What we know
…about water quality in the Hurunui catchment

Results from current monitoring and investigations

Key messages

• Didymo appears to be the dominant algae in the upper reaches

• Cyanobacteria (*Phormidium*) is an issue in the lower reaches of the Hurunui River

• Nitrate from intensive land use in the Amuri Basin is the main source of N to the Hurunui mainstem, with increasing trend in concentrations at some tributary and groundwater sites and for SH1

• The lag in nitrate reaching the river from land use in Amuri Basin and Waitohi area is uncertain and more work needed.

• The impact of AIC piping, development of HWP and Balmoral forest conversion is still to be seen.
**Key messages continued**

- The impact of altering in-river N & P concentrations on periphyton growth and species composition remain uncertain. Notwithstanding this,
  - the management of N & P, microbial contamination and sediment is considered necessary to avoid an adverse deterioration in freshwater quality;
  - Flushes and small floods are effective in regulating periphyton accumulation;
- Ecological health occasionally indicates degradation for some sites
- Swimmability (*E. coli* levels) is an issue for the tributary streams and at SH1 much of the time

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**Wadeable and Swimmable**

- **Wadeable** = People are exposed to a high risk of infection (>5% risk) from contact with water during activities with partial immersion and some ingestion of water
  - Annual **median** must not exceed 1000 MPN/100mL
- **Swimmable** = moderate risk of infection (< 5% risk) from activities likely to involve full immersion.
  - Annual **95th percentile** must not exceed 540 MPN/100mL

From NPS-FM (2014)
Wadeable and Swimmable

- **Wadeable**: All sites monitored are suitable for wading activities
- **Swimmable**:
  - 2013-14: 5 of 6 sites do not meet minimum requirements
  - Tributary streams frequently do not meet minimum requirements for swimmability
  - Hurunui River at SH1 did not meet minimum requirements for past 4 years – reflected by a ‘poor’ suitability for recreation grading
  - Decreasing *E. coli* trends for Dry Stream, Pahau River and St Leonards Drain

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<tbody>
<tr>
<td>Hurunui River at Mandamus</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Mandamus River – Tekoa Rd</td>
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<td>B</td>
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<tr>
<td>Waitohi above Hurunui Confl.</td>
<td>B</td>
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<tr>
<td>Dry Stream above Hurunui Confl.</td>
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<td>Insufficient data for analysis</td>
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<td>Pahau River above Hurunui Confl.</td>
<td>B</td>
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<td>A</td>
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<td>St Leonards Drain above Pahau</td>
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<td>Hurunui River SH1</td>
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Sites coded red do not meet the minimum acceptable state for Swimmability for that year.

Contact recreation (summer) monitoring

- Suitability for recreation monitoring only carried out for Hurunui River at the swimming site near SH7 bridge and at SH1.
- Recent improvement to “Fair” grading, but have both been previously considered unsuitable for recreation.
Aquatic ecosystem health

Monitoring of aquatic macro-invertebrates (bugs >0.5 mm) species as an indicator of overall water quality and stream habitat

- Mandamus and Pahau Rivers meet minimum plan objective
- Waitohi (2 sites), St Leonards Drain and Hurunui SH1 occasionally do not meet the minimum plan objective
- School Stream at SH7 does not achieve the minimum plan Objective
Key Messages: Aquatic Ecosystem Health

- 2 sites always meet plan objectives, 4 sites sometimes meet plan objectives,
- School Stream at SH7 does not meet the minimum plan objective
  - Stagnant flow, choked with macrophytes and floating algae
- AIC piping will reduce flows in many of the Amuri Basin streams

What is periphyton

- Algae or cyanobacteria e.g. didymo, green filaments, *Phormidium*
- In large quantities can be considered a nuisance due to impacts on river values
  - Recreation – *Phormidium* mats can be toxic
  - Ecological – can smother the benthic environment
  - Aesthetic appeal
Key factors driving Periphyton and Cyanobacteria

- River flow has greatest influence on periphyton growth, followed by nutrients when flow is optimal
- different periphyton appear to have different nutrient requirements
  - didymo = low nutrient requirements
  - cyanobacteria = elevated N, potentially low P in water
  - long filament = elevated N & P
- Need to manage both N & P to meet requirements of different periphyton

Total Periphyton - biomass

- NPS-FM National Objectives Framework – Benthic Periphyton – chlorophyll ‘a’
  - Only have suitable data at 2 sites: Hurunui SH1 + Pahau River
- Pahau River at Top Pahau Rd generally good
- Hurunui River at SH1 variable and not suitable all years

<table>
<thead>
<tr>
<th>Benthic Periphyton</th>
<th>No. samples</th>
<th>National Bottom line</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
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<tr>
<td>SQ0540</td>
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</tbody>
</table>
Cyanobacteria (*Phormidium*) mat cover in rivers

- Most problematic in Hurunui River
- Public Health Warnings often issued at SH7 (often on a side braid that is the swimming site) & SH1 due to moderate-high cover, and detaching mats

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Didymo cover in rivers

- Monitoring indicates Didymo is the dominant periphyton in the upper catchment (upstream of SH7)
- Didymo appears to dominate under low nutrient conditions
Nutrients and their impact on surface water quality

- **Nutrients**
  - At **low** concentrations - Beneficial in encouraging thin growths of algae in rivers (food for aquatic life)
  - At **higher** concentrations – encourage conspicuous nuisance growths of algae (periphyton)
  - At **very high** concentrations some nutrients (Nitrate-N, Ammonium-N) can be toxic

- Different guideline address different effects
Lag time – uncertain and more work needed

- Can take years to decades for nitrogen from land use to re-emerge in surface water
- We first see effects of changes in a few years, but it takes longer to equilibrate (steady state)
- Lag is spatially variable and recharge dependent
- Tools for lag: time trends, age tracers, modelling
  - We need more information to apply these
  - e.g. timing of conversions/intensification


- Amuri Plains – upwards nitrate trends in groundwater in >50% of sites
- Balmoral forest wells don’t have long enough record to see trends
Amuri Plains well (N33/0205 – 28 m deep)

Increasing nitrate trend, landuse intensification

Amuri Plains well (N33/0219 – 18 m deep)

Increasing nitrate trend since 2007, possibly landuse intensification, change from border dyke to spray irrigation
Nutrient impacts on periphyton – Nitrogen

- Increase in N from upper Hurunui (Mandamus/SH7) to lower (SH1/Swingbridge)
- From 1989 to 2016 nitrogen concentrations have significantly increased. Since 2006 there has been no significant trend observed (<1% annual change)

Nutrient impacts on periphyton – Nitrogen

- Increase in N from upper Pahau (Downs) to lower Pahau (above Hurunui)
- Nitrogen elevated in tributary streams (Amuri Basin)
- Greatest in spring-fed tributaries e.g Pahau Drain, St Leonards Drain
- Increasing trends from 2005 for Waitohi and St Leonards Drain, decreasing for Dry (irrigation race water – may change with AIC piping)
Nutrient impacts on periphyton – Phosphorus

- P concentrations indicates periphyton growth in the Hurunui mainstem is limited by phosphorus – does not account for sediment P sources i.e for Phormidium growth
- No significant trends 1989 – 2016 in mainstem, however slight decrease for SH1 when flow is taken into consideration
- Short term trend (2005 – Present) indicates a significant decrease in phosphorus when flow is taken to consideration

Nutrient impacts on periphyton – Phosphorus

- Tributaries show higher P than mainstem
- Decreasing trends from 2005 for Waitohi, Pahau, and Dry Stream
Key Messages: Nutrients and periphyton

• Hurunui River mainstem:
  – Upper river dominated by didymo, with both N & P limiting factors of periphyton growth
  – Lower river dominated by cyanobacteria
  – Cyanobacteria related to Increasing N concentrations, can be limited by P concentrations
    • Evidence that cyanobacteria can get P from fine sediment trapped in mats

Key Messages: Nutrients and periphyton

• Amuri Basin tributaries:
  – Elevated nutrient concentrations, with N increasing in some tributaries, P decreasing in some
  – Tributaries do not appear to be susceptible to nuisance periphyton growths
  – Elevated nutrient concentrations important as a source to the mainstem
Nutrient toxicity – National Criteria

• All river sites monitored have low ammonia toxicity risk
• Some nitrate toxicity effects on species for spring-fed streams i.e Pahau Drain and St Leonards Drain, and Dry Stream

Current land use - Draft GIS layer
Nitrogen loss from land – Draft GIS layer

Comparing ‘Source’ and ‘In-river’ loads to existing Plan limits

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Area (ha)</th>
<th>‘Source’ loads (Nitrogen tonnes/yr)#</th>
<th>‘In-river’ loads (Nitrogen tonnes/yr)*</th>
<th>Existing Plan (In-river) load limits (DIN tonnes/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurunui at Mandamus</td>
<td>105,754</td>
<td>228</td>
<td>55* (28-105)**</td>
<td>39</td>
</tr>
<tr>
<td>Hurunui at SH1 (Total)</td>
<td>252,395</td>
<td>1,886</td>
<td>713* (270-1451)**</td>
<td>963</td>
</tr>
</tbody>
</table>

# Based on summing loads from draft GIS layers on previous slides
* Based on rolling 6 year average annual load estimate as at 2016
** Brackets show large range of annual load estimates for the period 2005 to 2016
From our tributary monitoring most of the N comes from Amuri Basin tributaries (relative contribution)

Relative N Load

Hurunui at Mandamus
Mandamus at Tekoa Rd
Waitohi River above Hurunui Confl.
Dry Stream above Hurunui confl.
St Leonards Drain above Hurunui Confl.
Pahau River above Hurunui Confl.

From our tributary monitoring more of the P comes from the upper catchment (relative contribution)

Relative P Load

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Mandamus at Tekoa Rd
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Dry Stream above Hurunui confl.
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Questions

Nitrogen Trends 1989-Present

Mandamus = decreasing trend

SH1 = Increasing trend
• Increasing N trends for Waitohi and St Leonards Drain, decreasing for Dry (irrigation race water). No significant trend for Pahau
Mandamus

No significant trends in mainstem, however slight decrease for SH1 when flow is taken into consideration.

SH1

Decreasing phosphorus trends in mainstem, only when flow taken into consideration.
- Decreasing P trends for Waitohi, Pahau, and Dry Stream (St Leonards Drain shows non-significant decreasing trend)

- Decreasing *E. coli* trends for Dry Stream, Pahau River and St Leonards Drain