Memo

Date	24/08/18
To	Waimakariri Water Zone Committee
CC	
From	Waimakariri Project Team

1. Integrated Water Quality Management Solution for the Waimakariri Zone

2. Summary

The purpose of this memo is to present the key elements of an integrated water quality management solution across the whole Waimakariri zone (inclusive of Ashley/Rakahuri and Northern Waimakariri Tributaries areas).

The memo:

- Summarises the nitrate management options presented to the local community and stakeholders during the recent engagement programme;
- Summarises some of the key feedback from the engagement programme and the subsequent direction provided by the Zone Committee
- Explains how the feedback points towards the need for an integrated water quality management solution for the zone, and shows how this could be achieved through geographic zonation
- Provides an option for some of the key elements of this solution for the zone committee to consider
- Includes a set of possible draft ZIPA recommendations which summarises the solution option, for the Zone Committee to consider

The possible draft ZIPA recommendations are:

1. The requirements for landholder water quality management actions in the Waimakariri zone should be optimised to deliver the greatest overall water quality benefit. Two management units should be delineated for this purpose: A Nitrate Priority Management Zone and a Runoff Contaminant Priority Management Zone.

2. All land use in the Waimakariri zone to achieve the lesser of GMP for the current land use or Baseline GMP from 1 July 2020 or 2025 (if hold consent until this date)

3. Dairy, Dairy Support and intensive beef farming in the Nitrate Priority Management Zone should achieve a 10-15% beyond baseline GMP N loss reduction by 2030

4. Arable and horticultural land should achieve a 5% beyond baseline GMP N loss reduction by 2030

5. The nitrate loss reductions in 3. and 4. above should be repeated every 10 years until the nitrate concentration targets within that catchment have been met, or until the science information available at that time shows that the target is likely to be met in the future without the need for further reductions

6. Land which requires land use consent under PC5 and which is located within the Runoff Contaminant Priority Management Zone should ensure farming practices reduce overland flow losses of phosphorus, sediment and E. Coli, for example by requiring farmers (through FEPs) to provide for:

    a. a minimum 3-5 m set back distance from main spring-fed stream and main spring-fed stream tributaries. These setbacks should be planted with native vegetation and maintained in accordance with best practice riparian planting guidelines.

    b. sediment control structures where required to minimise the discharge of runoff contaminants to surface water bodies.

7. The Zone Committee is supportive of investigation and implementation of on the ground actions to address nitrate issues. These actions could include Managed Aquifer Recharge, stream augmentation and woodchip bioreactors. A zone-wide options study to assess the feasibility, costs and measures required to implement appropriate actions should be completed by the end of 2019, and this will inform the development of sub-catchment action plans. Rules in the LWRP should be assessed to ensure they are suitably enabling of these activities in the Waimakariri area.

8. The Zone Committee wish to explore a funding stream and management structure to deliver the significant improvements in stream health and mahinga kai diversity and abundance for the Waimakariri zone over the next 5-10 years. The option of a special Ratings District should be explored with WDC, and industry and government funding partners also sought.

9. The Zone Committee recommend that the intent of avoiding unreasonable “beyond GMP” nitrate loss reductions on low nitrate emitters should be achieved by not requiring such reductions within the Runoff Contaminant Priority Zone.

10. The Waimakariri Zone Permitted Activity (PA) winter grazing allowances should be reduced <u>across the whole Waimakariri zone</u> to minimise the potential for further nitrate increases in streams and groundwater. The following winter grazing PA property size thresholds should be implemented:

    a. < 5 ha do not require consent for winter grazing (instead of < 10 ha)

    b. 5 – 100 ha up to 5 ha (instead of 10 – 100 ha up to 10 ha)

    c. 100 – 1,000 ha up to 5% of property size (instead of up to 10%)

    d. >1,000 ha up to 50 ha (instead of up to 100 ha)

An alternative and possibly preferable option would be to reduce the PA allowance to 5 ha as per 10 a. above, and then to condense 10 b – c. into a 5% of property size allowance, leaving 10 d. unchanged. We discuss this in Section 7.1 .

3. Current nitrate and stream water quality management package

The Waimakariri Water Zone Committee and their CWMS partners recently engaged with the local community and stakeholders to explore options to reduce nitrate concentrations to below national and zone targets in streams and groundwater within the zone, and to manage the interzone nitrate transfer risk.

The Zone Committee consulted with Ngāi Tūāhuriri, stakeholders and the local community for the Northern Tributaries area on the following options:

- Requiring land use consent for all winter crop grazing activities over 4 ha (by lowering the consent thresholds)
- Allowing farmers to stop having to make further reductions beyond Baseline GMP below a given threshold (floor) – i.e. providing an exemption for low nitrate emitters
- On-farm nitrate loss reductions in stages over time, comprising:
  - ✓ Dairy, irrigated beef + dairy support reduce losses by up to 25% by 2030
  - ✓ Arable, Sheep, Deer reduce by up to 10% by 2030
  - ✓ Dairy, irrigated beef + dairy support reduce losses by 15% every 10 years after 2030 in catchments where nitrate targets not achieved
- Other strategies: MAR, stream augmentation, wetland construction, fencing, wider setbacks, catchment plans

In the Ashley/Rakahuri area, community consultation was more limited, and the discussion was restricted to changing from orange to red zone nutrient management rules.

4. Key elements of community and stakeholder feedback

4.1. Pre-workshop inputs

Te Ngāi Tūāhuriri Rūnanga expressed some concerns in meetings with Environment Canterbury staff that the currently proposed actions may not achieve the significant improvement in mahinga kai rapidly enough to maintain cultural practices. Significant action is sought by rūnanga to immediately stop the major social impacts being experienced by whānau due to the degradation of waterways in the Waimakariri Zone.

Additionally, Environment Canterbury has recently defined the achievement of a step-change in effort in the regeneration of biodiversity as an organisational priority. Enhancing aquatic biodiversity is a key component of this and will require a substantial investment of resources to achieve.

4.2. Community meetings

The main feedback from the community meetings is summarised below, grouped according to the main questions asked by the Zone Committee during the meetings.

4.3. Staged nitrate loss reductions

- General support for a staged approach to nitrate reductions – but a lack of consensus surrounding % reductions beyond Baseline GMP over time.
- There were a full range of views expressing that reductions beyond Baseline GMP between a 5% and 25% reduction are achievable.
- In response to this, an approach that would support people who are able to reduce by 25% to do so whilst allowing time for others who will take longer was put forward in various ways to maximise reductions as soon as possible.

4.4. Short-term strategies

- General support for Managed Aquifer Recharge (MAR), stream augmentation, denitrification walls, riparian planting.
- Noted that a funding source is required. Could come from a general rate or tax.
- Specific minimum widths for riparian planting around different waterbodies
- Incentivisation of enhancement projects – e.g. make it easier and less expensive to get resource consent to engage in enhancement projects.
- Trees and bushes should also be included in FEPs – to support animal welfare directives for shelter of stock, as well as benefitting nitrate absorption.
- Some preference was shown for an approach to enhancement projects that delivers short-term improvements to water quality (i.e. support for mahinga kai, improvements to surface run-off) and that is supported through FEPs and a reduced time/cost of consenting for enhancement work

4.5. Lower winter grazing thresholds

- Majority of feedback provided supported lowering PA thresholds for winter grazing.
- Should be done with caution in order to avoid loopholes that would allow for exploitation or prevent reductions in N being made.

4.6. Low nitrate leachers

- General feedback supported the idea of a ‘floor’ for low nitrate leachers as being equitable, while acknowledging the challenge posed by Overseer updates in understanding the operation of the floor.

4.7. Post-workshop feedback

Several stakeholders approached Zone Committee members and Environment Canterbury staff outside of the community meetings to discuss the possibility of focusing efforts on the runoff contaminants, rather than nitrate, in some catchments. Some members of the committee suggested that mapped areas of soils with low nitrate leaching potential could be used to determine where the runoff contaminants should be prioritised over beyond GMP nitrate reductions. The committee subsequently asked Environment Canterbury to further explore options for prioritising the management of land surface runoff contaminants (i.e. sediment, phosphorus and *E. coli*) and improving instream and riparian habitats.

Te Ngāi Tūāhuriri Rūnanga, various stakeholders and committee members have also highlighted the need to implement immediate on the ground actions to start addressing the water quality issues which have been highlighted during the Waimakariri Land and Water Solutions investigations to date.

5. Summary of feedback and proposed response summary

We have summarised the main feedback items and the response to that feedback in Table 1 below. Further details of the response and rationale for the response are provided in the following sections of this memo.

Table 1 Summary of proposed solutions for key pre-draft ZIPA feedback

Feedback	Response
Staged nitrate loss reductions: 25% beyond GMP reduction by 2030 too high	Dairy, dairy support and intensive beef land to achieve 10-15% beyond Baseline GMP reduction in nitrate losses Horticulture and arable to achieve 5% beyond GMP reduction in nitrate losses
Immediate steps for nitrate	Complete options assessment study by end of 2019, to feed into Catchment Action Plans and to initiate improvement measures Include enabling provisions in Plan
Prioritisation of runoff contaminants where this would provide greatest benefit.	Split zone into Nitrate Priority Management Zone and Runoff Contaminant Priority Management Zone
Step change in aquatic biodiversity and mahinga kai diversity and abundance	Prepare and implement Catchment Action Plans
Reduce winter grazing thresholds	Reduce PA thresholds
Exemption for low nitrate leachers	Most low nitrate leachers understood to be within proposed “Runoff Contaminant Priority Management Zone”, where farming would not be required to go beyond Baseline GMP Loss Rate

6. Priority management zones

The feedback on prioritisation of runoff contaminants summarised above points towards an integrated water quality management solution for the zone, using geographic zonation to define where additional nitrate management measures are top priority and where specific runoff contaminant management is the top priority to achieve the water quality outcomes defined by the committee.

All consented land use within the Waimakariri zone would be required to meet Baseline GMP in accordance with PC5 red zone nutrient management rules.

Beyond GMP nitrate reductions would be first priority for land outside of the Ashley River/Rakahuri/Te Aka Aka and spring-fed stream surface water catchments, and within the

recharge zones for the community drinking water supply wells. We refer to these areas as the Nitrate Priority Management Zone. Details of the beyond baseline GMP N loss reductions are discussed in Section 7.

Implementation of actions to manage runoff contaminants would be first priority for land within the river, spring-fed stream and estuary catchments. We refer to these areas as the Runoff Contaminant Priority Management Zone. Details of the proposed actions for this zone are discussed in Section 8. We consider that most "low nitrate emitters" will be located within this zone, since it encapsulates the areas of poorly drained soils within the zone.

Figure 1 shows the proposed Nitrate and Runoff Contaminant Priority (RCP) Management Zones. Details of how these zones were derived are attached to this memo (Section 10).

7. Proposed actions package for Nitrate Management Priority Zone

7.1. Permitted Activity thresholds (winter grazing)

Analysis provided in Section 9 suggests that reducing the winter grazing PA thresholds by 50% would reduce the potential for further increases in nitrate losses to groundwater and surface water bodies on the zone, without causing a significant increase in the number of existing properties over 10 ha which would require consent.

Reducing the PA threshold to 2.5 ha for properties < 100 ha, 2.5% for areas > 100 ha and 25 ha for properties > 1,000 ha would provide a greater reduction in the potential for further increases in nitrate losses. Approximately 100 properties would need to apply for land use consent if this was implemented across the Waimakariri zone.

Reducing the PA threshold to 5 ha for properties below 100 ha and leaving the existing PC5 provision of 10 % for areas > 100 ha and 100 ha for properties > 1,000 ha would leave a pathway open by which significant nitrate load increases could occur, with the potential for significant adverse water quality effects.

The analysis shows that a significant proportion of the winter grazing PA nitrogen load potential is for properties in the 4 – 10 ha range. Providing additional restrictions on winter grazing for these properties throughout the zone will both reduce the potential for water quality deterioration and reduce the beyond GMP N load reductions required in some catchments.

We recommend that the Zone Committee should consider the following winter grazing PA property size threshold options:

a. < 5 ha do not require consent for winter grazing (instead of < 10 ha)

b. 5 – 100 ha up to 5 ha (instead of 10 – 100 ha up to 10 ha)

c. 100 – 1,000 ha up to 5% of property size (instead of up to 10%)

d. >1,000 ha up to 50 ha (instead of up to 100 ha)

An alternative option, which we have not yet fully assessed, would be as follows:

a. < 4 ha do not require consent for winter grazing

b. 4 – 1,000 ha up to 5% of property size

c. >1,000 ha up to 50 ha

The advantages of this second option over the first are:

1. It would further reduce the additional nitrogen load potential, particularly from small blocks. This means that the beyond GMP N loss reductions required by landholders in some catchments would be lower, and the potential for higher nitrogen loads in other catchments (e.g. Te Aka Aka) would be reduced.

2. It is simple to understand and implement.

7.2. Management actions

We have grouped management actions into immediate steps, short-term, medium-term and long-term actions.

7.3. Immediate steps for nitrate management

There are a variety of technologies and actions which could potentially reduce stream and in some instances groundwater nitrate concentrations within a five-year timeframe. These include the following options:

- Managed Aquifer Recharge
- Constructed wetlands for nitrate treatment and runoff contaminant management
- Woodchip bioreactors (e.g. for drains)
- Cust River augmentation via irrigation races

The Zone Committee may wish to recommend that a zone-wide Options Assessment is undertaken in the near future to evaluate these options, and to provide information to feed into the Catchment Action Plans. The options assessment would be undertaken in partnership with key local stakeholders and partners and could include:

- A high-level concept design for each option
- Assessment of the likely water quality improvements achievable by each option
- Capital and operating cost estimates
- SWOT analysis
- Recommendations for next steps towards development of preferred option(s)

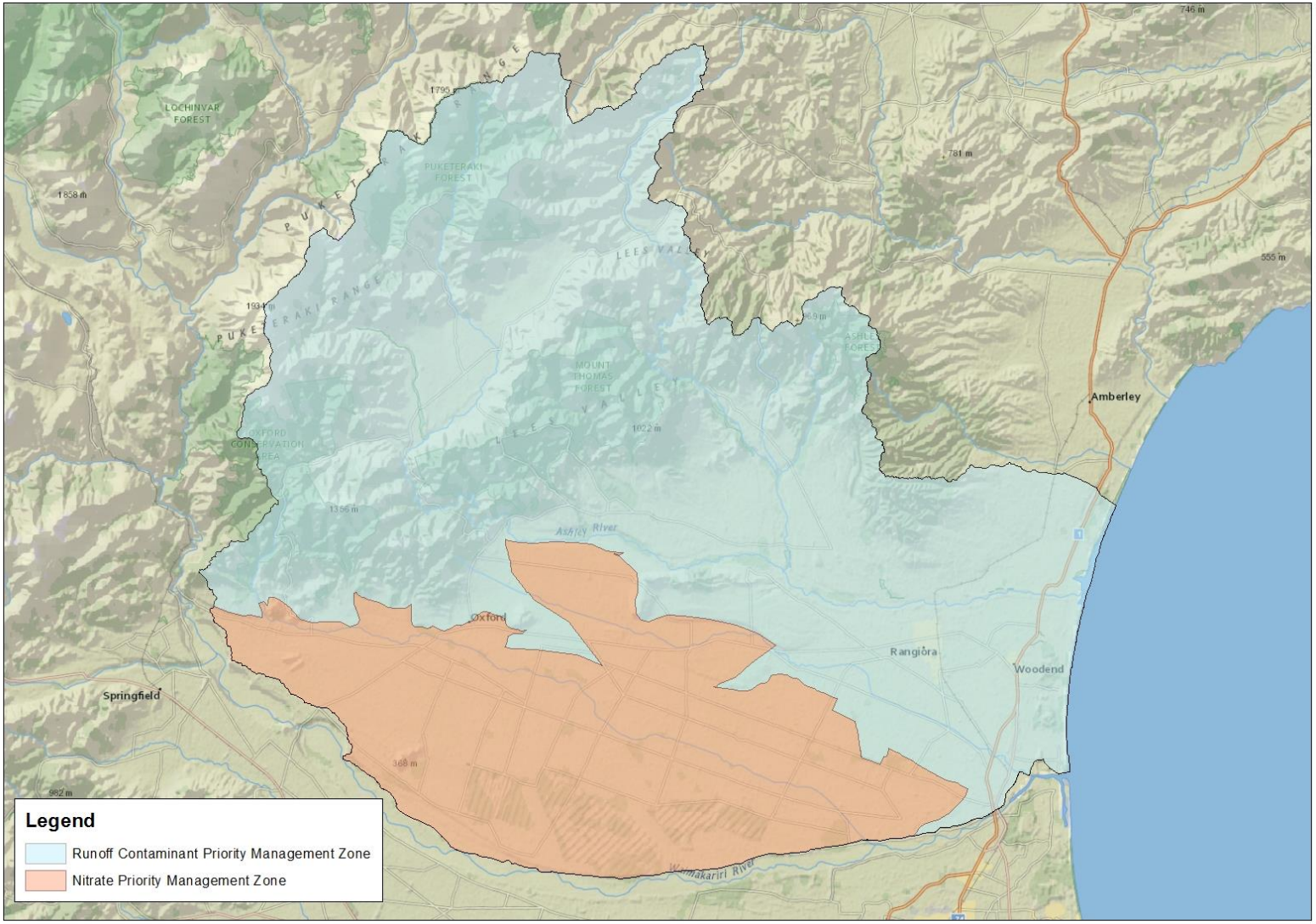

Figure 1 Priority management zones

The committee may also wish to recommend that Rules in the LWRP should be assessed to ensure they are suitably enabling of the above activities in the Waimakariri area.

7.4. Short term actions (by 2025)

Consented Farming Activities (Plan Change 5)

Consented farming activities are required to produce an audited Farm Environment Plan that describes the practices to be implemented on farm. Farms must also to meet the lower of their Baseline GMP Nitrogen Loss Rate or GMP Loss Rate for the current farming activity (as estimated by the Farm Portal tool) from 1 July 2020. For most farmers and irrigation schemes however, this requirement will actually "kick in" from 2025 which is when existing land use consents expire.

Permitted Farming Activities (Plan Change 5)

Farming activities that do not exceed the consent thresholds for winter grazing of cattle or irrigation are required to prepare a "Management Plan" and register with the Farm Portal. Although not audited, the Management Plan requires specific farming practices to be implemented and the plan to be provided to Environment Canterbury on request.

The Zone Committee may wish to recommend that Environment Canterbury runs an education campaign (including workshops) promoting the Management Plan requirements, and request copies of 50 Management Plans per year and visit 10 properties per year to confirm that the good farming practice actions are being implemented. The Committee could seek that resources are allocated for this task in the next Long-Term Plan Review.

Lifestyle Blocks

Though not required by the LWRP, the promotion of Lifestyle Block Management Plans and workshops will educate small block landowners on ways to reduce their nitrogen and other contaminant losses, exclude stock from and enhance waterways on their properties.

7.5. Medium term actions (by 2030)

The following measures apply to all land within the Nitrate Priority Management Zone:

- Dairy, dairy support and intensive beef land to achieve 10-15% beyond Baseline GMP reduction in nitrate losses
- Horticulture and arable to achieve 5% beyond Baseline GMP reduction in nitrate losses

Staff understand that horticulture and arable have been suggested by the ZC as being potentially higher risk for nitrate loss, and should therefore be required to meet some level of beyond GMP restrictions.

The ZC should note that the Farmer's Panel and subsequent economic work only covered dairy. Accordingly, we lack a similar level of economic information on the impacts on dairy support and intensive beef farming types from making these reductions.

7.6. Long term actions (beyond 2030)

For land within the catchments of those water supply wells and streams where:

I. nitrate concentration targets have not been achieved, and;
II. nitrate concentrations are not expected to be achieved in the future based on forward projections of nitrate concentrations using best available science and modelling information available at that time

The following additional nitrate loss reductions will be required every 10 years until I. and II. above no longer apply:

- Dairy, dairy support and intensive beef to achieve further steps of 10-15% beyond Baseline GMP reduction in nitrate losses if required to meet nitrate concentration targets
- Horticulture and arable to achieve further steps 5% beyond Baseline GMP reduction in nitrate losses if required to meet nitrate concentration targets

8. Proposed package for Runoff Contaminant Priority Management Zone

8.1. Short term actions (by 2025)

Stock Exclusion

Region-wide rules excluding intensively farmed stock from waterbodies will be extended to include all open drains that have surface water in them, stock water races and irrigation canals that discharge directly into a river, lake or wetland.

Region-wide rules excluding intensively farmed stock from waterbodies will be extended to include all plains springheads that permanently or intermittently contain water or connect to a river or surface waterbody.

Additional FEP Requirements

Where justified, amendments could be made to Schedule 7 Farm Environment Plans to include *additional* requirements specific to the Waimakariri sub-region Runoff Contaminant Priority Management Zone.

Example, additional FEP requirements in relation to the “waterbodies (wetlands, riparian areas, drains, rivers, lakes)’ Management Area might include:

- Additional maps showing the location of key features such as:
    - Areas of significant indigenous biodiversity and habitat
    - Critical contaminant source areas including drains
    - Setbacks from springs, rivers and wetlands with ecological values
    - Mahinga kai, wāhi tapu and wāhi taonga

- Describe how significant indigenous biodiversity and habitat will be protected and or enhanced and compliance with district plan rules
- Describe how waterways, instream and bankside habitats will be enhanced
- Setback requirements from wetlands, springs, rivers (e.g. variable or minimum 3 m width)
- Details of fencing and riparian planting including species to be planted and for what purpose (habitat enhancement or runoff mitigation)
- How critical contaminant source areas will be managed e.g. wetlands, sediment traps, bunding, or increased planting setbacks from waterbody
- Minimum buffer distances from waterways for the application of fertilisers and discharges including tile drain areas
- Timeframes for actions

Outcome of short-term actions

These recommendations would create mandatory actions for consented land use only. Analysis of the PC5 consenting rules and current land use data indicates that approximately 17,500 of the total 162,500 ha (i.e. around 10%) of land within the proposed RCP Management Zone is likely to require land use consent under the PC5 rules. Further analysis (Figure 2) indicates that of the total 425 km of spring-fed stream reaches and tributaries of spring-fed streams within the RCP Management Zone, approximately 100 km (~25%) intersects or borders land which requires consent (and hence an FEP) under PC5. This means that if the FEP provisions above are implemented, the zone committee can be confident that significant stream health improvements would be made on 25% of the spring-fed stream reaches within the RCP Management Zone.

8.2. Medium term actions (by 2030)

Bank Stabilisation

- Plan provisions that support banks stabilisation works to reduce phosphorus rich sediment getting into lowland spring-fed streams.

Example - Wairewa/Lake Forsyth Bank Stabilisation

Requiring individual landowners to undertake significant bank stabilisation works themselves is challenging particularly if the erosion is not of their making. The RMA is effects based and plan rules should fairly address effects caused by a current activity or land use.

The Wairewa / Lake Forsyth plan change (PC6) supports work to reduce significant bank erosion on the Ōkana and Ōkuti rivers around Little River. Resource consent and compliance with a River Bank Erosion Plan (LWRP Schedule 24c) to avoid making the situation worse and causing adverse effects downstream.

Experts identified specific sites requiring remediation and the most effective type and costs. As there is little incentive for individuals to seek resource consent and carry out expensive works themselves, Environment Canterbury applied for a “global consent” (in process) for landowners to work under with approval from Wairewa rūnanga. The Banks Peninsula Zone Committee committed $60,000 of funding towards the work which are estimated to cost approx. $85,000 (as of two years ago).

8.3. Long term actions (beyond 2030)

Significant and costly actions would be required to achieve the substantial improvement in instream health and mahinga kai being sought in some feedback to and from the Zone Committee. For spring-fed streams and rivers these would comprise:

- fencing with a setback (e.g. 3 m or greater) from the top of stream banks for a higher proportion of the land bordering the significant stream reaches (i.e. including land which does not currently require land use consents and FEPs);
- extensive riparian planting and weed control within these setbacks;
- installation of additional setback protection and/or sediment traps and/or wetlands at the base of more critical source areas which drain into streams and rivers;
- rebattering excessively steep banks that are prone to collapse; and
- active removal of legacy bed sediment from streams (e.g. dredging and/or sand-wanding).

Preliminary rough order cost analysis (Section 12) indicates that somewhere in the order of $60M of expenditure may be required to implement these actions.

Although comparison of these costs with those associated with a 20% beyond GMP N loss reduction suggests that it would less expensive to implement the actions above, the magnitude of the required expenditure means that an inter-generational implementation period is likely to be required.

Given that many of the current impacts on stream health and mahinga kai (e.g. drainage, stream realignment and sediment and phosphorus discharges) relate to actions undertaken by either previous landholders or local authorities, it would be inappropriate to require current landholders to pay for these legacy stream degradation issues. A similar situation exists in the Te Waihora catchment, where substantial investment is also needed for restoration work to achieve the required ecological and cultural outcomes. Work in this area has identified the need for a multi-source funding stream, with contributions from local rate payers, industry and government.

A funding mechanism and management body would be required for the Waimakariri zone to pool resources and oversee the implementation of these actions. Removing or addressing fish passage barriers would also need to be considered (this has not been included in the cost estimate above, since the responsibility would be held by the owner of this infrastructure).

A funding stream and management structure could potentially be developed for the Waimakariri zone over the next 5-10 years. The option of a special Ratings District Could be explored with WDC, and industry and government funding partners sought. In addition to the intrinsic benefits associated with ecological and mahinga kai restoration, feedback from some local farmers to the committee suggests that implementation of the actions above would support farm product brand differentiation.

The measures required for hill-fed catchments are currently less clear. High quality in-river habitat still exists in the Ashley River / Rakahuri, but sediment inputs, toxic periphyton mat growth, and invasive bankside weeds remain a problem. The influence of the Ashley / Rakahuri on the Te Aka Aka is of particular importance. The required actions would predominantly be based around:

- investing more resources in ensuring compliance with the National Environmental Standard for production forestry;
- implementation of measures to ensure that sediment losses from bank erosion and land drainage are minimised;
- extensive riparian weed control programmes;
- wetland enhancement, including around the Te Aka Aka Estuary;
- developing and implementing a management plan to ensure that the ecological and cultural values of the estuary are maintained under sea level rise; and
- understanding and managing the drivers of benthic cyanobacteria mat growths.

The costs associated with the hill-fed stream actions above have not been assessed.

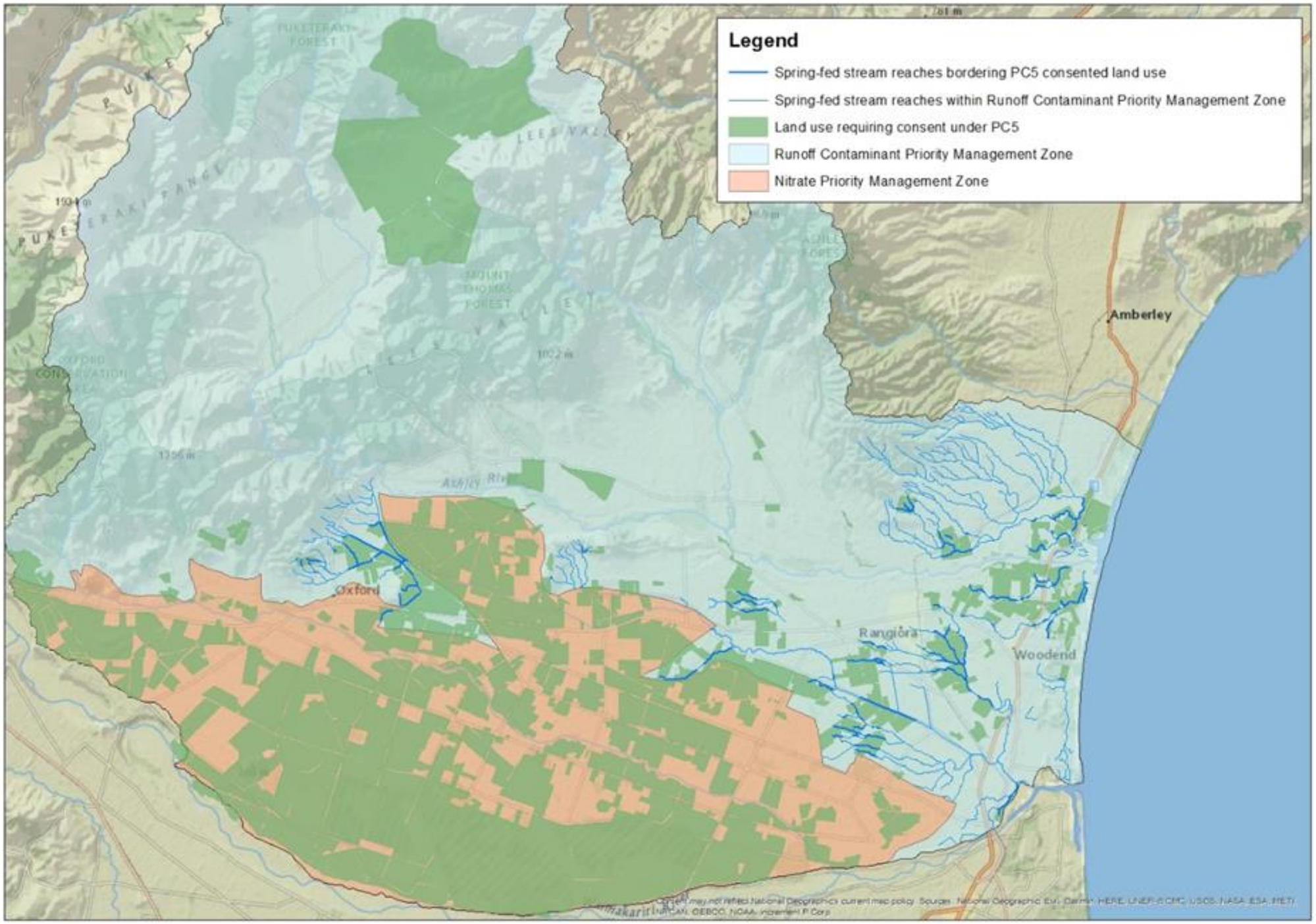

Figure 2 **Spring-fed stream reaches within RCP Management Zone**

Attachments

9. Winter grazing PA threshold assessment

9.1. Scenarios

We have evaluated up to seven PA threshold options as per **Error! Reference source not found.** below. All scenarios assume 50% uptake of the winter grazing PA allowances.

Table 2[1] ***Winter grazing scenarios utilised to evaluate the effects of changing winter grazing PA rules on consent requirements and cumulative N losses.***

Scenario	Property size		
	<100 ha	**100 – 1000 ha**	**>1,000 ha**
1	Any additional winter grazing requires consent		
2	2.5 ha	2.5 %of property area	25 ha
3	5 ha	5 %of property area	50 ha
4	7.5 ha	7.5 %of property area	75 ha
5	10 ha	10 % of property area	100 ha
6	5 ha	10 % of property area	100 ha
7	As per scenario 6, but any property <10 ha requires consent for any winter grazing		

We have not yet completed a full N load evaluation for options 6 and 7; consent numbers have been assessed, and N loads for properties <10 ha, working under an assumption that no winter grazing occurs on properties < 10 ha. We did not analyse the N loads associated with Scenario 6 because the results for Scenario 7, which is more restrictive, suggest that significant additional N losses would be possible under that scenario.

9.2. Results summary

The N load analysis (**Error! Reference source not found.** and **Error! Reference source not found.**) indicates that nitrate discharges to water bodies could increase significantly under scenarios 4, 5, 6 and 7. For instance, the N load could potentially increase by around 30% in the Cam River and by 40% in Saltwater Creek under Scenario 6. Notable N load increases could also occur under scenario 3. Results for Scenario 7 in **Error! Reference source not found.** show that significant catchment N load increases could occur, even if no properties < 10 ha undertook any PA winter grazing.

[1] Note: The scenarios outlined apply differently to estimation of cumulative N losses and the number of consents required:
- Estimated N-losses are calculated for each interval (e.g. Scenario 3 represents the losses associated with winter grazing up to the 5ha / 5% / 50 ha threshold)
- Estimated consent numbers represent the number of properties where existing winter feed areas exceed the nominated PA thresholds (e.g. Scenario 3 represents the number of properties with existing areas of winter feed that exceed the 5ha / 5% / 50 ha threshold, but which are not already captured by the 10ha/ 10% / 100ha PC5 rules).

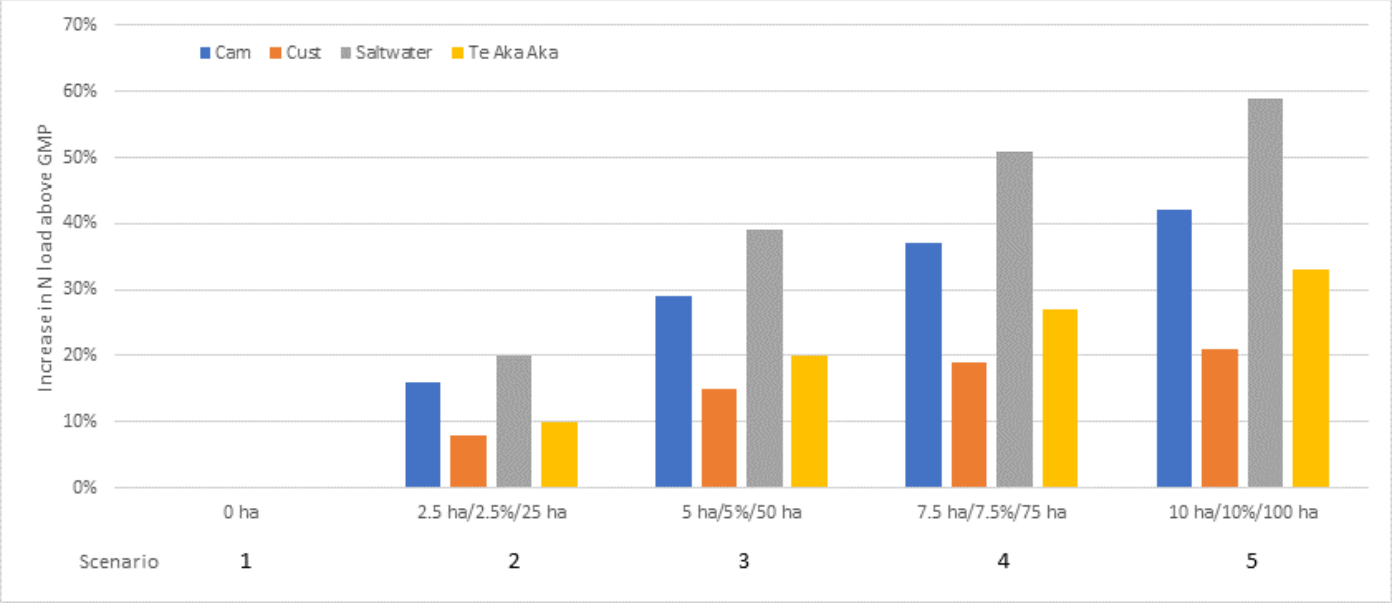

Figure 3 Potential increase in nitrate concentrations with 50% uptake of PA winter grazing allowance scenarios

Consent requirement analysis (**Error! Reference source not found.**) shows that ~250 properties would require land use consent if the PA thresholds were reduced to zero ha (scenario 1) for the whole Waimakariri zone; 30 additional properties would require consent under scenario 3. The majority of the consents would be for properties in the Ashley-Waimakariri Nutrient Allocation Zone (NAZ).

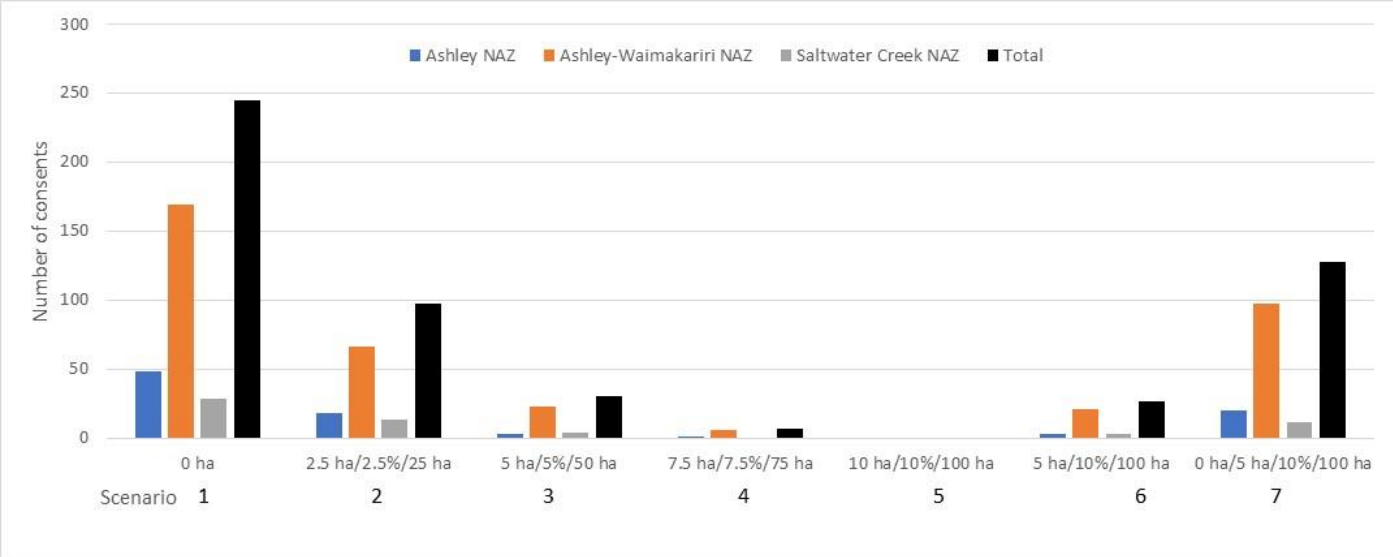

Figure 4 Potential increase in number of consents required under PA winter grazing allowance scenarios

9.3. Result details

Table 3**Error! Reference source not found.** provides a summary of the number of existing properties that would require consent over and above those required under PC5 if each

scenario was implemented. Scenario 5 would not create any additional consents because it comprises the PC5PA rules

Table 3*. Number of consents required*

Zone	Scenario						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Ashley NAZ	48	18	3	1	0	3	20
Ashley-Waimakariri NAZ	169	66	23	6	0	21	97
Saltwater Creek NAZ	28	13	4	0	0	3	11
Cam River	5	2	1	1	0	-	-
Cust River	20	12	7	2	0	-	-
Te Aka Aka	71	29	7	1	0	-	-

Table 4 - Cumulative N losses under different winter grazing PA scenarios

Catchment	Baseline tonnes N	Where winter grazing can occur	Scenario									
			1	2		3		4		5		7	
				tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%
Cam	41.9	All Properties	0	13.6	32.6	21.4	51.1	24.8	59.2	26.5	63.2	-	-
		Properties >4ha	0	6.5	15.5	12.3	29.4	15.3	36.5	17.4	41.5	-	-
		Properties >10ha	0	1.7	4.1	3.4	8.1	5.2	12.4	7.0	16.7	12.1	29
Cust	361.9	All Properties	0	41.0	11.3	70.9	19.6	82.4	22.8	91.5	25.3	-	-
		Properties >4ha	0	30.3	8.4	55.7	15.4	67.2	18.6	76.3	21.1	-	-
		Properties >10ha	0	6.4	1.8	13.3	3.7	21.1	5.8	29.5	8.2	55	15
Saltwater	83	All Properties	0	23.6	28.4	41.5	50.0	51.6	62.2	57.8	69.6	-	-
		Properties >4ha	0	17.0	20.5	32.6	39.3	42.7	51.4	48.9	58.9	-	-
		Properties >10ha	0	3.9	4.7	8.1	9.8	12.4	14.9	17.0	20.5	34	41
Te AkaAka	780	All Properties	0	106.4	13.6	194.5	24.9	252.2	32.3	295.1	37.8	-	-
		Properties >4ha	0	77.9	10.0	153.6	19.7	210.9	27.0	253.3	32.5	-	-
		Properties >10ha	0	24.7	3.2	54.3	7.0	88.9	11.4	124.9	16.0	216	28

Note: Estimated N losses assume 50% uptake of the maximum area available under each PA option

- All properties – Cumulative N loss resulting from winter grazing on all properties within the nominated NAZ or source zones
- Properties >4ha – Cumulative N loss from additional winter grazing on properties larger than 4 ha within the nominated NAZ or source zones
- Properties >10ha – Cumulative N loss from additional winter grazing on properties larger than 10 ha within the nominated NAZ or source zones

10. Priority management zone delineation criteria

The management zones were defined by:

1. Evaluating which contaminants are having the greatest impact in each water body (see Section 11)
2. Grouping the surface water catchments where runoff contaminants are having the greatest impact, and defining this area as the preliminary Runoff Contaminant Priority (RCP) Management Zone
3. Cutting the groundwater recharge zone for wells supplying water to more than 5,000 people out of the RCP Management Zone
4. Cutting areas of poorly drained soils out of the RCP Management Zone

Figure 5: Priority management zones with those water supply well groundwater recharge zones where nitrate is projected to exceed 5.65 mg/L N. Note: interzone source area not shown.

Figure 6: Priority management zones with surface water catchments. Runoff contaminant priority zone includes all surface water catchments except those which generally drains to ground (e.g. Eyre River), Silverstream (where nitrate management is a priority), and those water supply well recharge zones which supply water to more than 5,000 people.

Figure 7: Priority management zones with soil drainage layer overlain. Note: poorly drained soils generally fall within the runoff contaminant priority zones, with some exceptions (e.g. an area of poorly drained soils falls within the Kaiapoi and Rangiora water supply well recharge zone.).

Figure 8: Priority management zones with proposed management areas overlain

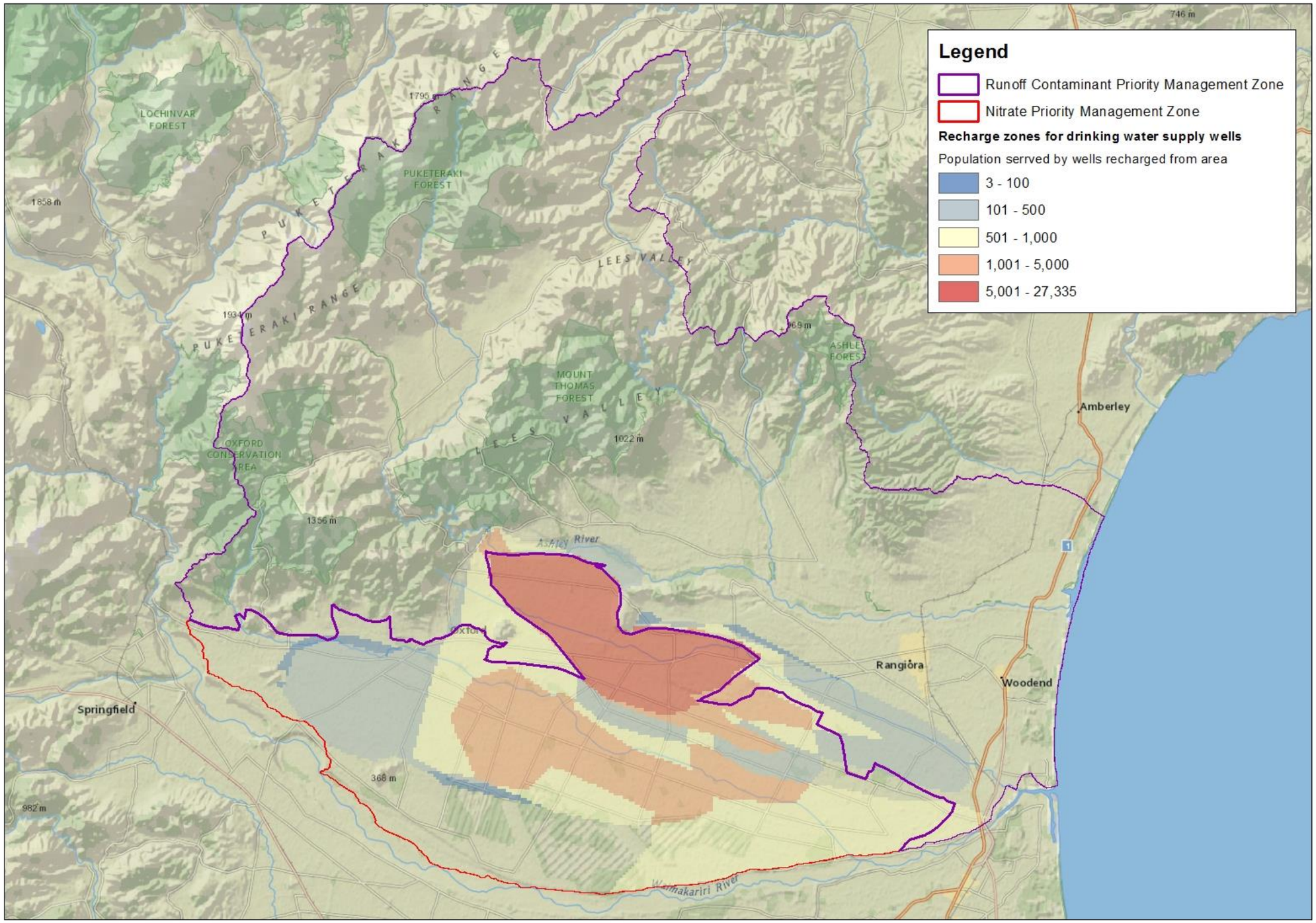

Figure 5 **Priority management zones with water supply well groundwater recharge zones where nitrate projected to exceed 5.65 mg/L N (interzone source area not shown)**

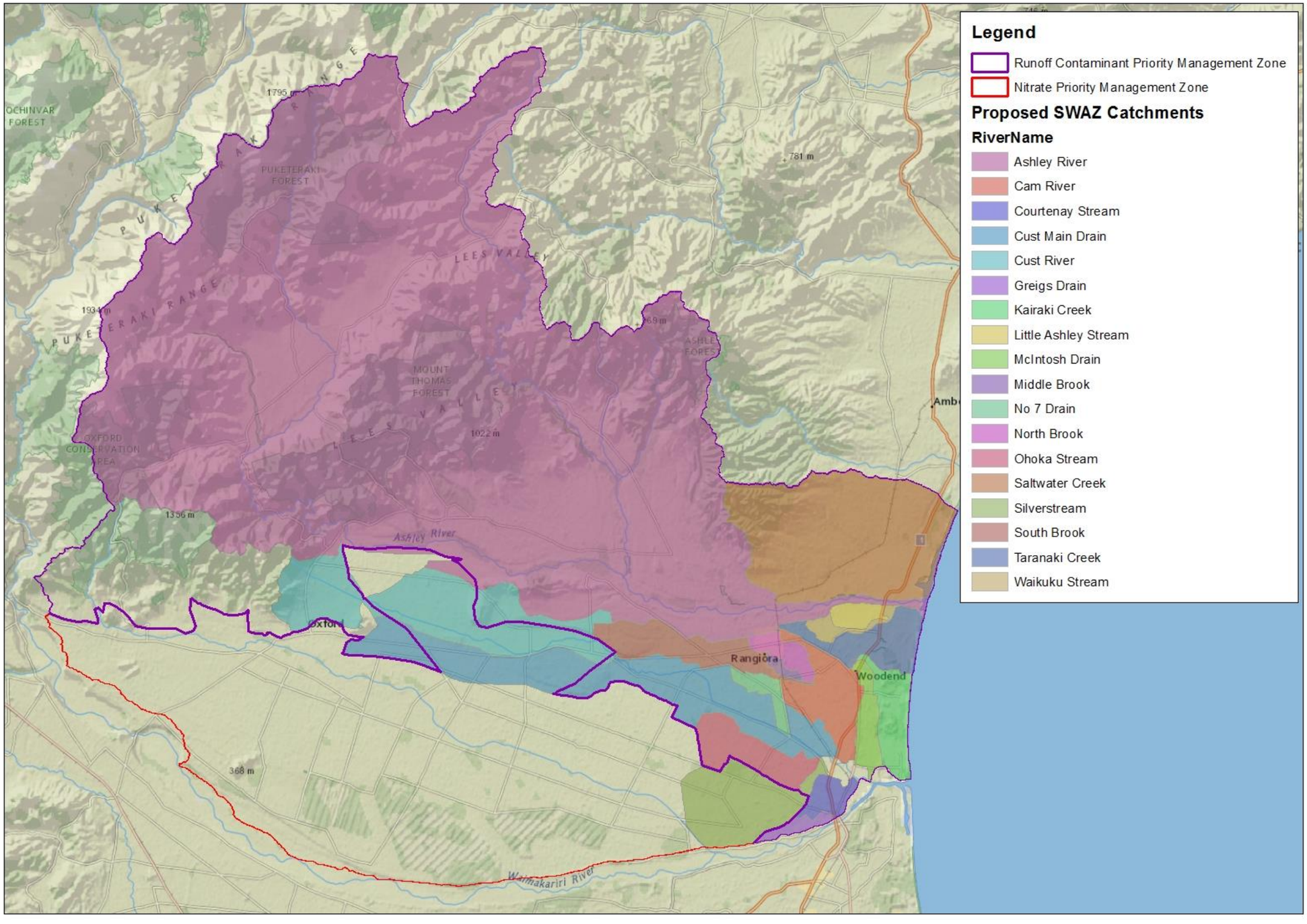

Figure 6 **Priority management zones with surface water catchments**

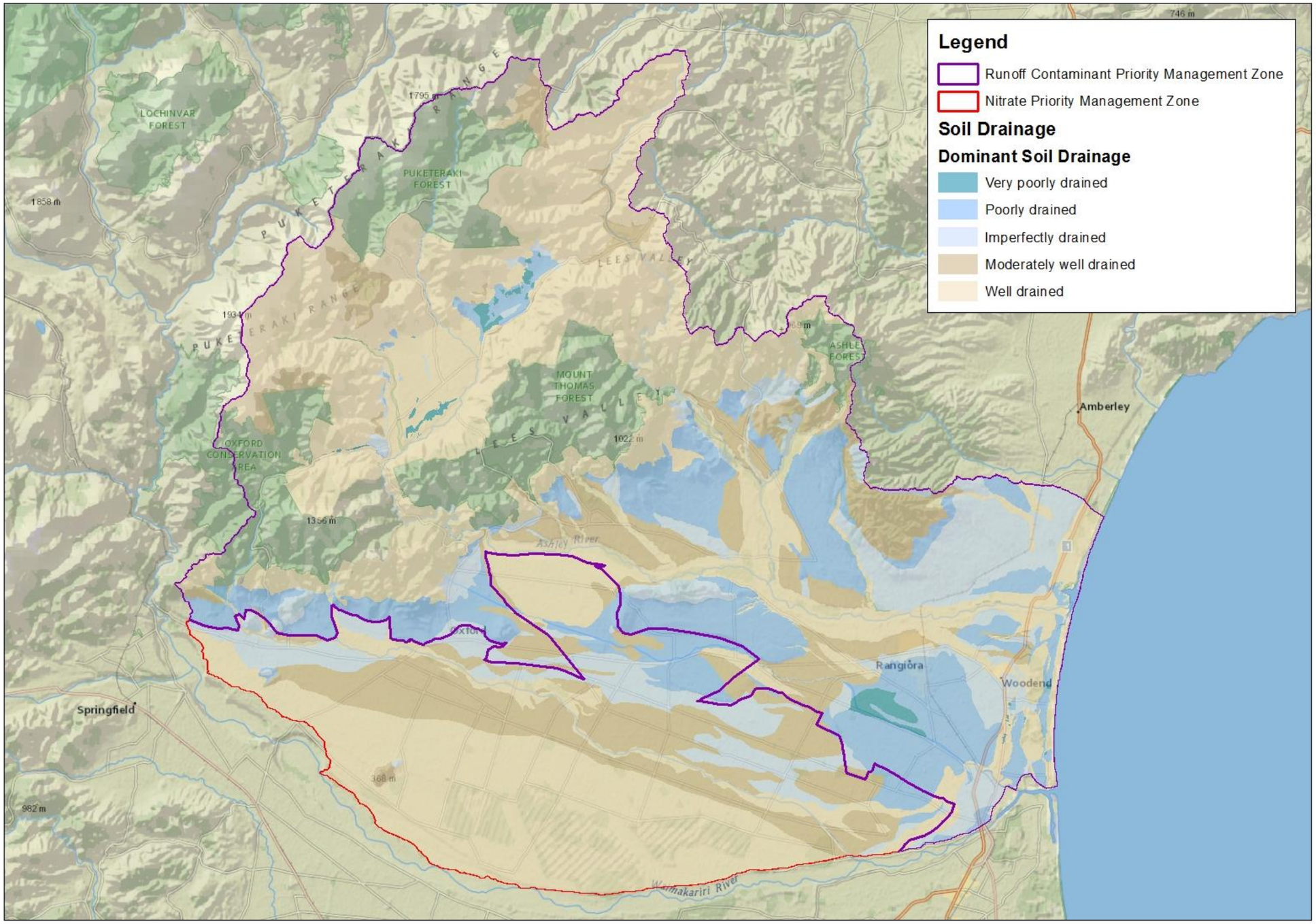

Figure 7 **Priority management zones with soil drainage**

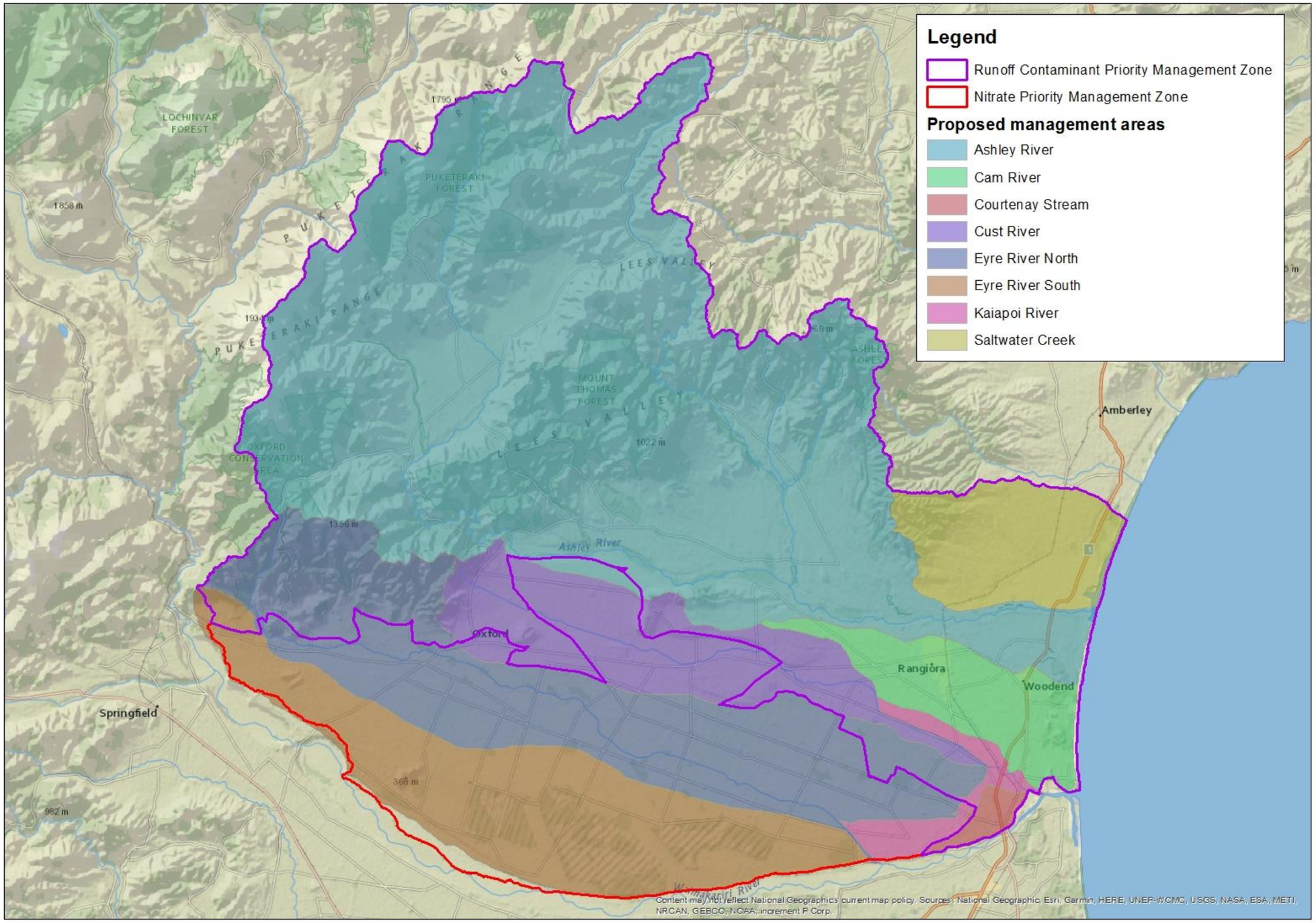

Figure 8 **Priority management zones with proposed management areas**

11. Which contaminants are having the greatest impact on in-stream health?

On-the-ground stream rehabilitation projects are likely to provide better outcomes for instream health and mahinga kai in many lowland catchments than reducing nitrate losses from land. This is because sediment severely degrades stream habitat, and bankside and instream habitats that were once present have now been extensively lost. Small reductions in nitrate will only yield small benefits for most instream communities due its seemingly less importance as a driver of community health.

Figure 9 - Figure 11 provide a qualitative assessment summary of the relative impact of stream contaminants and physical habitat on overall stream health. The assessment suggests that:

- Sediment is having the greatest impact on overall stream health in the Cam River, Ohoka Stream, Courtenay Stream, Saltwater Creek, Ashley River/Rakahuri, and Te Aka Aka
- Sediment and physical habitat are having the greatest impact on overall stream health in the three brooks (North, Middle and South), the Cust tributaries and the Ashley spring-fed streams
- Nitrate is having the greatest impact on overall stream health in Silverstream; nitrate and *E. coli*. in Cust Main Drain and nitrate and habitat in the Cust River.

The following section provides a brief summary of how nitrate versus surface runoff contaminants affect waterways in the Waimakariri Zone and discusses their relative impact on instream health.

Greenwood et al. (2012) found that sedimentation was the single most important predictor of invertebrate community composition in some Canterbury streams. This is because sediment fills-in bed habitat, reduces oxygen in and near substrate (Sear and DeVries, 2008), binds nutrients, and supports nuisance weed growth. Fish likewise suffer lost habitat and refugia, lose viable food sources from lost invertebrate productivity, and undergo physiological stresses associated with clogged gills and other disorders. Burdon et al. (2013) determined that invertebrate community health declines markedly in habitat with greater than 20% fine sediment cover. Long reaches of spring-fed streams in the Waimakariri Water Zone far exceed this amount of fine sediment cover and this is reflected by their poor ecological health. Reducing sediment inputs and removing legacy bed sediment will enhance aquatic habitat for invertebrates and fish in streams. It will also benefit Te Aka Aka by reducing what is a key driver of macro algal growth in the estuary.

Nitrate is also a significant issue contributing to the degraded ecological health of zone waterways. Concentrations are far exceeding those necessary for promoting nuisance algal and plant growths and are likely having toxic effects on freshwater biota in the northern Waimakariri tributaries. The highest nitrate concentrations in the zone are recorded in Silverstream at Harpers Road, where both the median and the 95th percentile values exceeded thresholds for the 80% protection of species (Hickey, 2013). However, Greer and Meredith (2017) found that although nitrate levels are at their highest in the upper

Silverstream, invertebrate communities are still healthier than in other spring-fed streams in the zone, and indeed many others in lowland Canterbury. This suggests that nitrate toxicity is unlikely to be the most important driver of ecosystem health in the Kaiapoi River catchment. This is not to say that if nitrate concentrations were lower, biodiversity would not improve. On the contrary, the early life-stage development of salmonids (trout and salmon) and some other taxa are highly sensitive to high nitrate concentrations. The Silverstream salmon hatchery, for example, has identified that salmon and trout eggs and alevins cannot be successfully reared at current stream nitrate levels. There may therefore be some components of Waimakariri Zone stream communities (particularly sports fishes) that will not be regained until nitrate concentrations are significantly reduced. For this reason nitrate is likely to be having the greatest impact on the overall health of Silverstream at current concentrations.

Stream nitrate levels elsewhere in the Waimakariri Zone are generally substantially lower than those in the Silverstream. Given this, it is assumed that it functions less significantly as a driver of stream community health, particularly in terms of toxicity. Science-lead 'Expert Panel' meetings (held earlier in the Waimakariri sub-regional process) supported this notion with the idea that sediment is the number one contributor to degraded habitat and aquatic community health in the zone.

Reducing nitrate losses from land will undoubtedly contribute to improved waterway health, however small reductions will only yield small declines in instream concentrations. In this case, it is unlikely that concentrations will reach those low enough to prevent nuisance algal and plant growths. Toxicity effects on stream taxa may be reduced, but these will be more proportional to the extent to which nitrate losses are reduced. By comparison, on-the-ground measures such as extending fencing setbacks and improving riparian planting will not only help prevent sediment runoff, but also reduce nutrient (e.g., phosphorus) and faecal contamination from land. As a result, nuisance instream plant and algal growths may reduce, while human health risks associated with recreating in water and gathering mahinga ka will diminish. Bankside planting creates more margin habitat, improves out-of-stream biodiversity values, and can intercept and assimilate low levels of shallow soil nitrate. Streamside plantings provide shading instream to keep water temperatures cool and prevent algal growths. Plants also provide habitat cover from overhanging vegetation and instream woody debris, food sources (e.g. leaf litter and invertebrates), and stabilise bankside soils preventing excessive erosion.

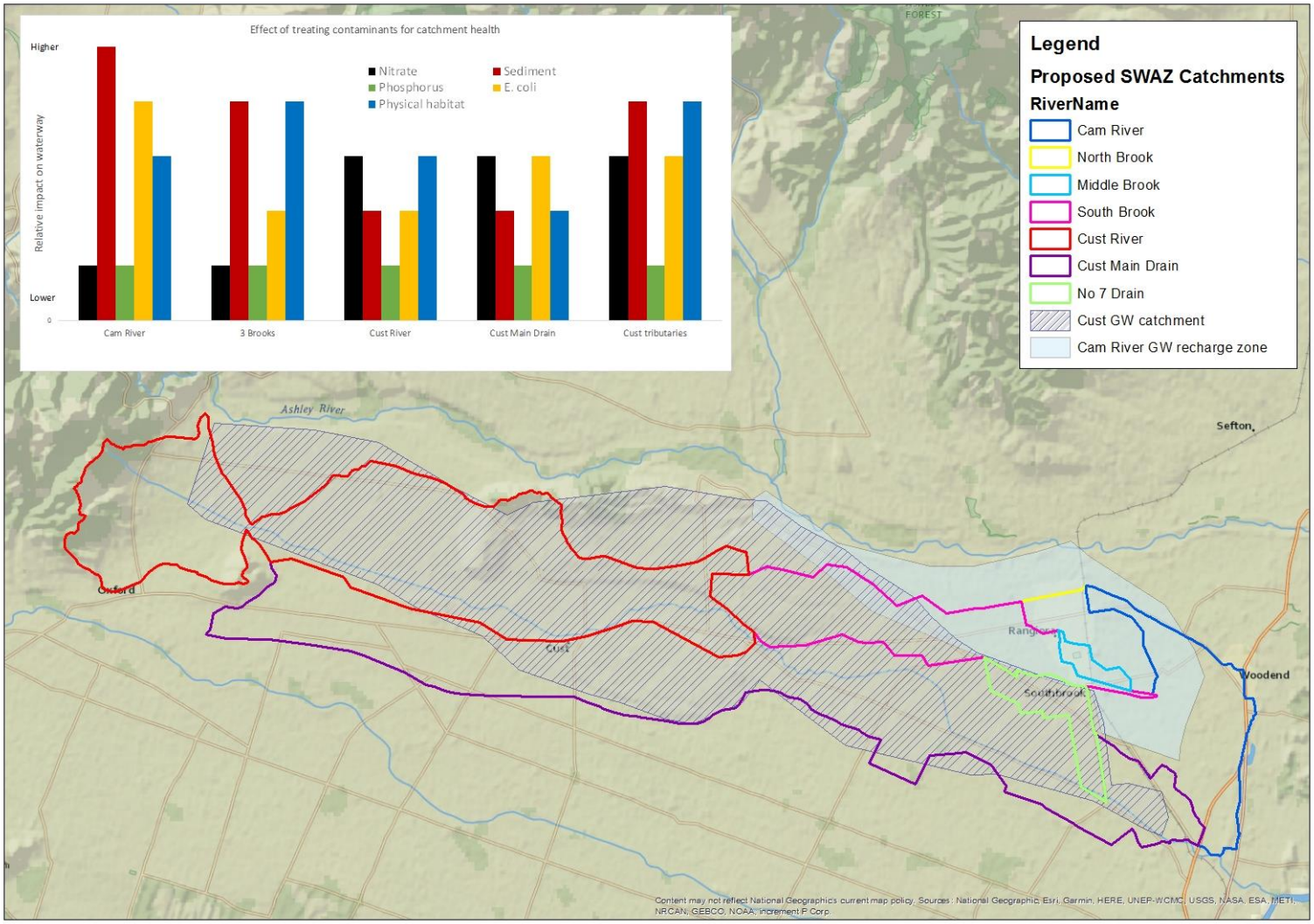

Figure 9 **Indication of relative contaminant impact for Cust and Cam catchment**

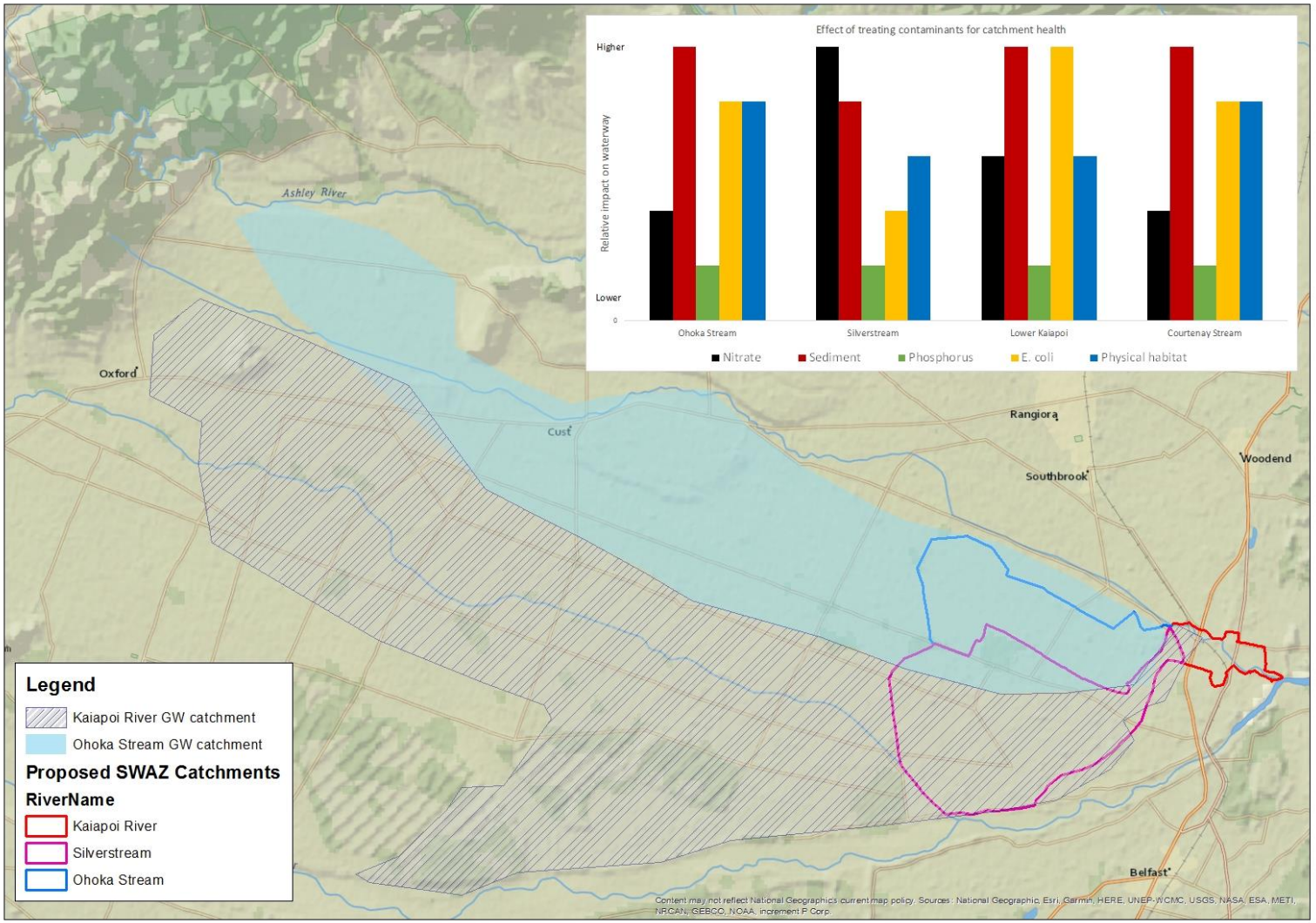

Figure 10 Indication of relative contaminant impact for Kaiapoi River catchment

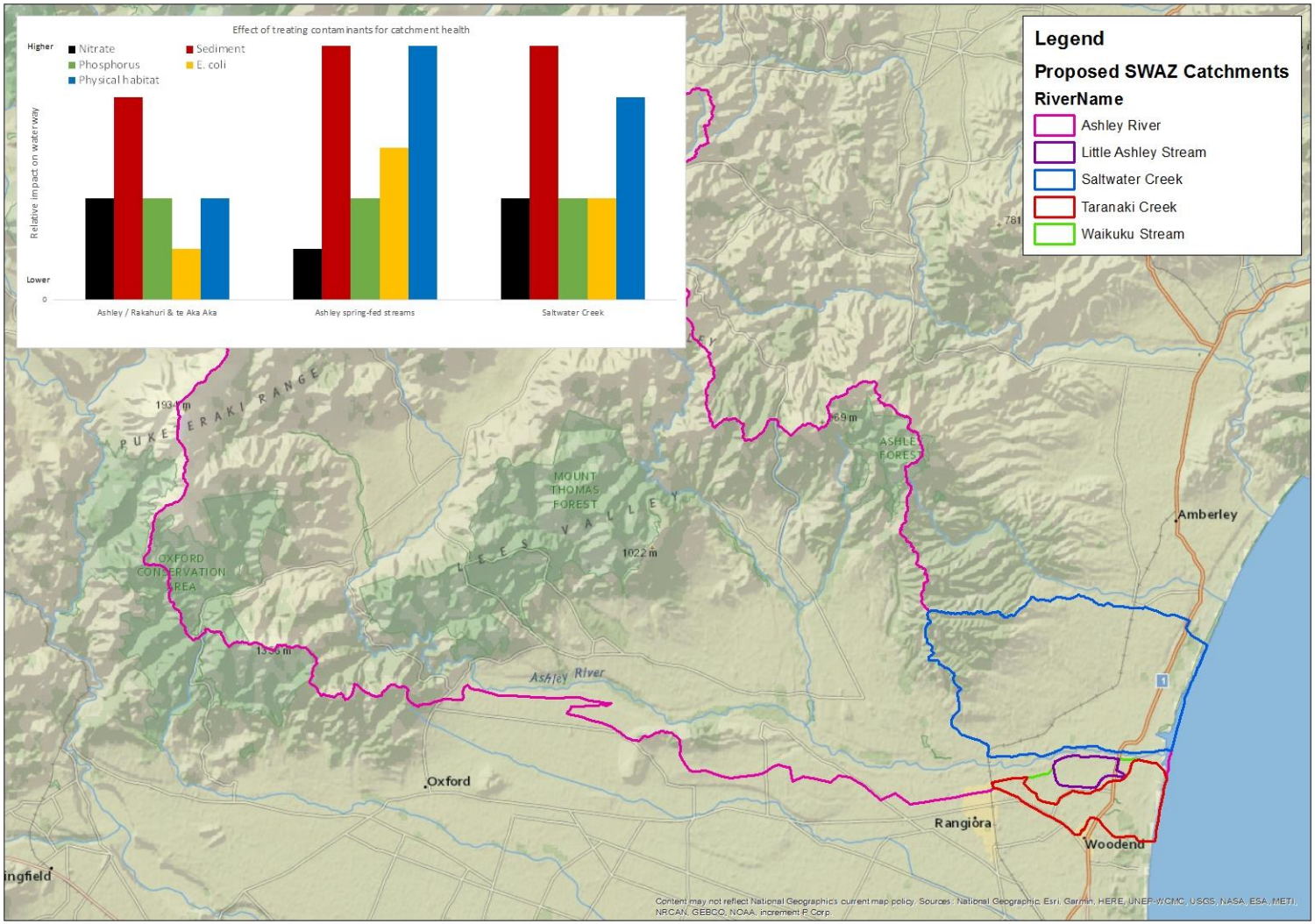

Figure 11 Indication of relative contaminant impact for Ashley catchment

12. Cost analysis for RCP Management Zone long term actions

12.1. Overview

This section provides rough order cost estimates for the runoff contaminant and stream habitat restoration actions that are likely to be required to support significant improvements in stream health and mahinga kai diversity and abundance. Costs have been compared to those associated with a 20% beyond Baseline GMP N loss reduction, for reference. The following work is required to complete this cost analysis:

- Summarise the costs for a 10-15% beyond GMP N loss reduction for the zone
- Assess the cost of the additional FEP requirements proposed for the Runoff Contaminant Priority Management Zone
- Compare both costs

We are currently working on this analysis and will provide relevant information to the committee when available.

12.2. Management actions

This analysis considers 6 options to improve instream biodiversity. These are:

- Fencing
- Planting
- Rebattering of collapsed banks
- Rebattering of steep banks
- Sediment removal
- Sediment traps

Initial cost estimates for these options are provided below. It should be noted that some of these costs will need to be covered under actions already required under PC5 and/or proposed for inclusion in the specific RCP Management Zone FEP requirements. These cost estimates will therefore be updated when the draft ZIPA recommendations have been finalised.

Removal of fish passage barriers have not been costed at this stage.

12.3. Rough order cost estimates

Detailed assumptions are contained in Table 5 below based on extrapolation from case studies where stream walk data has been collected on the biodiversity restoration work required.

They show that the total cost of undertaking all these items across all streams would be in the order of $60 million in total. This includes all the spring-fed streams, including the Ashley tributaries as well as the Waimakariri tributaries. The largest part of the costs are for planting, rebattering of steep slopes, and sediment traps.

Whilst it is likely that not all of these costs will be required, the costs do not include ongoing operating costs. For some of these the operating costs would be considered within the

normal purview of farm operation – for example fencing maintenance. Retired areas and plantings may require weed control in the future depending on how well they have been done, and wetlands may require removal of material. Sediment traps require regular clearance of material to be effective in ongoing operation.

It should also be noted that drains are not included in these costings. It may be that additional work to prevent the transport of sediment from drains into streams would be required if the biodiversity in the streams was to be maintained.

Table 5 shows that the cost of the biodiversity work would be $560/ha across the whole of the Northern Waimakariri tributaries area. This would reduce to $170/ha for a reduced scope, and when spread out over 10 years would be in the order of $17/ha/year, and $8.50/ha/year over 20 years (Table 6).

Table 5: Cost per item for Biodiversity Restoration in Northern Waimakariri Tributaries

Item	Units	Quantity	Per unit cost	Total cost
Fencing cost	m	2,370	$15.6	$11,780,000
Planting	m	2,370	$10.5	$24,510,000
Land cost	ha	230	$10,000	$2,330,000
Sediment trap	per trap	2,500	$2,250	$3,060,000
Rebattering cost for collapsed	m	3,110	$65	$200,000
Rebattering cost for steep	m	281,840	$65	$18,320,000
Sediment removal	m of stream	87,430	$20	$750,000
Management	per ha	110,000	$5.9	$640,000
Total				**$61,600,000**

Table 6:Source of costings for biodiversity

Item	Source of units	Source of cost
Fencing cost	Case study streamwalk data	From MPI Stock Exclusion Costs report (2016)
Planting	Case study streamwalk data	From MPI fencing costs
Land cost	Case study streamwalk data extrapolated, allowing 3m setback distance, 30m2 for wetland.	Indicative
Sediment trap	Hudson - number of traps/km	From WDC costings
Rebattering cost for collapsed	Case study streamwalk data	WDC costing data
Rebattering cost for steep	Case study streamwalk data	WDC costing data
Sediment removal	Length of REC stream order 1, 43% of streamwalk streams have streambed with >20% fine sediment	$20/linear m from WDC costings
Management	Area of contributing catchment	From ECan SFF application for working on with lifestyle blocks, converted to per ha.

Table 7: Costs for biodiversity restoration in total and with priority areas targeted

	Total	Total/ha over 110,000 ha	Annual $/ha over 10 years
Total cost	$61,600,000	$560	$56
Total cost with 20% of steep banks, sediment traps, and planting plus 50% of fencing	19,000,000	$170	$17

12.4. Comparison with the cost of a 20% beyond GMP N loss reduction

The implications for farm operating profit of beyond GMP N loss reductions are summarised for properties in Figure 12 below. They show that for dairy operations the costs of reductions in N loss appear to be lower than for sheep and beef and arable properties, but they increase rapidly at higher levels of N reduction. For sheep and beef, dairy support and arable the costs of reductions are estimated to be approximately linear, and costs will be incurred whatever level of reduction is chosen.

The costs of a catchment wide reduction of 20% would be in the order of $21 million per annum including the Interzone area. If implemented immediately this would cost $210 million over the 10 years of the plan, but if it were not required until the end of the period the costs would be significantly lower for individual properties.

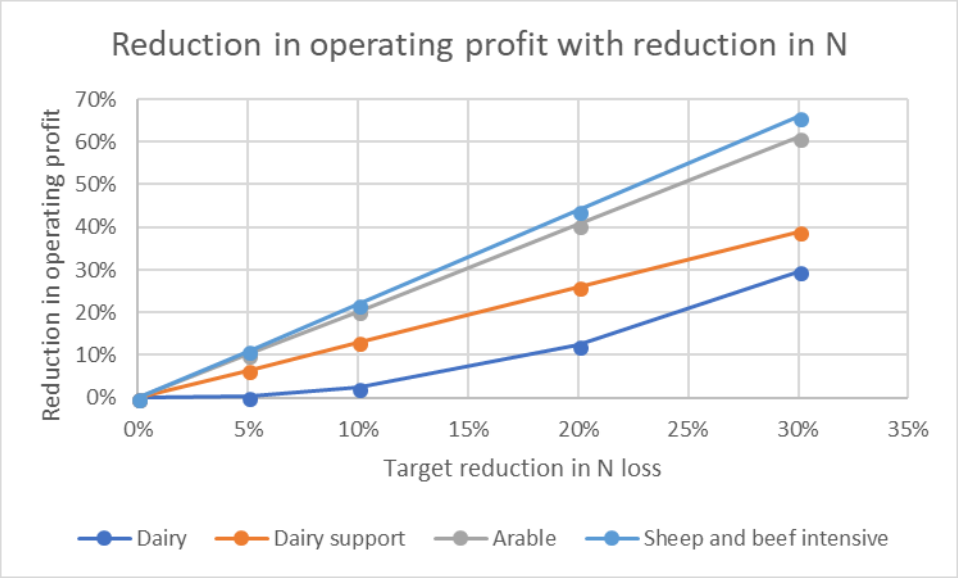

Figure 12: Implications of targets for reduction in N loss for operating profit, by farm type

The total reduction in farm value that is associated with the reduction in operating profit is shown in Table 8 below. It is likely that the costs in terms of land value would be experienced much earlier in the period, because purchasers would be unwilling to buy properties that had a requirement for lowering of N and therefore available profit.

1. For a requirement of 20% reduction in N losses the reduction in land value for the Northern Tributaries and interzone combined will be $400 million (dairy only), rising to $980 million if the reduction were to be required of all land uses.
2. The Farmers Panel Mitigation option of a 5 – 10% reduction in N losses for dairy only would cause a reduction in land value of $10 million for a 5% reduction to $90 million for a 10% reduction.

Table 8: Reduction in land value with reduction N losses required

Reduction in N required	Northern Waimakariri Tributaries		Interzone	
	All land use ($m)	Dairy only targeted ($m)	All land use ($m)	Dairy only targeted ($m)
5%	$140	$10	$20	$0
10%	$320	$70	$60	$20
20%	$800	$310	$180	$90
30%	$1,450	$710	$350	$220

For individual landholders the costs of contributing to a stream health restoration programme with a reduced N reduction target would be significantly lower than the costs of a 20% beyond GMP reduction in N loss.

The aggregate reduction in operating profit would be $21 million per annum, which would sum to $210 million per annum over 10 years. However, the reduction in land value would be

more significant, because this is likely to occur immediately and would impact on the solvency of the business. The reduction in land value could amount to between $400 and $980 million.

The cost of the stream health restoration is therefore likely to be significantly less than a 20% beyond GMP N loss reduction target for most landholders. There will, however, be individuals who for various reasons are able to meet the 20% reduction in N losses for only minor costs and for these individuals the preference may be to achieve lower N losses rather than contribute to stream restoration measures.

13. References

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