

Draft memo

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To	Waimakariri Zone technical team
CC	
From	Michael Greer

Current Pathways: assessment of ecosystem effects preliminary results

An expert panel has been commissioned to provide technical advice for the Waimakariri sub-regional planning process. As part of this work, the panel assessed the likely effects of a shift to Good Management Practice (GMP) on stream health under a “Current Pathways” scenario (see Appendix 1 for the full scope of the panel’s role). This memorandum:

- outlines the assumptions made about riparian management practices under this scenario, based on recommendations of riparian GMP from relevant guidance documents and plans.
- outlines the technical metrics that the expert panel assessed, and the river units that these assessments were made for.
- describes the assessment methodology the panel employed.
- presents the results of the panel’s assessments.

Good riparian management under the “Current Pathways” scenario

Background

A key part of operating at GMP is minimising nitrogen loss rates from land. However, just as important is effective riparian management. Just how much a shift to good riparian management practice will affect stream health in the Waimakariri zone requires the on the ground actions to be quantified.

Recommendations of guidance documents and plans

The following documents provided guidance on what constitutes good riparian management.

Waimakariri Irrigation Limited: Guide to Preparing a Farm Environment Plan

Waimakariri Irrigation Limited expects:

- water users to meet, as a minimum, the stock exclusion rules in the Land and Water Regional Plan, and the requirements of the 'Sustainable Dairying: Water Accord' where relevant.
- all regular stock crossings have a bridge or culvert.

Industry-agreed Good Management Practices relating to water quality

The farming industry recommends that:

- to the extent that is compatible with land form, stock class and intensity, exclude stock from waterways.

Sustainable Dairying: Water Accord

The dairy industry agrees that dairy companies will implement measures to exclude dairy cattle from:

- waterways and drains greater than 1 m in width and 300 mm in depth.
- significant wetlands.

Measures shall be implemented as per the following timetable.

- For waterways and drains:
 - 90% exclusion of waterway length present on dairy farms by 31 May 2014.
 - 100% exclusion of waterway length present on dairy farms by 31 May 2017.
- 50% of dairy farms with waterways will have a riparian management plan by 31 May 2016, and all of these farms will have completed:
 - half of their riparian management plan commitments by 31 May 2020.
 - full implementation of their riparian management plan by 31 May 2030.
- 100% of all dairy farms with waterways will have a riparian management plan* by 31 May 2020.

Land and Water Regional Plan policies

The policies in the Land and Water Regional Plan (LWRP) state:

- damage to the bed or banks of water bodies, sedimentation and disturbance of a waterbody, direct discharge of contaminants, and degradation of aquatic ecosystems is avoided by:
 - excluding intensively¹ farmed stock from lakes, rivers and wetlands.

¹ Intensively farmed stock includes:

- cattle or deer grazed on irrigated land or contained for break-feeding of winter feed crops.
- dairy cattle, including cows, whether dry or milking, and whether on irrigated land.
- farmed pigs.

- excluding stock from swimming, salmon spawning and other sensitive waterbody areas, and the waterbody bed and banks closely upstream of these areas.
- limiting access to wetlands, and the banks or beds of lakes and rivers to stock species that prefer to avoid water and at stocking rates that avoid evident damage.

Existing Land and Water Regional Plan rules

Existing rules in the LWRP stipulate that:

- unless categorised as a prohibited activity under Rule 5.71, the use and disturbance of the bed (including the banks) of a lake, a river that is greater than 1 m wide or 100 mm deep (under median flow conditions), or a wetland, by intensively farmed stock and any associated discharge to water is a non-complying activity.
- the use and disturbance of the bed (including the banks) of a lake or river by any farmed cattle, farmed deer or farmed pigs and any associated discharge to water is a prohibited activity in the following areas:
 - in an inanga or salmon spawning site listed in Schedule 17.
 - within 1000 m upstream, in the bed of a lake river, of a fresh water bathing site listed in Schedule 6.
 - in the bed (including the banks) of a spring-fed plains river, as shown on the planning maps.

New Land and Water Regional Plan rules (PC4)

New rules in the LWRP stipulate that:

- the use and disturbance of the bed (including the banks) of a lake or river by any farmed cattle, farmed deer or farmed pigs and any associated discharge to water is a prohibited activity in any inanga spawning habitat.

Land and Water Regional Plan Schedule 7 – Farm Environment Plan

The LWRP specifies that Farm Environment Plans (FEPs) will aim to:

- manage wetland and waterway margins to avoid damage to the bed and margins of a water body, avoid direct input of nutrients, and to maximise riparian margin nutrient filtering.
- manage wetlands and water bodies so that stock are excluded as far as practicable from water, to avoid damage to the bed and margins of a water body, and to avoid the direct input of nutrients, sediment, and microbial pathogens.

Assumptions around what riparian management will look like under Current Pathways

Based on the guidance provided by the documents outlined above, several assumptions were made about what the minimum standard of riparian management will be under GMP.

Extensive sheep and beef

Implementation guidance in the '*Industry-agreed Good Management Practices relating to water quality*' states that:

"exclusion of extensively farmed stock from waterways in hill and high country areas may not be practical, but rather a mix of mitigations and practices can be used to minimise sediment and faecal bacteria losses from farms".

Based on this, the rules in the LWRP, and recommendations from Environment Canterbury staff, the following assumptions were made about what constitutes good riparian management for streams that flow through extensive sheep and beef farmland.

- Outside of the areas bullet pointed below, the riparian management of rivers that flow through extensive sheep and beef farms will remain largely unchanged. Landowners are under no obligation to fence or plant these streams.

Note: there will be targeted fencing and planting programmes, and the effects of these programmes were assessed by the panel.

- All farmed stock will be excluded from the bed (including the banks) of spring-fed plains rivers.

Note: this is an existing rule, and is already observed by a lot of landowners. Environment Canterbury has recently conducted a stream walk of the Cam River catchment and found that fencing has been conducted along approximately 65% of its length. This figure may be the best measure of existing compliance in the zone. Therefore, the expert panel assumed that 35% of each of the spring-fed plains streams in the zone will be fenced in the future with the effect of excluding farmed cattle, deer and pigs from these streams.

- All farmed stock will now be excluded from waterways identified as inanga spawning habitat.
- All farmed stock will be excluded from reaches less than 1000 m from scheduled bathing sites.

Note: This rule only applies in the Ashley River 1000 m upstream of the Ashley Gorge Picnic Ground. Compliance may already be at or near 100%.

Intensive stock (excluding dairy)

There are strict rules in the LWRP relating to the exclusion of all intensively grazed stock from streams. The relevant non-statutory guidance documents do not require a higher level of management than the LWRP rules. Where the LWRP states that "*the use and disturbance of the bed of a lake, a river or a wetland, by intensively farmed stock is a non-complying activity*", the *Industry-agreed Good Management Practices relating to water quality* simply recommends that "*to the extent that is compatible with land form, stock class and intensity, exclude stock from waterways*". Similarly, in its *Guide to Preparing a Farm Environment Plan*, Waimakariri Irrigations Limited (WIL) recommends that irrigators simply obey the

LWRP stock exclusion rules. It does not appear to expect a higher level of mitigation as a standard.

Based on this, the following assumptions were made about what the riparian management of streams that flow through intensively stocked (excluding dairy) farmland will look like under GMP.

- Intensively farmed stock will be excluded from all waterways greater than 1 m wide or 100 mm deep.

Note: this is an existing rule that is already observed by a lot of landowners. Data collected from the Cam River stream walk may be the best measure of existing compliance in the zone. Therefore, the expert panel assumed that 35% of river reaches in the zone, that flow through intensive farmland (excluding dairy), will be fenced in the future, with the effect of excluding all intensively farmed stock.

1. Stock exclusion will involve fencing with a setback and vegetated strip of at least 1 m.

Dairy

Unlike other types of intensive farming, dairy is subject to the *Sustainable Dairying: Water Accord*. This accord sets timelines for the fencing of waterways (including “drains”) that run through dairy farms and the implementation of riparian management plans. This enables us to assess with greater certainty the effects of future riparian management.

Based on the requirements of the *Sustainable Dairying: Water Accord*, the following assumptions can be made about what the riparian management of streams that flow through dairy farms will look like under GMP.

- 100% of streams and drains greater than one metre in width and deeper than 30 cm on dairy farms will be fenced by May 2017.

Note: in 2016, the percentage of waterways fenced through dairy farms was 98% (excluding drains). Therefore, using current state as a baseline (2011 to 2016), the expert panel assessed the effects of fencing the remaining 2% of river reaches that flow through dairy farms, plus any smaller streams that could be considered as “drains”.

- Conservatively, stock exclusion will involve fencing with a setback of at least 1 m.

Small holdings

A large area of the zone, particularly around the lowland streams, is dominated by small holdings. These farms are subject to the same rules as larger blocks of land. The following assumptions can be made about the riparian management of streams that flow through small holdings.

- Small holders will exclude all farmed cattle, deer and pigs from spring-fed plains rivers.

Note: 65% existing compliance was assumed.

- Stock exclusion will involve fencing with a setback and vegetated strip of at least 1 m.

Predictive maps of current and future fencing under the “Current Pathways” scenario were used by the expert panel for their assessments.

Technical metrics assessed by the expert panel

A number of metrics were assessed by the expert panel. These were categorised by “tiers” and are explained below.

Tier 1 metrics

Metrics that will be directly affected by a change in land and/or water use including riparian management.

Nitrogen

The concentrations of key nitrogen species. Both toxicity and plant growth were taken into account when considering the effects of any predicted changes.

Parameters considered:

- Ammonia
- Nitrate
- Combined as dissolved inorganic nitrogen (DIN)

Predicted changes in metric provided by:

The change in concentration at key nodes throughout the zone. Data was provided to the panel.

Effects considered:

- Toxicity
- Periphyton and macrophyte growth
- Cyanobacteria growth.

Phosphorous

The concentration of both dissolved reactive phosphorous (DRP) and total phosphorous (TP). When considering the effects of any predicted changes in concentrations on plant

growth, both forms were considered, i.e. DRP for periphyton and macrophytes, and TP for cyanobacteria.

Parameters considered:

- Dissolved reactive phosphorus
- Total phosphorus

Predicted changes in metric provided by:

The expert panel assessed the magnitude of change in phosphorous concentrations under GMP, based on their understanding of the role that riparian management has on regulating phosphorus input.

Effects considered:

- Periphyton and macrophyte growth
- Cyanobacteria growth

Sediment input

The amount of sediment entering the river network. Likely changes in sediment cover and suspended sediment concentrations were assessed when considering the effects of any predicted changes in sediment input.

Parameters considered:

- Sediment load

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of the role that riparian management has on regulating sediment input.

Effects considered:

- Suspended sediment and the likely direct effects on flora and fauna
- Sediment deposited on the bed and the likely direct and indirect effects on flora and fauna

Faecal contamination

The level of faecal contamination throughout the river network.

Parameters considered:

- *Escherichia coli*

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of the role that direct stock access has on faecal contamination, and the regulating role of buffer strips in minimising runoff.

Effects considered:

- Human health risks and the resulting suitability for recreation

Flow

The entire hydrological regime including mean flow, variability, and flood frequency.

Parameters considered

- Mean annual low flow (MALF)
- Q5-Q95

Predicted changes in metric provided by:

Where possible, flow stats were provided to the expert panel by Environment Canterbury technical staff.

Effects considered:

- All aspects of habitat, plant growth, and water quality

Tier 2 metrics

Metrics that include water quality and habitat parameters that will be indirectly affected by a change in land and/or water use including riparian management (i.e. changes resulting from changes in Tier 1 metrics).

Plant growth

All aspects of plant growth including cyanobacteria. Effects were considered in terms of ecological health, aesthetic value, and human health risks.

Parameters considered:

- Periphyton cover
- Macrophyte cover

- Cyanobacteria cover

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of how changes in Tier 1 metrics will impact plant growth.

Tier 1 metrics to consider:

- Nitrogen
- Phosphorus
- Sediment
- Flow

Effects considered:

- Periphyton
 - Habitat value for both fish and invertebrates
 - Oxygen and pH
 - Aesthetics
- Macrophytes
 - Habitat value both for fish and invertebrates
 - Oxygen and pH
 - Aesthetics
 - Implications for drain management
- Cyanobacteria
 - Habitat value for both fish and invertebrates
 - Aesthetics
 - Human health risks

Connectedness

The total length of connected flowing water in a stream through time.

Parameters considered:

- Connectedness

Predicted changes in metric provided by:

Where possible, flow stats were provided to the expert panel by Environment Canterbury technical staff.

Tier 1 metrics to consider:

- Flow

Effects considered:

- Fish passage

Tier 3 metrics

Metrics that quantify trophic level and other value responses to Tier 1 and 2 changes.

Invertebrate community health

Changes in invertebrate community composition in response to Tier 1 and Tier 2 metrics.

Parameters considered:

- Quantitative Macroinvertebrate Community Index (QMCI)

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of how changes in Tier 1 and 2 metrics will impact invertebrate communities.

Tier 1 metrics to consider:

- Nitrogen (toxicity)
- Sediment
- Flow

Tier 2 metrics to consider:

- Plant growth

Effects considered:

- Effects on lower and higher trophic levels

Fish diversity

Changes in fish diversity at the local, regional, and national scale in response to changes in Tier 1 and Tier 2 metrics. The effects of these metrics were considered in terms of fish abundance, the species present, and the distribution of these species regionally and nationally.

Parameters considered:

- Fish diversity at the local scale
- Fish diversity at the regional scale (e.g. an increase in N in an area with a homogenous fish community composed solely of long-fin eels will have more of an impact on regional fish diversity than the same increase in an area with a homogenous fish community composed solely of common bully, despite the local scale effects being the same)
- Fish diversity at the national scale (e.g. the loss of a small population of Canterbury mudfish will have a greater impact on national biodiversity than the loss of a small population of long-fin eels)

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of how changes in Tier 1 and 2 metrics will impact fish communities, the threat classification of different species, and the distribution of threatened species in the zone.

Tier 1 metrics to consider:

- Nitrogen (toxicity)
- Sediment
- Flow
- Dissolved oxygen, temperature and pH

Tier 2 metrics to consider:

- Plant growth
- Connectedness

Tier 3 metrics to consider:

- Invertebrate community health

Effects considered:

- Effects on lower and higher trophic levels
- Mahinga kai values
- Angling values

Overall suitability for recreation

The suitability of a river for recreation both in terms of the health risk for contact recreation, and aesthetic value for all forms of recreation.

Parameters considered:

- Human health risks
- Aesthetic and amenity values

Predicted changes in metric provided by:

Expert panel knowledge based on their understanding of how changes in Tier 1 and 2 metrics will impact relevant rivers and streams in terms of their human health risk and amenity/aesthetic value.

Tier 1 metrics to consider:

- Faecal contamination
- Sediment
- Flow

Tier 2 metrics to consider:

- Plant growth (cyanobacteria)

River units for which the panel made their assessments

Unit 1: Ashley River below the Gorge and the Loburn Fan

Rivers with data:

- Ashley River
- Glentui River
- Garry River
- Bullock Creek
- Okuku River
- Grey River
- Makerikeri River

Unit 2: Lower Ashley Catchment spring-fed streams and coastal wetlands

Rivers with data:

- Saltwater Creek
- Waikuku Stream

- Taranaki Creek

Unit 3: Kaiapoi Catchment spring-fed streams

Rivers with data:

- Cust Main Drain (below Hunters Stream)
- Kaiapoi River (including Silverstream)
- Ohoka River
- Cam River
- South Brook
- North Brook

Unit 4: Upper Eyre and Cust River catchments

Rivers with limited data:

- Cust River
- Eyre River
- Gammons Creek
- Hunters Stream
- Mounseys Stream
- Coopers Creek
- Trout Stream
- Ellis Drain
- Ashley Gorge Drain

Unit 5: Ashley River Catchment above the Gorge

Rivers with limited data:

- Ashley River

Unit 6: Tidal reaches of the Waimakariri, Kaiapoi and Cam Rivers

Rivers with limited data:

- N/A

Maps displaying unit boundaries were provided to the expert panel.

Assessment methodology

The expert panel assessed each metric qualitatively. For each sub-catchment unit, each panel member presented their assessment for each metric using the format in the following example.

Metric: <i>E.coli</i>			Sub-catchment unit: Mississippi Basin
Change	Effect	Confidence	Justification
-2 (Large -)	-2 (Strong -)	0 (Not assessed)	<p><u>Change:</u> In an area with low run off and no border dyke irrigation or tile drainage, direct access by stock will be the major source. Complete exclusion of intensively farmed stock should reduce levels. However, sheep farming is widespread in the area. As these animals will not be excluded, a large improvement is not expected</p> <p><u>Effect:</u> Although reductions across the area should be moderate, levels in key bathing sites are already controlled through upstream fencing and are well below guideline levels. Therefore, it is unlikely that the recreational value of actual bathing sites will improve.</p> <p><u>Confidence:</u> Levels are already low, land use is not expected to increase, and riparian management practices will improve. There is no potential for further degradation but any improvements are unlikely to have an effect.</p>
-1 (Moderate -)	-1 (Moderate -)	1 (Low)	
0 (No/negligible)	0 (No/negligible)	2 (Moderate)	
+1 (Moderate +)	+1 (Moderate +)	3 (High)	
+2 (Large +)	+2 (Strong +)		

An overall assessment was then summarised by the chair and agreement sought from the group.

Results

The results of the expert panel's assessments are provided below.

Unit 1: Ashley River below the Gorge and the Loburn Fan

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen	Negligible	Negligible	Low	
	Phosphorus	Negligible	Negligible	Low	
	Sediment input	Negligible	Negligible	Low	
	Faecal contamination	Negligible	Negligible	Low	
	Flow	Negligible to moderate decrease	Negligible to moderate negative	Low	Half the panel believes that the increased drying was minor, and that the resulting effects on recruitment will also be minor. The other half believes that degradation beyond an already poor current state may have disproportionate effects on fish recruitment.
2	Plant growth	Negligible	Negligible	Low	
	Connectedness	Negligible to moderate decrease	Negligible to moderate negative	Low	Effects are the same as flow.
3	Invertebrate community health	Negligible	Negligible	Low to moderate	
	Fish diversity	Negligible to moderate decrease	Negligible to moderate negative	Low	Reduced recruitment could have a negative effect on both the eel (mahinga kai) and salmonid (recreational) fisheries, which will impact the recreational and cultural value of the catchment.
	Overall suitability for recreation	Negligible	Negligible	Low to moderate	

Unit 2: Lower Ashley Catchment spring-fed streams and coastal wetlands

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen	Large increase	Moderate negative	Moderate	The effects of increased nitrogen concentrations are likely limited to toxicity. Nitrogen concentrations are already sufficiently high to cause nuisance macrophyte growths, and a further increase is unlikely to increase the risk of these growths occurring.
	Phosphorus	Moderate decrease	Negligible	Low to moderate	
	Sediment input	Moderate decrease	Moderate positive	Moderate	Fine sediment cover appears to be the most important driver of invertebrate community health in this unit. Consequently the reduction in sediment in the Saltwater Creek and Taranaki Creek catchments will likely have positive effects on overall stream health. However, future fencing setbacks are unlikely to reduce sediment cover to below 20%, which is the threshold for detrimental effects on invertebrates and fish (both native and salmonids). Furthermore, there will still be a legacy that will need to be addressed.
	Faecal contamination	Moderate decrease	Moderate positive	Low to moderate	Direct faecal input into the Saltwater Creek and Taranaki Creek catchments from stock in streams should decrease with the predicted additional fencing, and recreational opportunities should increase as a result. However, it is unlikely that streams will become suitable for recreational activities involving full immersion.
	Flow			Not assessed	
2	Plant growth	Negligible	Negligible	Low	
	Connectedness			Not assessed	

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
3	Invertebrate community health	Negligible	Negligible	Low	
	Fish diversity	Negligible	Negligible	Low	The panel accepts that fencing inanga spawning habitat may increase inanga reproduction, but it is unclear where these benefits will be felt.
	Overall suitability for recreation	Moderate increase	Moderate positive	Low to moderate	Improvements due to reduced faecal contamination. The social and cultural team will provide further assessment of the benefits of improved suitability for recreation.

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Unit 3: Kaiapoi Catchment spring-fed streams

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen	Large increase	Strong negative	Moderate	There is significant potential for detrimental nitrate toxicity effects, on both invertebrates and fish. The area where these risks are greatest is in the upper Silverstream where invertebrate communities are currently healthiest. There, the median nitrate concentrations are expected to exceed the acute threshold of 20 mg/L.
	Phosphorus	Moderate decrease	Negligible	Moderate	
	Sediment input	Moderate decrease	Moderate positive	Low to moderate	Fine sediment cover appears to be the most important driver of invertebrate community health in this unit. Consequently, the reduction in sediment will likely have significant positive effects on over all stream health. However, future fencing setbacks are unlikely to reduce sediment cover to below 20%, which is a potential threshold for detrimental effects on invertebrates and fish (both native and salmonids). Furthermore, there will still be a legacy that will need to be addressed.
	Faecal contamination	Moderate decrease	Moderate positive	Low to moderate	Through much of the zone, <i>E.coli</i> levels are only sporadically above recreational guidelines. It is possible that with reduced stock access <i>E. coli</i> levels may drop sufficiently so that all or some streams are once again suitable for recreational activities that involve full immersion.
	Flow			Not assessed	
2	Plant growth	Negligible	Negligible	Low to moderate	
	Connectedness			Not assessed	

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
3	Invertebrate community health	Negligible	Negligible	Low	The panel agrees that on balance invertebrate community health will be unchanged. However, there will be localised detrimental effects of high nitrate particularly in the upper Silverstream.
	Fish diversity	Moderate decrease	Moderate negative	Low	At the local scale fish populations are likely to be directly and indirectly affected by the increased risk of nitrate toxicity. The detrimental effects of nitrate may be partially offset by a reduction in fine sediment cover, and an improvement in edge habitat quality in recently fenced areas. There is the potential for salmonid and native fisheries to decline due to the detrimental effects of increased nitrate.
	Overall suitability for recreation	Moderate increase	Moderate positive	Low	Improvements due to reduced faecal contamination. The social and cultural team will provide further assessment of the benefits of improved suitability for recreation.

Unit 4: Upper Eyre and Cust River catchments

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen			Not assessed	Data is sparse for all metrics in this sub-unit.
	Phosphorus	Negligible	Negligible	Low	
	Sediment input	Negligible	Negligible	Low	
	Faecal contamination	Negligible	Negligible	Low	
	Flow			Not assessed	
2	Plant growth	Negligible	Negligible	Low	
	Connectedness			Not assessed	
3	Invertebrate community health	Negligible	Negligible	Low	
	Fish diversity	Negligible	Negligible	Low	
	Overall suitability for recreation	Negligible	Negligible	Low	

Unit 5: Ashley River Catchment above the Gorge

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen			Not assessed	
	Phosphorus	Negligible	Negligible	Low	
	Sediment input	Negligible	Negligible	Low	
	Faecal contamination	Negligible	Negligible	Low	
	Flow	Negligible to moderate decrease	Negligible to moderate negative	Low	Half the panel believes that the predicted increase in drying in the lower Ashley is minor, and the resulting effects on fish recruitment will also be minor. The other half believes that degradation beyond an already poor current state may have disproportionate effects on fish recruitment.
2	Plant growth	Negligible	Negligible	Low	
	Connectedness	Negligible to moderate decrease	Negligible to moderate negative	Low	Effects are same as flow.
3	Invertebrate community health	Negligible	Negligible	Low	
	Fish diversity	Negligible to moderate decrease	Negligible to moderate negative	Low	Reduced recruitment could have a negative effect on both the eel (mahinga kai) and salmonid (recreational) fisheries, which will impact the recreational and cultural value of the catchment.
	Overall suitability for recreation	Negligible	Negligible	Low	

Unit 6: Tidal reaches of the Waimakariri, Kaiapoi and Cam Rivers

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
1	Nitrogen	Large increase	Strong negative	Moderate	<p>The effects in these tidal reaches are likely to be different to those in flowing spring fed streams. Effects will be on the communities living on either exposed mudflats, submerged macrophytes, or overlying water with longer residence times (phytoplankton blooms).</p> <p>As with streams, the increased nitrogen concentrations are in the range of toxicity for aquatic organisms which may include novel species such as mud crabs, freshwater crayfish and freshwater mussels.</p>
	Phosphorus	Moderate decrease	Negligible	Moderate	
	Sediment input	Moderate decrease	Negligible	Moderate	
	Faecal contamination	Moderate decrease	Moderate positive	Moderate	<p>Current faecal levels in tidal waters are high, so reduced sources should have a beneficial effect, although there is uncertainty of the range of sources in the tidal waters. Wide range of recreational uses from rowing, boating and river festivals</p>
	Flow	Negligible	Negligible	Low	
2	Plant growth	Negligible	Negligible	Moderate	
	Connectedness	Negligible	Negligible	Moderate	
3	Invertebrate community health			Not assessed	
	Fish diversity			Not assessed	

Tier	Metric	Change	Effect	Confidence	Description of drivers/effects where applicable
	Overall suitability for recreation	Moderate increase	Moderate positive	Low	Improvements due to reduced faecal contamination. The social and cultural team will provide further assessment of the benefits of improved suitability for recreation.

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Appendix 1: Expert panel scope

Phase 1 Develop an understanding of the current state of the zone

- The panel is presented Environment Canterbury's report on the current state of water quality and ecology in the zone, and asked to provide feedback
- The panel is presented with maps of the key ecological and recreational values in the zone and are asked to provide advice on the improvement of these maps
- Options for predicting current riparian management practices are presented to the panel and then refined based on the panels comments
- A map of the river network, current land use and current riparian management practices provided to the panel

Phase 2 Develop the scenario assessment methodology

- Define what riparian management under each scenario looks like
- The technical metrics the panel will assess is decided with input from the panel
- The river units for which the panel will make their assessments are agreed upon
- An assessment methodology is finalised

Phase 3 Scenario assessment

- Individuals assess likely changes in technical metrics under each scenario based on the information collected during Phases 1 and 2
- Differing opinions discussed and consensus reached where possible

Phase 4 Develop solutions phase assessment methodology

- The panel develops a time effective method of determining what actions need to be undertaken if community outcomes relating to water quality and ecology are to be met

Phase 5 Solutions assessments

- The panel tests the effects of a range of advanced riparian mitigations options on key technical metrics
- The panel make recommendations about the minimum level of mitigation required to meet community outcomes, and presents the benefits of any further action
- The panel recommends where riparian mitigations will add the most value based on known values in the zone

Phase 6 Reporting

- The expert panel will contribute to the writing of the report explaining the process undertaken and assessments.

Note: Phases 4 and 5 may change as the solutions phase of this process can become quite fluid.