2021

Monitoring Sites

-  Aquatic Life - WRC
-  Water Quality - WRC
-  River Flow - WRC
-  Water Quality - KCRC
-  eDNA - KCRC



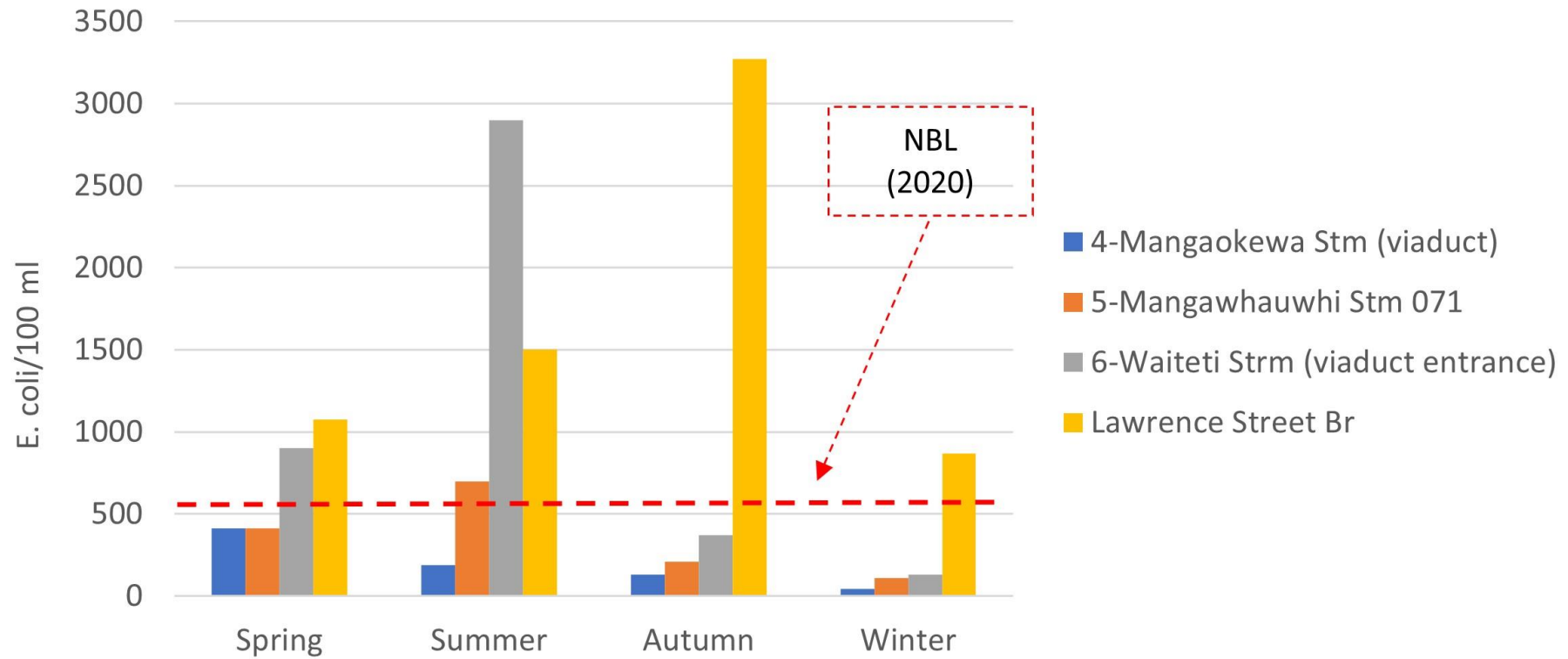
Upper Mangaokewa ¹ Annual Summary 2021 Labs: Hill/Analytica	Human Contact E. coli/100 ml	Ecosystem Health							
		Water Quality							
		Nitrate (TON mg N/L)		Ammonia (mg N/L)		Dissolved Reactive Phosphorus (mg P/L)		Sediment	
								Water Clarity Value ²	National Bottom Line
KCRC WQ SITES	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	95th Percentile	Median	
4-Mangaokewa Stm (viaduct)	377 ↓	0.50 ↓	0.70 ↓	0.004 ↓	0.009 ↓	0.009 ↓	0.013 ↓	1.80 ↑	1.34
5-Mangawhauwhi Stm 071	657 ↓	0.96 ↑	1.20 ↑	0.010 ↓	0.014 ↓	0.004 ↓	0.008 ↓	1.73 ↑	1.34
6-Waiteti Stm (viaduct entrance)	2600 ↓	0.55 ↓	0.65 ↓	0.020 ↑	0.022 ↓	0.008 ↓	0.011 ↓	0.93 ↑	1.34
WRC WQ SITES									
Lawrence Street Br	2600 ↓	0.52 ↓	0.98 ↓	0.014 →	0.020 ↓	0.014 ↑	0.023 ↓	0.88 ↑	0.61
Mangaokewa R. Baseline (Jan-2015 to Aug-2020)	15200	0.63	1.03	0.014	0.042	0.013	0.028	0.87	0.61

Annual Summary

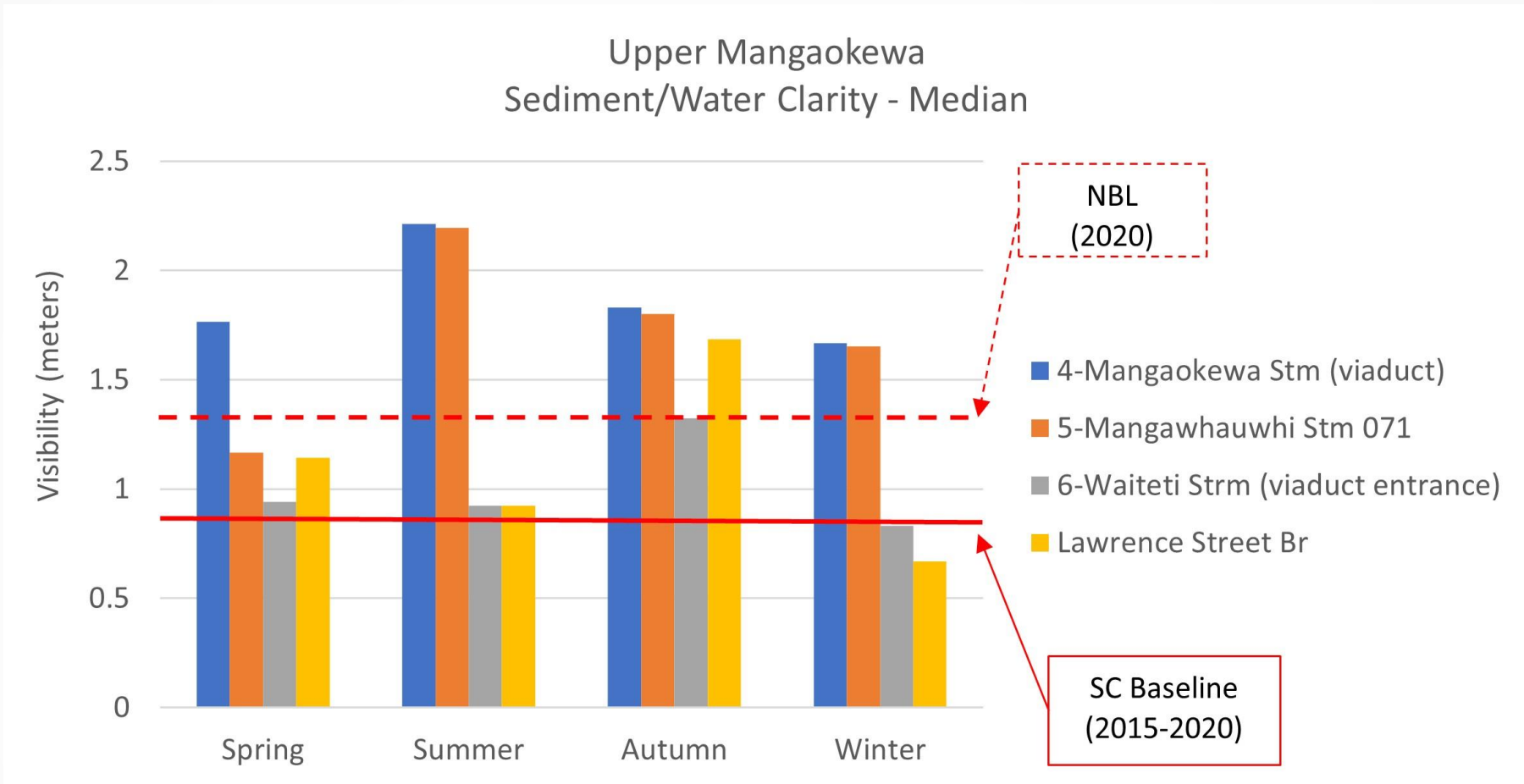
Attribute Band - Current State



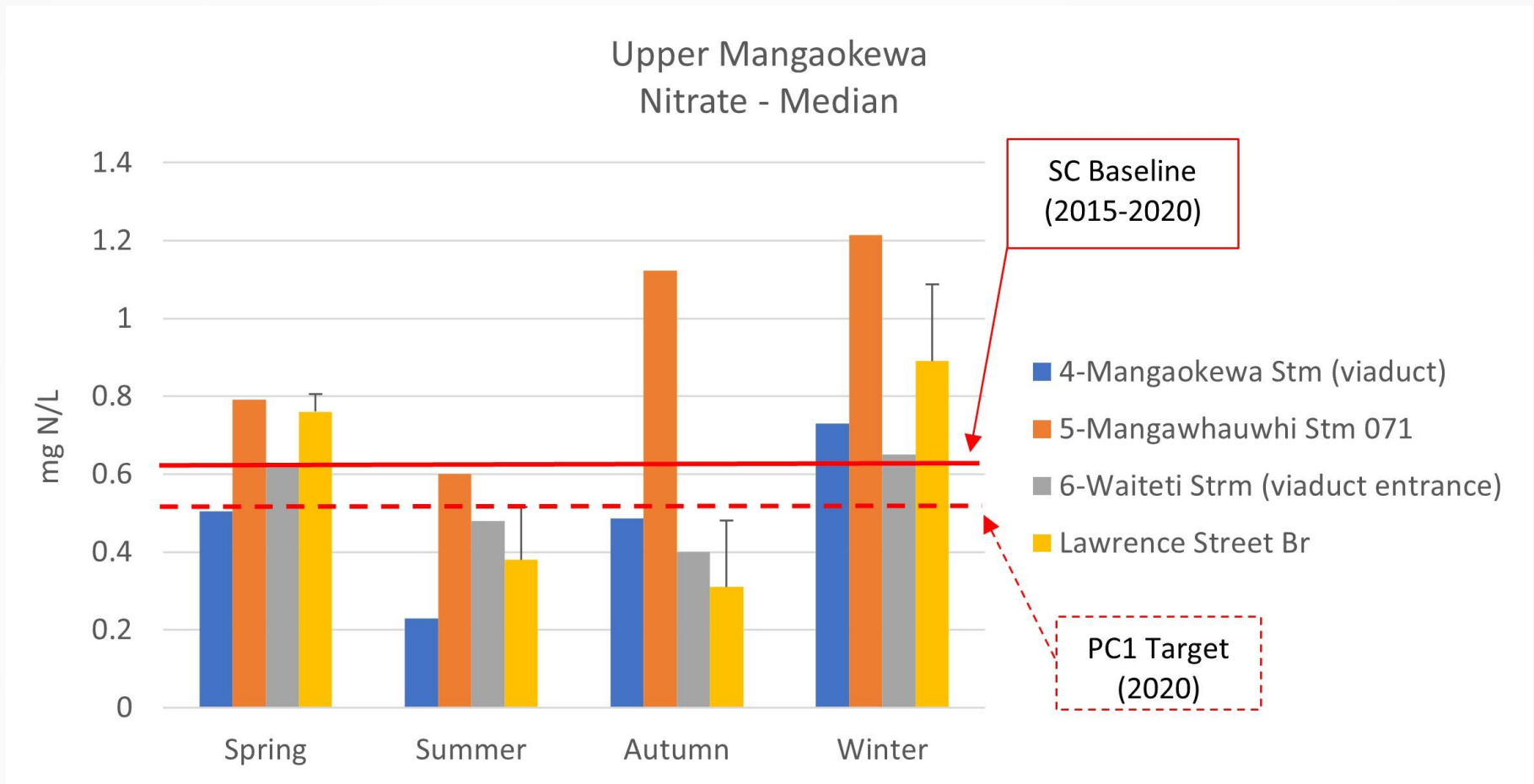
Upper Mangaokewa E. coli - 95th Percentile



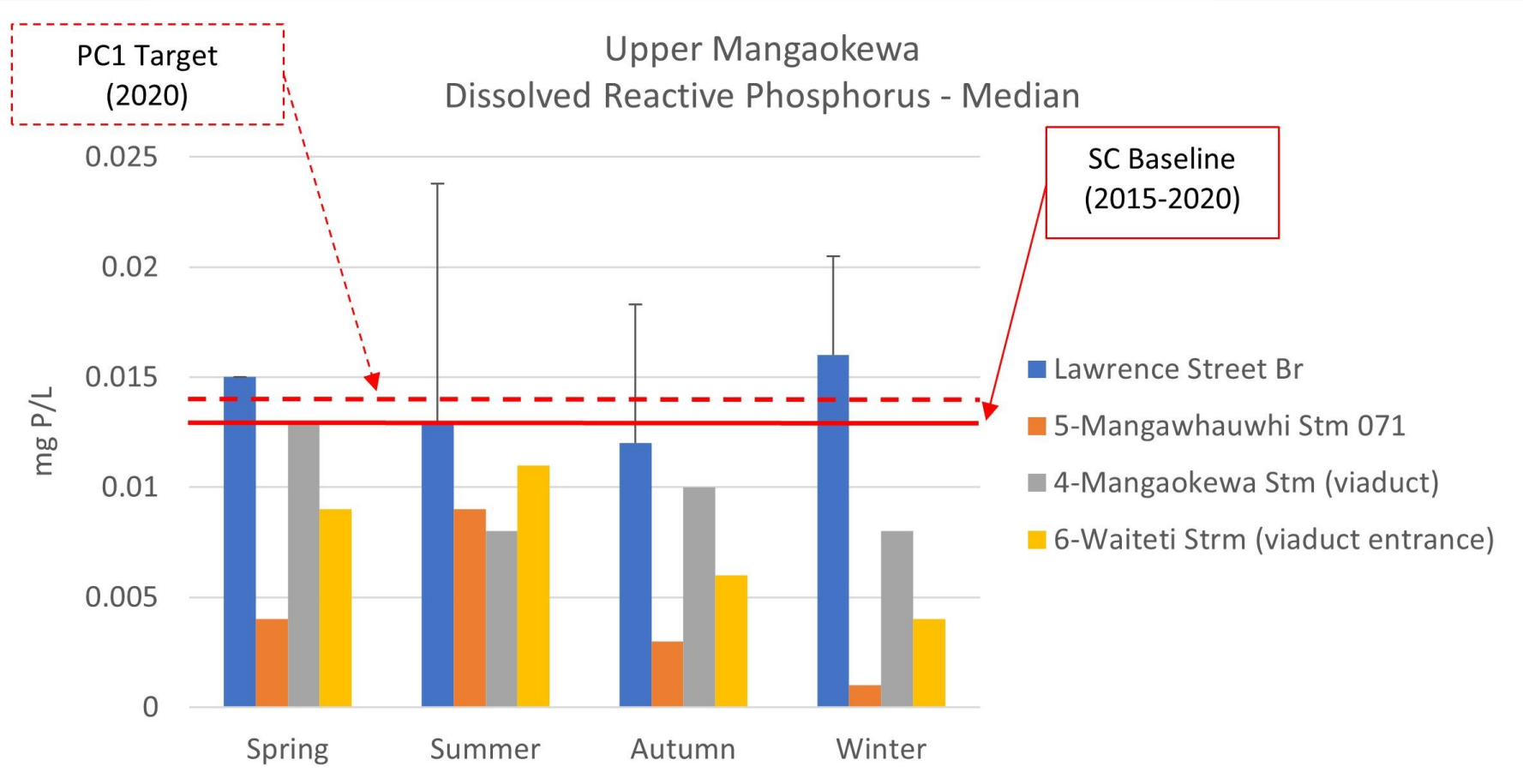
E. Coli – Seasonal Results



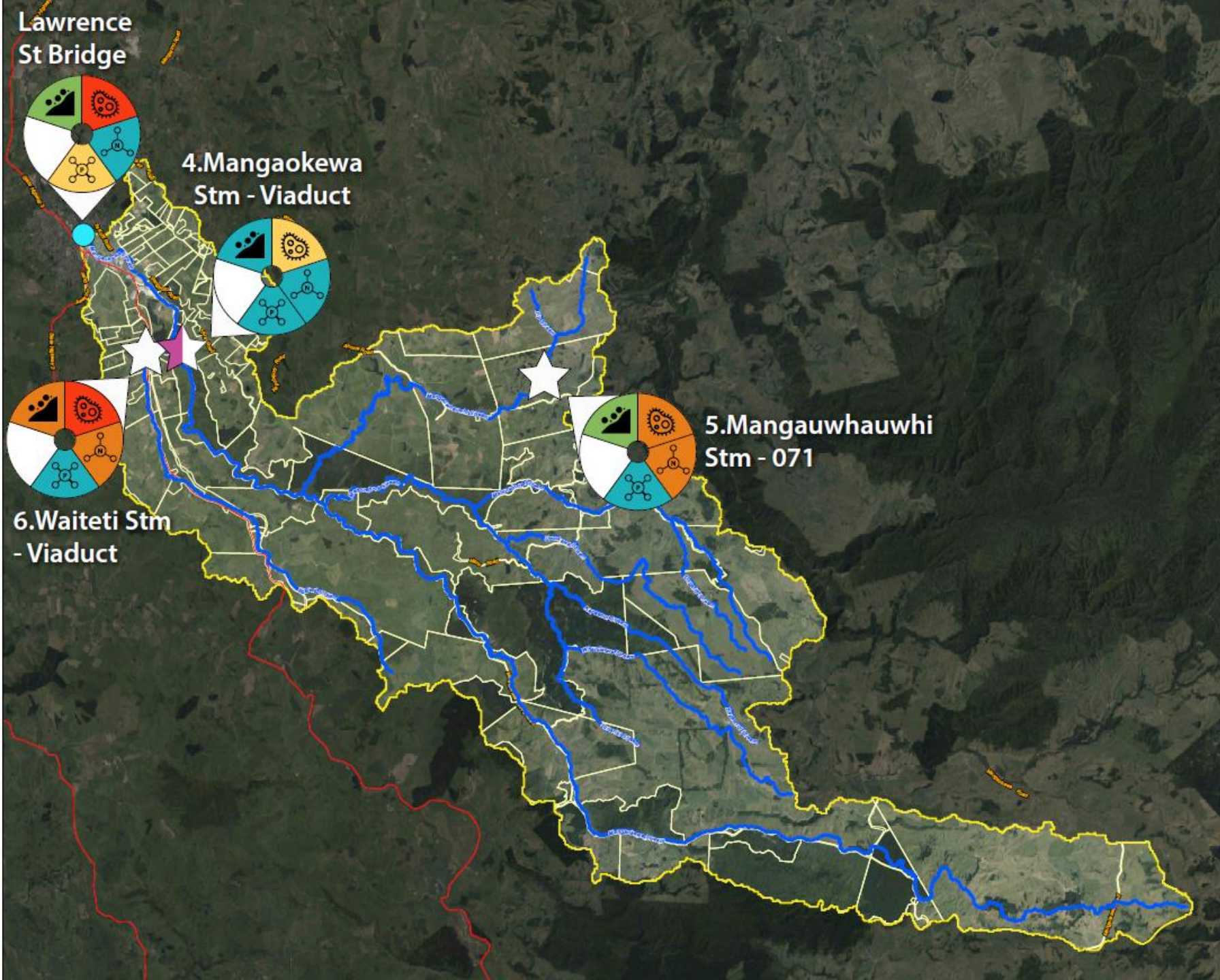
Water Clarity – Seasonal Results



Nitrate – Seasonal Results



DRP – Seasonal Results



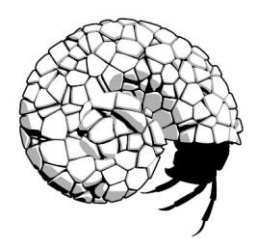
Key Results

- E. coli, nitrate and ammonia are the attributes to address
- DRP is elevated at Lawrence st bridge
- Water clarity is lowest at 6.Waiteti stm
- Highest general WQ at 4.Mangaokewa
- Lowest general WQ at 6.Waiteti

Environmental DNA (eDNA)



WILDERLAB

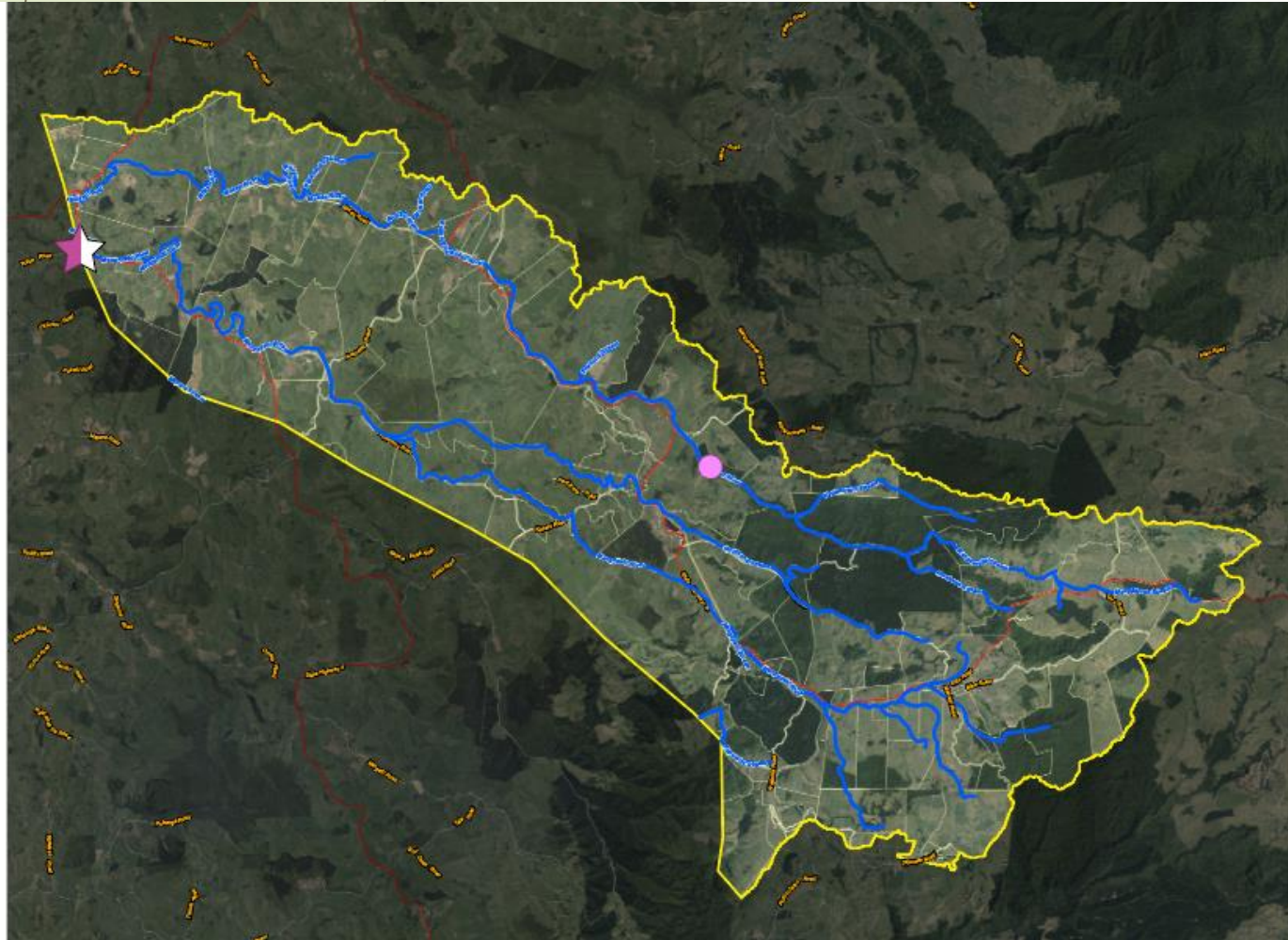


Adaptive
Environmental Consulting

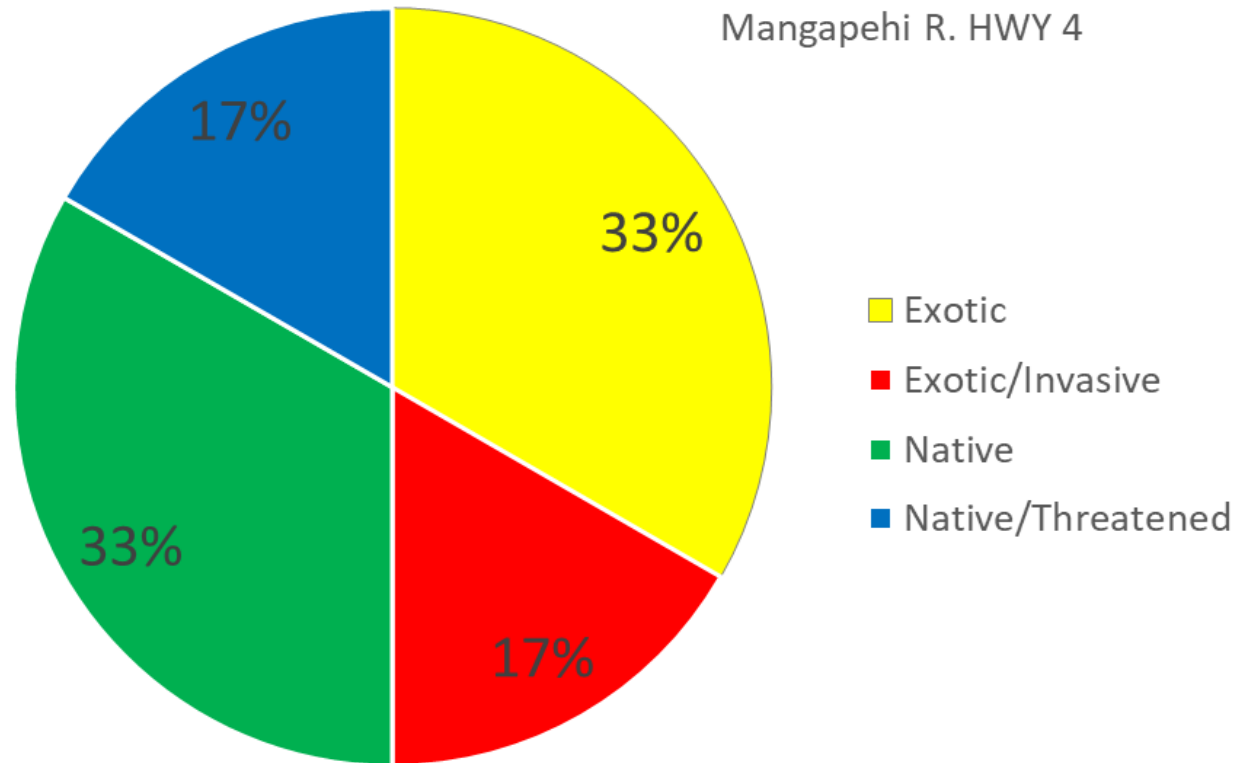


WILDERLAB

eDNA site Upper Mokau 14-Mangapehi River



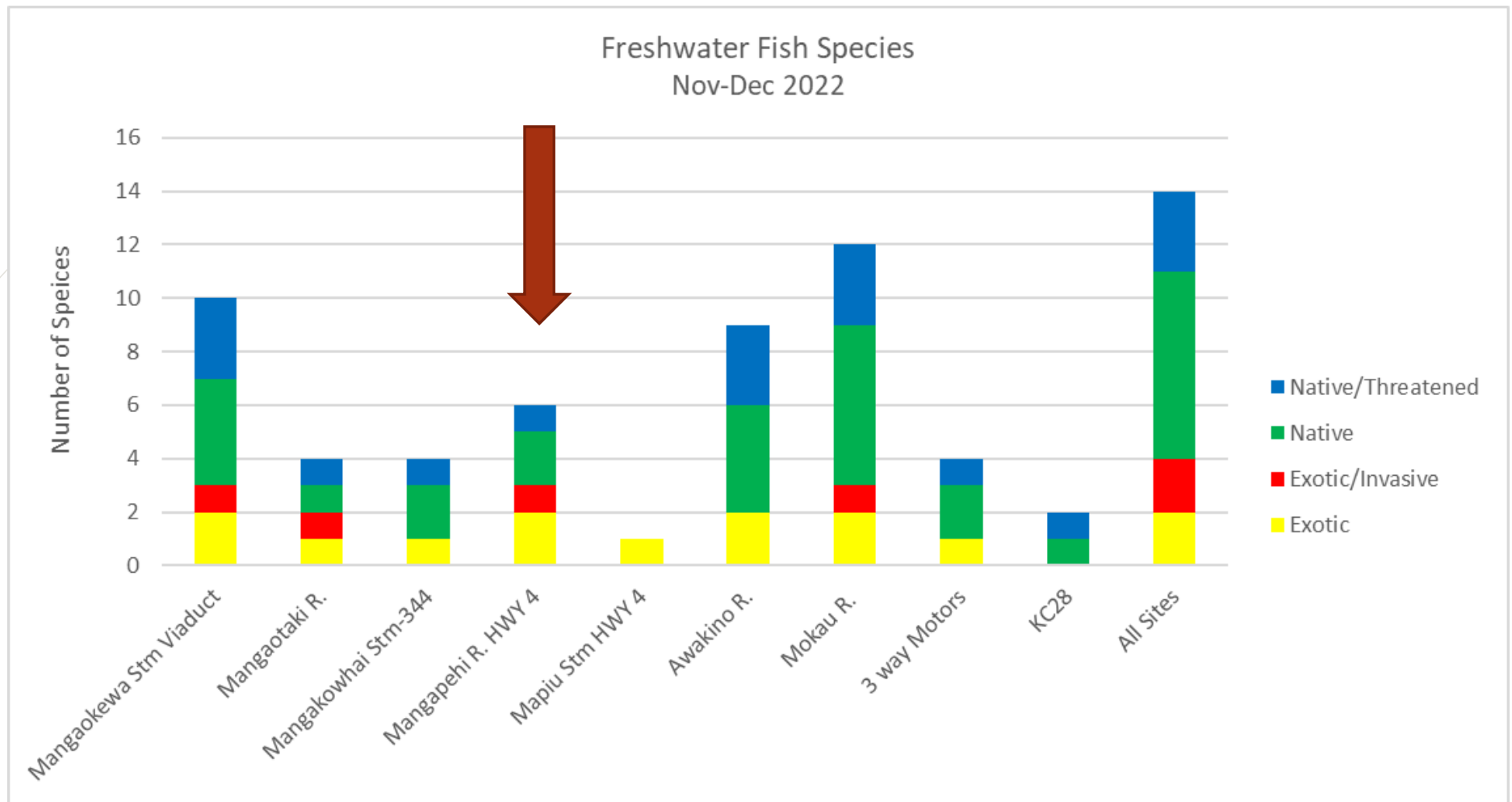
Freshwater Fish Species Threat status



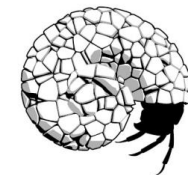
Gambusia – Exotic - invasive



Upland Bully – Native Sp



Freshwater Fish Number of species detected and their threat status



Sensitive taxa (values of 8 or more)



Double gill mayfly
(*Tepakia*)

Mayflies

Green stonefly
(*Stenoperla*)

Stoneflies

Spiral cased caddis
(*Helicopsyche*)

Cased caddisflies

Swimming mayfly
(*Nesameletus*)

Mayflies

Stonefly (*Zelandoperla*)

Stoneflies

FACTSHEET

Tolerant taxa (values of 3 or less)



Oligochaete worms
(*Oligochaeta*)

Segmented worms

Snail (*Physa*)

Snails

FACTSHEET

Chironomid midge
(*Chironomus*)

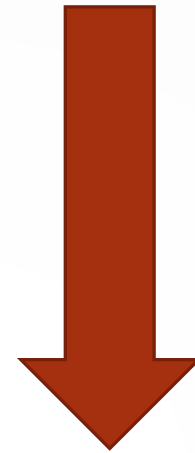
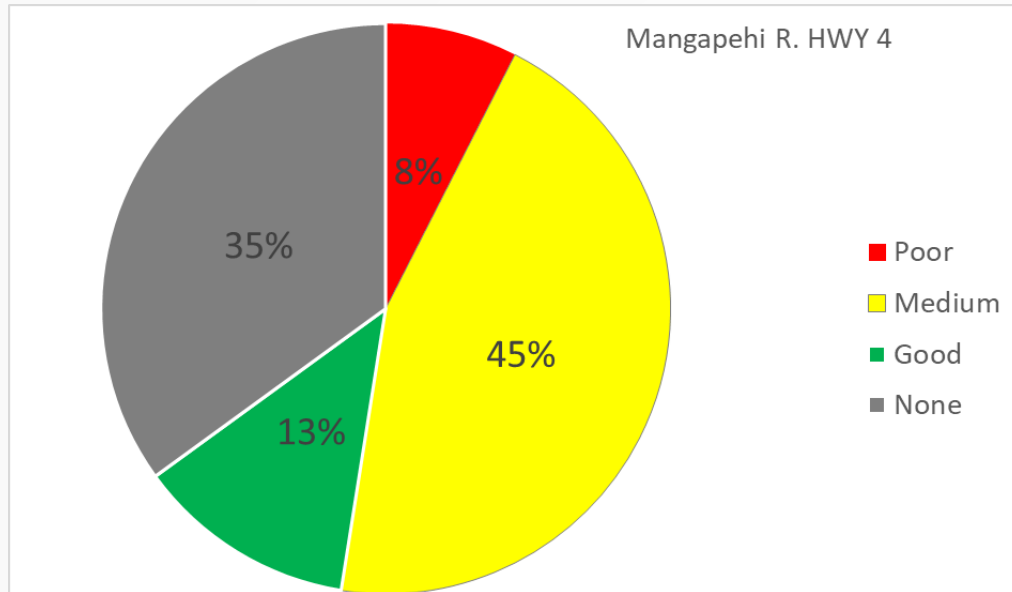
Midges

Rat tail maggots
(*Syrphidae*)

Other true flies

**Macroinvertebrate
Community Index
Scores
(MCI)
1 - 10**

5 Nov 2021 – All Invertebrates



Sites	KC4	KC11	KC12	KC14	KC20	KC25	KC26	KC27	KC28
	Mangaokewa Stm Viaduct	Mangaotaki R.	Mangakowhai Stm-344	Mangapehi R. HWY 4	Mapiu Stm HWY 4	Awakino R.	Mokau R.	3 way Motors	KC28
MCI Score	119	126	109	112	112	127	105	101	121
National Grade	B	B	C	B	B	B	C	C	B

Freshwater Invertebrate Community Health Index (MCI) eDNA Results 2021

14-Mangapehi R. Site Characteristics

Riparian vegetation

➤ Weedy grass, convolvulus & blackberry

Stock Access

➤ Yes, Cattle & Sheep

Water temperature (°C)

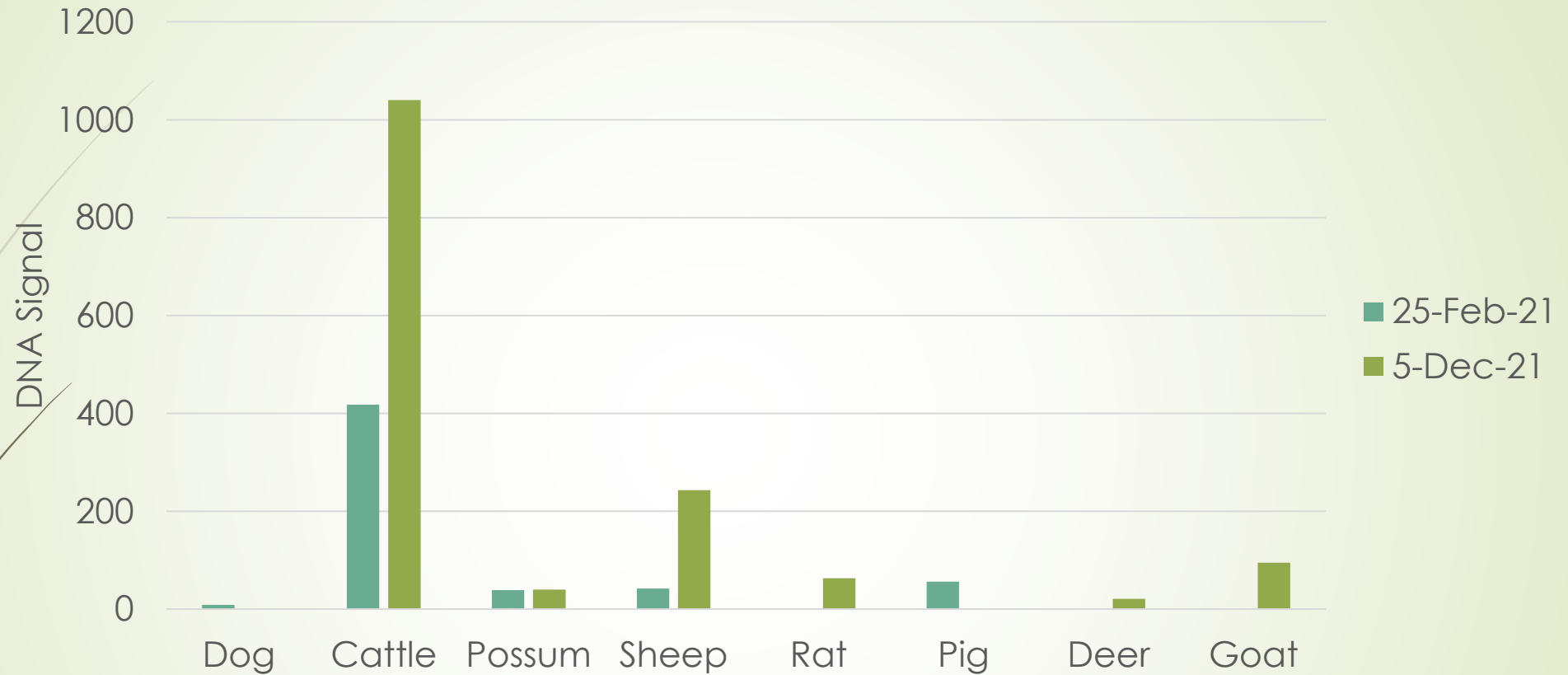
➤ Feb = 20.1; Dec = 11.3

Conductivity (µS/cm)

➤ Feb = 121; Dec = 96

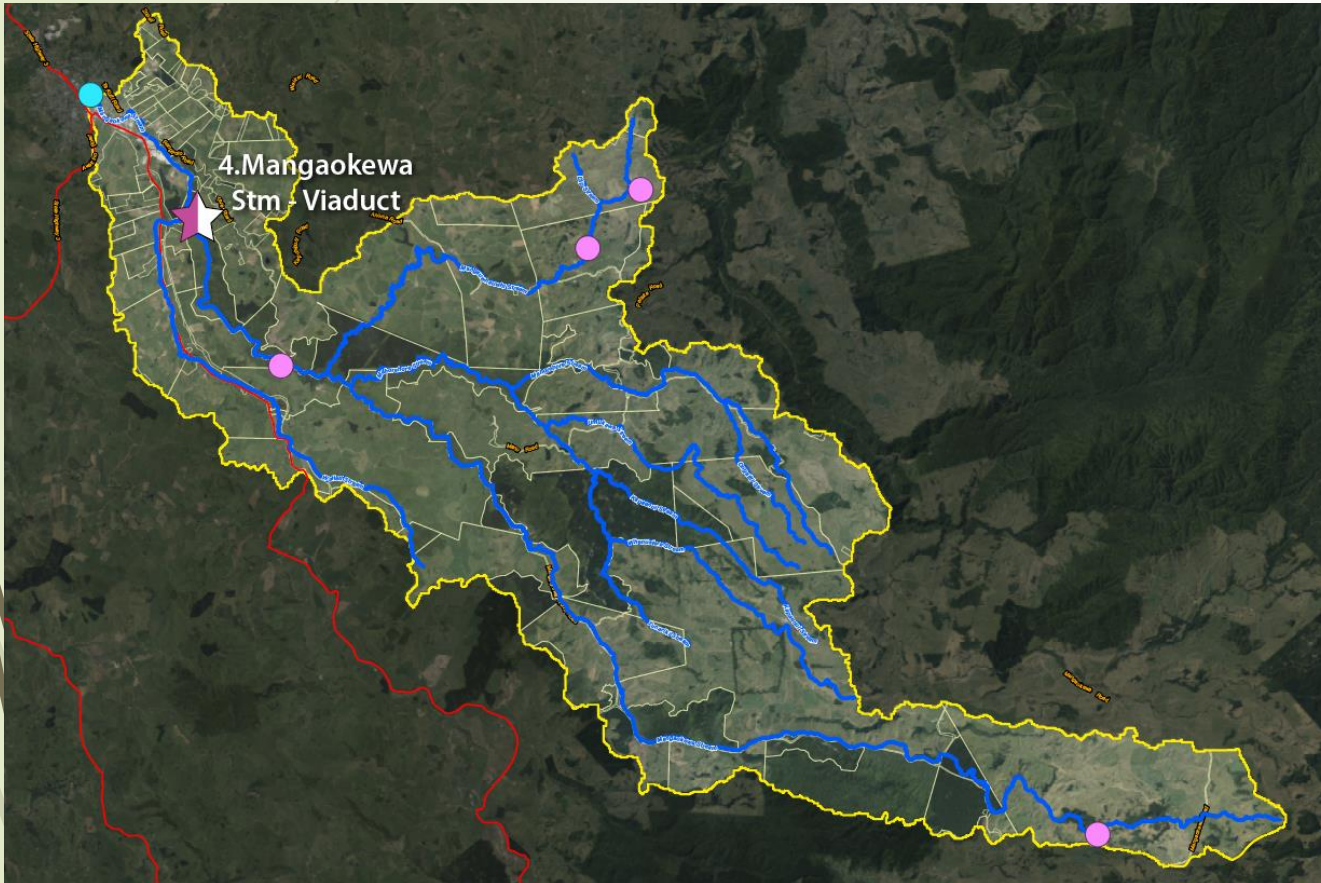


Mammals - 14. Mangapehi Stream



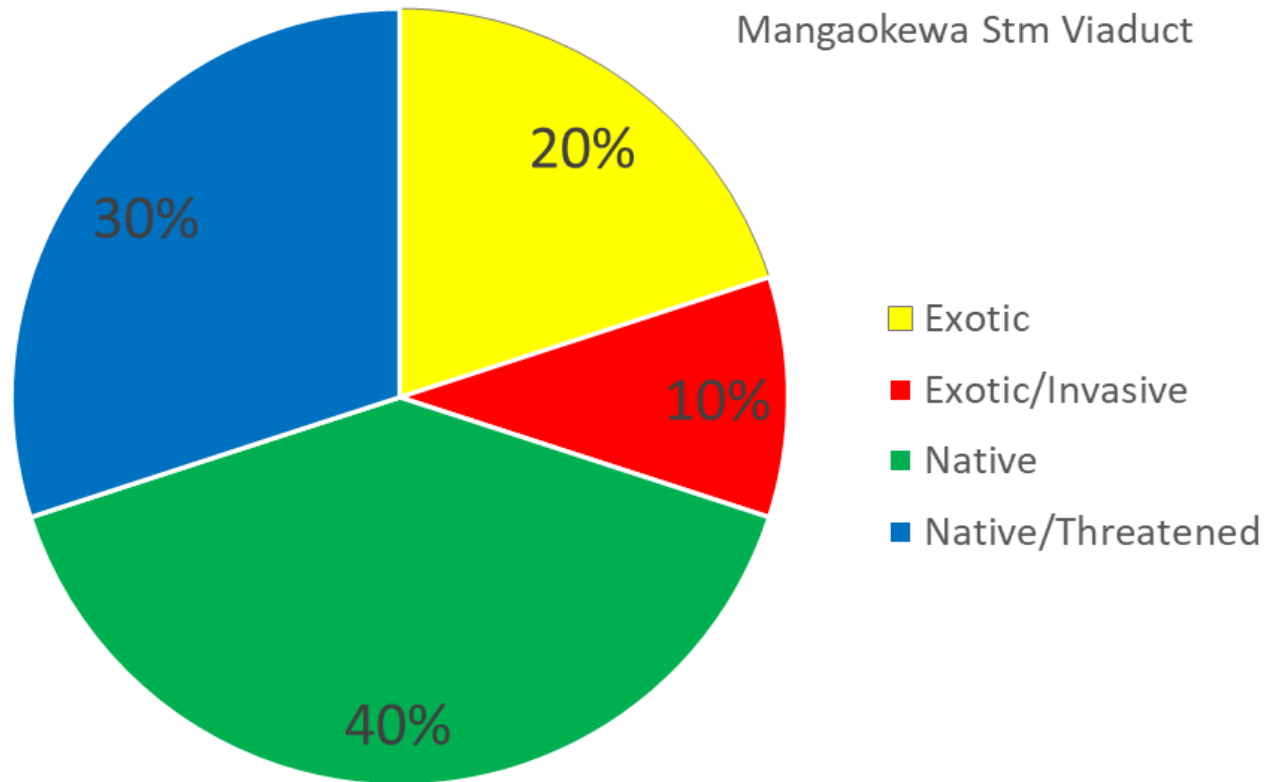
Mammalian eDNA Signal Strength

eDNA site Upper Mangaokewa 4-Mangaokewa Stream

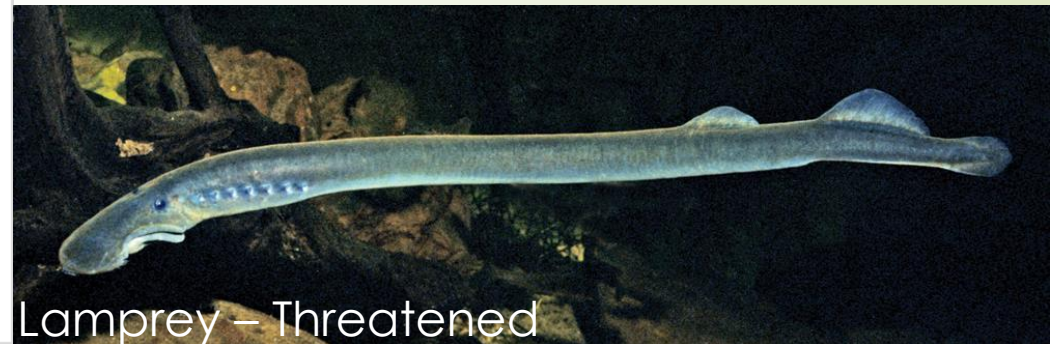


Freshwater Fish Species Threat status

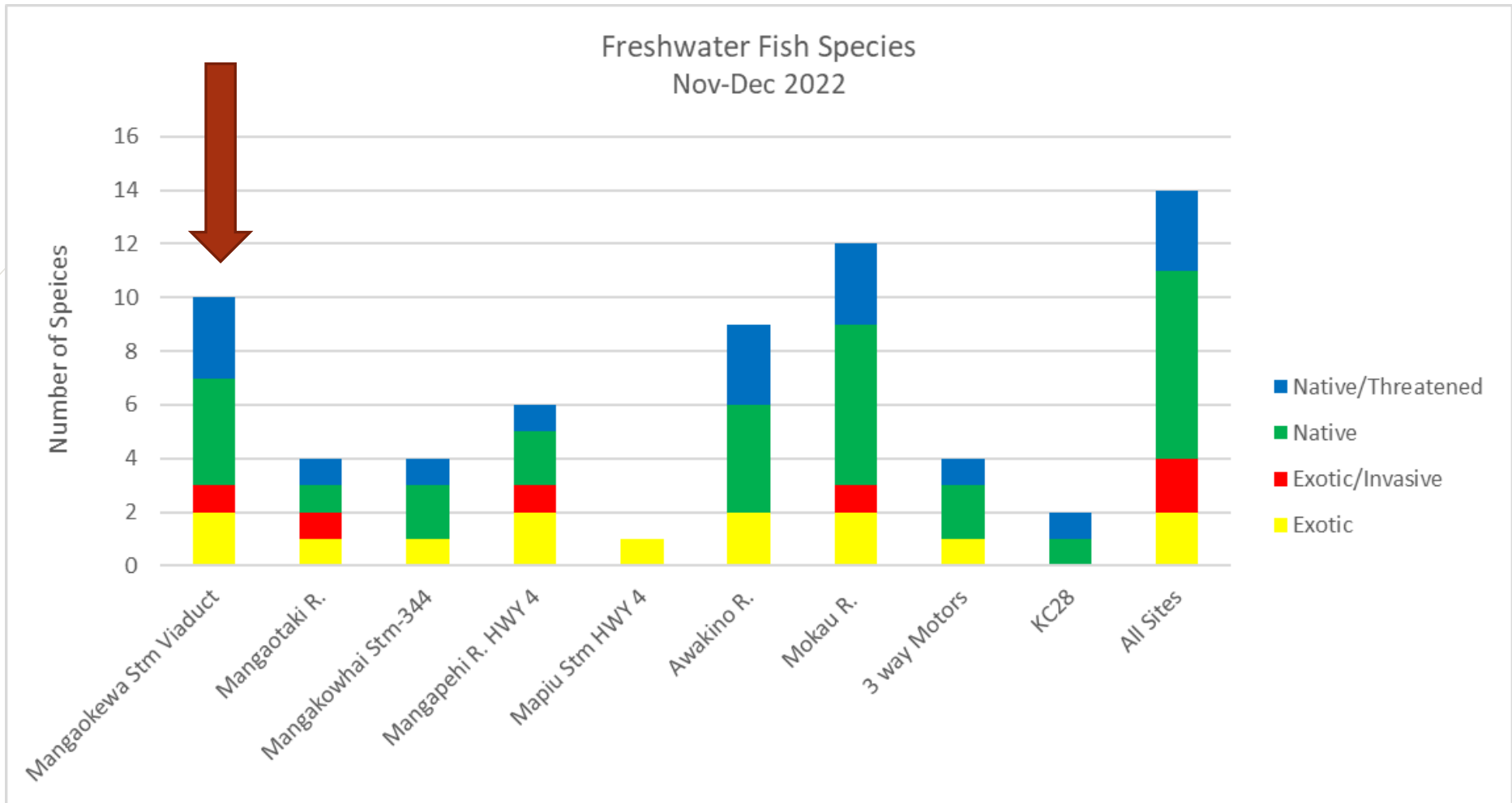
Mangaokewa Stm Viaduct



Torrentfish– At Risk - Declining

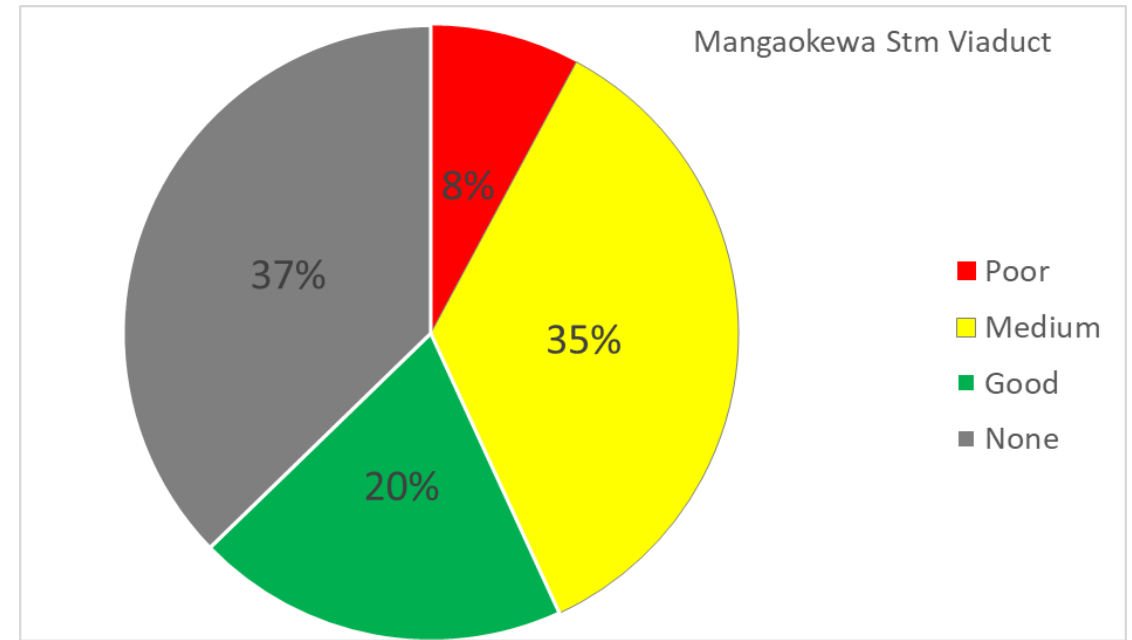


Lamprey – Threatened
Sp



Freshwater Fish Number of species detected and their threat status





Sites	KC4	KC11	KC12	KC14	KC20	KC25	KC26	KC27	KC28
	Mangaokewa Stm Viaduct	Mangaotaki R.	Mangakowhai Stm-344	Mangapehi R. HWY 4	Mapiu Stm HWY 4	Awakino R.	Mokau R.	3 way Motors	KC28
MCI Score	119	126	109	112	112	127	105	101	121
National Grade	B	B	C	B	B	B	C	C	B

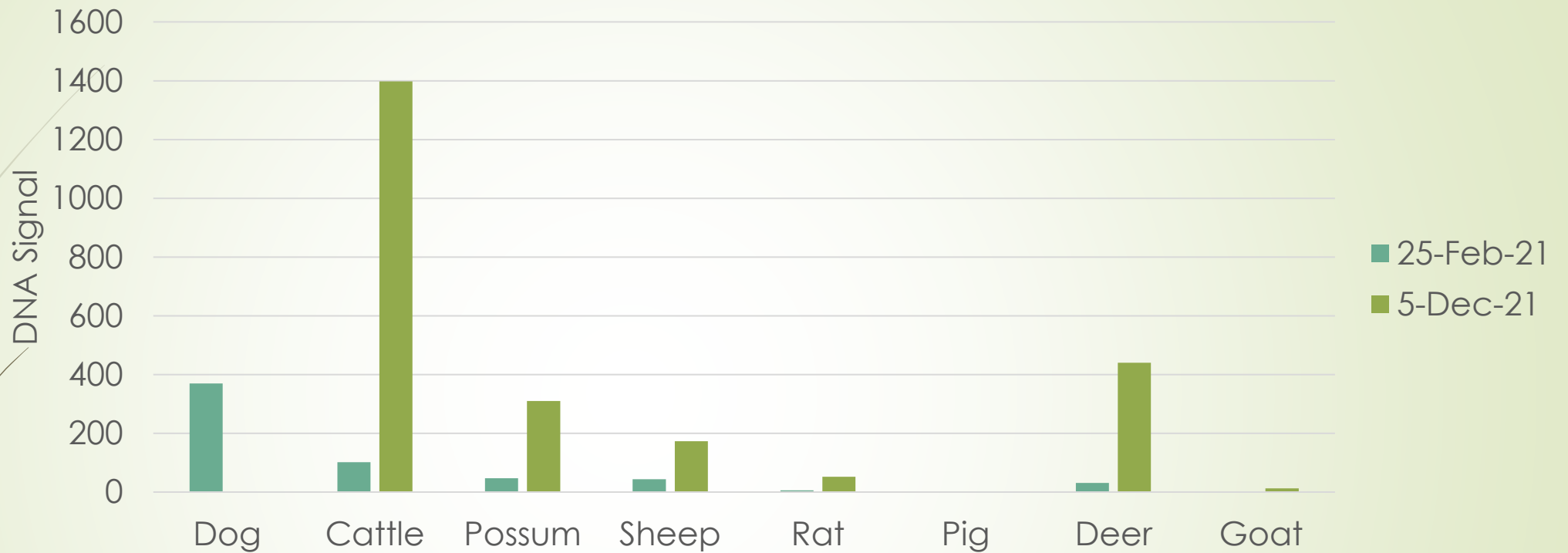
Freshwater Invertebrate Community Health Index (MCI) eDNA Results 2021

4-Mangaokewa stream Site Characteristics

- **Riparian vegetation**
- Exotic grass one side, native the other
- **Stock Access**
- No, public reserve
- **Water temperature (°C)**
- Feb = 19.2; May = 11.5
- **Conductivity (µS/cm)**
- Feb = 231; May = 156



Mammals - 4. Mangaokewa Stream



Mammalian eDNA Signal Strength

Summary Points - Upper Mokau Mangapehi

Summary of 2021 KCRC Water Quality

- E. coli is the key attribute to investigate
- Keep an eye on risk to water clarity/sediment and/or nitrate loss

Water Quality Baseline 2015-20

- E.coli and Sediment were elevated in Mokau River

eDNA

- 6 Fish sp. Detected - mid diversity over all KCRC sites
- MCI = 112/ B Grade



Summary
Points -
Upper
Mangaokewa

Summary of 2021 KCRC Water Quality

- E. coli, nitrate and ammonia are the key attributes to investigate
- DRP is elevated at Lawrence St bridge
- Water clarity is low at 6-Waiteti stream

Water Quality Baseline 2015-20

- E.coli, nitrate, ammonia & DRP were elevated

eDNA

- Good results for native fish community and invertebrates

How Farm Management Influences Catchment Health



Management Actions

<https://www.farmmenus.org.nz/drystock-farms/>

Impact	N	P, Sed, E. coli
High	>25%	>50%
Medium	10-25%	20-50%
Low	<10%	<20%

Actions - Drystock Farms	Greatest Potential Reduction/WQ Benefit			
	Sediment	E. coli	N	P
Nutrient Management	20-50%	-	10-25%	>50%
Stock Management	>50%	20-50%	10-25%	>50%
- To improve herd fertility and finishing rate	-	-	10-25%	<20%
- To reduce erosion & soil damage	>50%	20-50%	<10%	>50%
Planting to Reduce Erosion	>50%	20-50%	10-25%	20-50%
Managing Critical Source Areas	>50%	>50%	<10%	>50%
Riparian Management	>50%	>50%	10-25%	>50%
- Sediment Traps	>50%	<20%	<10%	>50%
- Provide deer wallows away from waterways	>50%	>50%	<10%	20-50%
Management of Fodder Crop Areas	>50%	20-50%	>25%	>50%
FEP - Good farmer buy-in	>50%	>50%	>25%	>50%
FEP - Poor buy-in	<20%	<20%	<10%	<20%

Management Actions

<https://www.farmmenus.org.nz/dairy-farms/>

Impact	N	P, Sed, E. coli
High	>25%	>50%
Medium	10-25%	20-50%
Low	<10%	<20%

Actions - Dairy Farms	Greatest Potential Reduction/WQ Benefit			
	Sediment	E. coli	N	P
Nutrient Management	-	-	10-25%	20-50%
Riparian Management	>50%	>50%	10-25%	20-50%
- Sediment Traps	20-50%	<20%	<10%	20-50%
- Constructed wetlands	20-50%	20-50%	10-25%	20-50%
Effluent management	20-50%	>50%	10-25%	>50%
Feed pads - Off Pasture Options	>50%	>50%	>25%	>50%
Good Grazing Management - On Pasture Options	20-50%	20-50%	<10%	20-50%
Managing Critical Source Areas	>50%	>50%	>25%	>50%
Cropping Management	>50%	20-50%	>25%	>50%
FEP - Good farmer buy-in	>50%	>50%	>25%	>50%
FEP - Poor buy-in	<20%	<20%	<10%	<20%

► Reference

Menu

Menu of practices to improve water quality: dairy farms

Menu of practices to improve water quality: drystock farms

Menu of practices to improve water quality: cropping land

These menus provide a range of practices targeting cropping land, dairy and drystock farms to improve nutrient management and reduce impacts on water quality. [About these menus](#)



Healthy Farms
Healthy Rivers
ACTIONS FOR CHANGE



Dairy for life



Headlands
minimise. Surplus. optimise profit.



<https://www.farmmenus.org.nz/>



Click on the arrows on the variables in the header row to reorder the farm practices based on that variable. Use this menu in conjunction with your consultant or your Land Environment Plan.

Management area	On farm practice	N	P	Sed	Pa	Cost	Benefit	Factors to consider
Cropping management	Actively manage grazing of winter crop areas to reduce risk of N leaching, run off, soil loss and compaction	L	M	M	M	\$\$	\$\$\$	Graze from top to bottom of paddock contour. Avoid leaving stock on during wet periods, for long periods, or concentrated on small sections of the crop.
Planting to reduce erosion	Afforestation of steep southern faces (above Land Use Capability 6e)	M	M	M	-	\$\$ - \$\$\$	\$ - \$\$	Protects areas of greatest erosion risk and replaces low growing slopes with long term productive investment. Best suited to areas with large weed burdens and minimal profitability. Profitability depends on forestry regime and market. Any afforestation plan should include a harvest plan to ensure all land is harvestable.

Soil Damage - Pugging



Source: Keith Betteridge, AgResearch



Source: Keith Betteridge, AgResearch

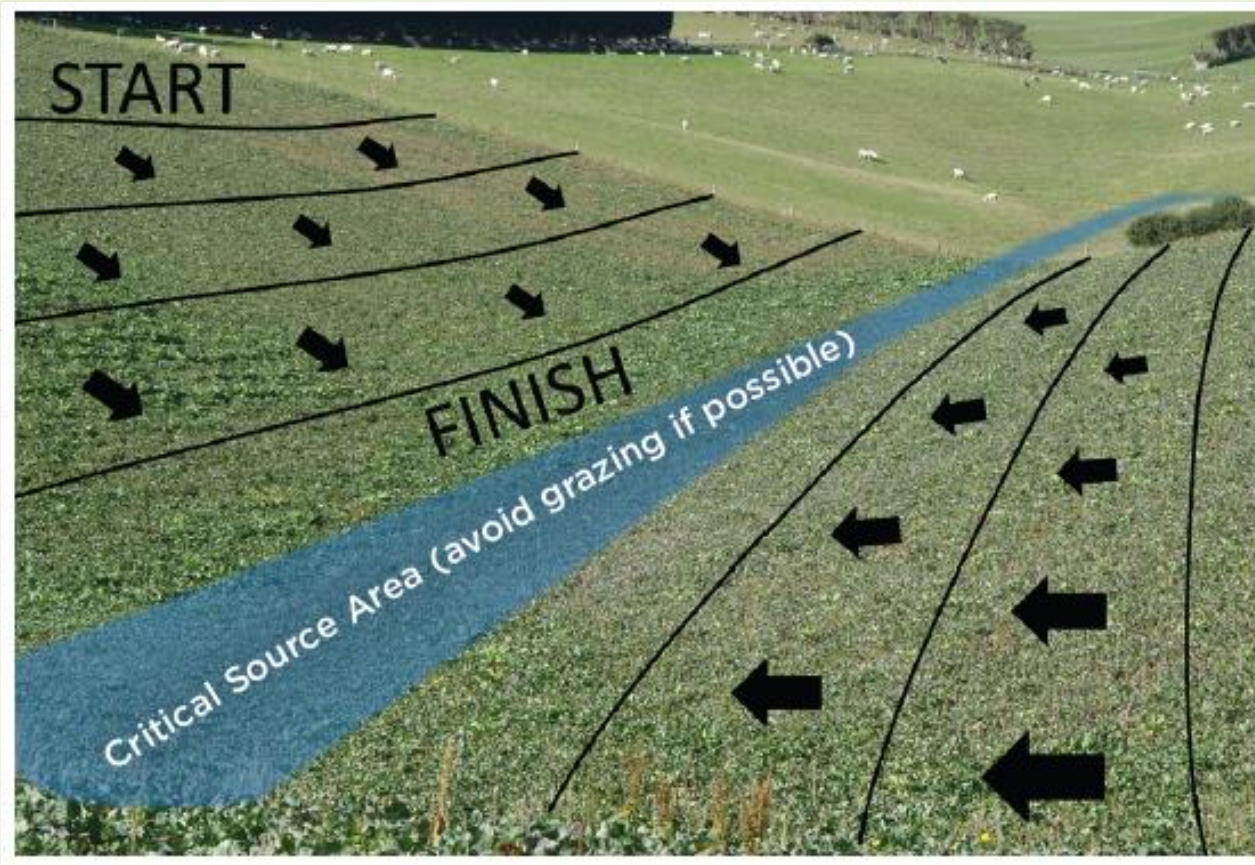
Overgrazing & soil damage

- Reduces spring pasture production by up to 80%
- Can take 3 or more years to recover.

[Click here to find out more about soil erosion processes in New Zealand](#)

[Click here to find out more about soil and pasture management](#)

[Click here to learn about 11 ways to reduce pugging in your pasture](#)

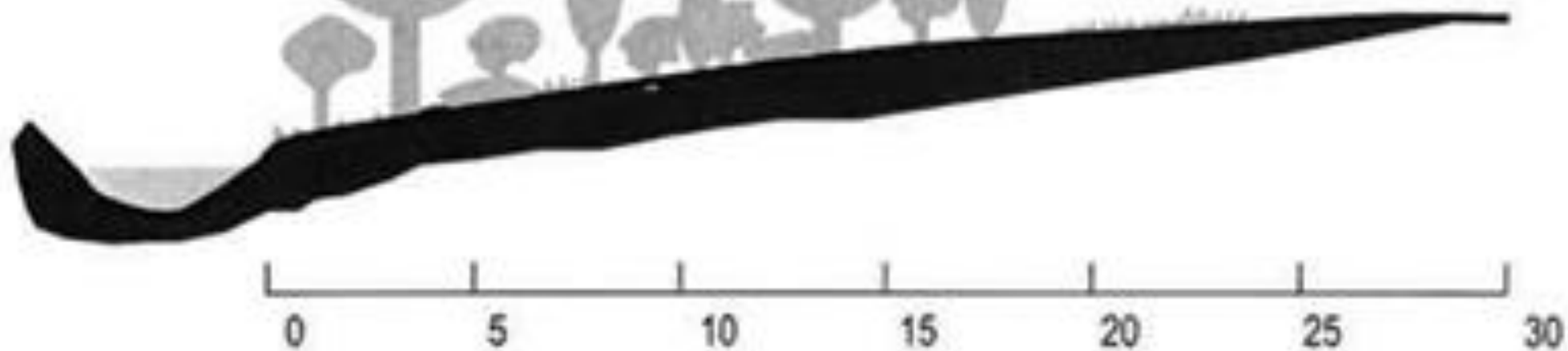


<https://beeflambnz.com/wintergrazing/pre-grazing>

Take action to reduce potential losses of sediment, nutrients and E. coli to waterways during wetter months

Functions of riparian buffers

[Click here to learn more about the role riparian setback distances](#)



Livestock damage

Fish habitat

Bank stability

Flood control

Shade

Leaf input

Filtration

Wood input

Nutrient uptake

Wildlife habitat

Diagram from conference paper by J Quinn (2012)

Riparian management - results from New Zealand

Riparian management schemes assessed, showing measures of water quality and stream health recorded as better (+), worse (-), or no change (=) in the buffer compared to the control reach for each variable.

Site	Time since planting (yr)	Planted length (m)	Average buffer width (m)	Difference in buffer relative to pasture control reach						
				Phosphorus (over 10% change in dissolved P)	Nitrogen (over 10% change in dissolved N)	Faecal inputs (over 10% change in <i>E. coli</i>)	Visual clarity (over 10% change)	Mean temperature (more than 1 deg change)	Stability (change in Pfankuch class)**	Invertebrates (change in QMCI class)***
Raglan	2	200	12.7	+	+	-	=	=	+	=
Matarawa	3	300	3.5	-	=	+	+	=	+	-
Little Waipa	4	660	10.6	+	=	+	+	-	=	=
Waitetuna	6	1600	7.2	=	-	nd	-	=	=	=
Mangawara	8	200	15.5	=	=	=	=	nd	=	+
Tapapakanga	10	2000	11.4	+	+	+	+	-	=	-
Kakahu*	20	3600	21	+	+	nd	+	+	=	+
Waitomo	20	100	18.8	=	=	-	-	=	=	=
Taupo*	24	4200	75	+	-	nd	+	+	+	+

[Click here to view source publication](#)

What can we do to improve catchment health?

- Retire & plant marginal land
- Exclude stock from streams, wetlands & boggy areas
- Plant retired riparian margins
- Manage nutrients & effluent conservatively
- Identify and address CSAs





Thank You

