Memo

Date	13 March 2019
To	Lisa Jenkins,
CC	Ian Whitehouse
From	Ned Norton

Assessment of effects of the proposed approach to "fix the 10% rule" on water quality in the Jed River

SUMMARY

i) I have estimated the "plausible worst-case" increase in nitrogen loss from "low intensity dryland farming" under the proposed Plan Change 1 approach is probably in the order of 8-14% for the Jed catchment, compared to the nominal 10% increase allowed for under current HWRRP permitted activity rules, although the worst-case seems unlikely to occur.

ii) I would expect the risk of phosphorus losses to be the same under the proposed Plan Change 1 as under the current HWRRP rules (i.e., less than 10% increase) based on the two approaches having the same reliance on well implemented Farm Management Plans (FMPs).

iii) I have assessed the effects of the above increases against the relevant narrative Objectives 5.1 and 5.2 of the HWRRP. Key findings are bulleted below.

iv) Objective 5.1(c) requires that nutrients in the Jed mainstem be managed to "*control periphyton growth that would adversely affect recreational, cultural and amenity values*". While any increase in the nutrients nitrogen and/or phosphorus would be negative in terms of increasing the risk of nuisance periphyton growth generally, it seems unlikely that the small, if any, nutrient increase arising under the proposed Plan Change 1 permitting of "low intensity dryland farming" would lead to measurable change to nuisance periphyton in the Jed, when compared to the current HWRRP permitted activity rules. This is providing that:

- FMPs are prepared as required by Plan Change 1 and associated best practices implemented;
- Winter grazing on dryland farms, which is a key nutrient loss risk activity, requires particularly careful on-farm management to avoid local increases and associated local reach-scale effects in streams as well as avoiding contribution to nutrient increases at whole catchment scale.
- The current extent of stream shading is maintained or improved. Current nutrient concentrations are unlikely to be limiting periphyton growth and shading appears particularly important in controlling periphyton currently in the Jed, as well as probably assisting the resilience of aquatic species to the naturally low summer Jed flows;

v) Objectives 5.1(d) and 5.2(a) require consideration of nitrate toxicity for aquatic species. The Jed and tributaries currently meet the “A band” category for nitrate toxicity – meaning there is unlikely to be nitrate toxicity effects even on sensitive species. This situation is unlikely to change under proposed Plan Change 1.

vi) Objectives 5.1(e) and 5.2(b) require consideration of nitrate toxicity for human consumption. Jed in-stream nitrate concentrations are well below the Maximum Acceptable Value (MAV) of 11.3 mg/L described in the New Zealand Drinking Water Standards and set as a region-wide maximum limit for groundwater in the Land and Water Regional Plan (LWRP). They are also well below the half MAV (5.65 mg/L) limit set for groundwater as an annual average concentration in the LWRP. In this respect Jed in-stream nitrate concentrations do not compromise suitability for human drinking and this situation is unlikely to change under proposed Plan Change 1.

vii) There is a groundwater monitoring site in the Jed catchment where groundwater has exceeded the nitrate MAV of 11.3 mg/L several times (maximum 11.9 mg/L) in the last five years and another site which has approached half MAV at times, with a maximum of 4.8 mg/L. The causes of these elevated groundwater concentrations are unknown, but I reiterate the point made in (iv) above that high nutrient loss risk activities, such as winter grazing in the case of dryland farms, require careful on-farm management to also avoid localised effects on groundwater, even if concentrations measured in streams meet standards.

viii) The greatest risk of significant nutrient increases in the Jed catchment would arise under new irrigation if water was brought from the Waiau River into the Jed catchment. There is currently only one irrigated property irrigating about 31ha out of 6,411ha in the Jed catchment. There is a significant area of potentially irrigable land around Cheviot, but it appears unlikely to be economically feasible to bring water in, at least at this time. Any new irrigated land use would be subject to the need for resource consent and an associated assessment of effects on nutrients, as it would not fit under the definition of “low intensity dryland farming” proposed in Plan Change 1.

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1. Purpose

The purpose of this memo is to assess the effects of the proposed approach to “fix the 10% rule” (in Plan Change 1 amendments to the Hurunui and Waiau River Regional Plan [HWRRP]) on water quality in the Jed River.

2. Background

During the Hurunui Waiau Zone Committee-led process of developing the proposed approach to “fix the 10% rule” the main focus has been on the Hurunui and Waiau catchments because these are where water quality issues and interest in further intensified land use development are most significant. However, the proposed approach involves changes to the HWRRP permitted activity rules for dryland farming that would also apply to dryland farming in the Jed catchment and so it is also necessary to consider the effects of the proposal in that catchment.

3. Proposed HWRRP amendments to "fix the 10% rule"

The proposed amendments are described in detail in the Section 32 Report for Plan Change 1. In summary, the amendments look to permit dryland farming (i.e., no consent required) if the activity meets the definition of "low intensity dryland farming" (see below), has a Farm Management Plan, and is either part of a Dryland Farmer Collective Agreement or is registered in the ECan Farm Portal, all instead of the current "10% rule" permitted activity requirement for dryland farmers to run OVERSEER budgets and demonstrate no more than a 10% increase in nutrient losses compared to a defined baseline for their property (i.e., as at December 2013).

The proposed definition of "low intensity dryland farming" is critical and means *"a farming activity where:*

- *a) no part of the property is irrigated; and*
- *b) the area of the property used for winter grazing* [which is defined] *is less than:*
  - *i. 10% of the area of the property, for any property between 100 hectares and 1000 hectares in area; or*
  - *ii. 100 hectares, for any property greater than 1000 hectares in area; and*
- *c) the farming activity does not include the farming of more than 25 weaned pigs or more than 6 sows, or the farming of poultry fowl at a stocking rate of more than 10 birds per hectare, up to a maximum of 1000 birds; and*
- d) *the farming activity does not include a component where livestock are confined within a hard-stand area for the purpose* of intensive controlled feeding with the purpose of encouraging high weight gain."

In essence, the proposal makes it simpler for dryland farmers to be permitted by narratively defining "low intensity dryland farming" and removing the requirement for OVERSEER budgets and the "10% nutrient loss" test, while still placing clear constraints on nutrient loss by constraining the scale of activities most likely to increase nutrient loss (i.e., irrigation, winter grazing, intensive confined feeding).

4. Approach to this assessment

To assess the effects of the proposal on water quality in the Jed River two key questions are:

1. What is the predicted increase in nutrient loss under the Plan Change 1 proposal compared to the existing HWRRP rules?
2. Does the predicted increase in nutrient loss from low intensity dryland farming (if any increase) compromise relevant limits, policies and objectives in the HWRRP?

These same questions have already been addressed for the Hurunui and Waiau Rivers. For example, for the Hurunui River which has numeric catchment nutrient load limits set in the

HWRRP to achieve stated numeric periphyton biomass criteria, and where the nitrogen load limit is currently over-allocated (e.g., Norton, November 2018), assessments have identified a possible worst-case predicted nitrogen load increase from dryland farming that requires offsetting in order to meet the HWRRP nitrogen load limit in future. However, the Jed catchment does not have any catchment nutrient load limits or related numeric periphyton biomass criteria set in the HWRRP by which to assess the current state of allocation of nutrients. For the Jed catchment therefore, the relevant assessment to make is against the narratively expressed HWRRP water quality Objectives 5.1 and 5.2 quoted as follows:

Objective 5.1

Concentrations of nutrients entering the mainstems of the Hurunui, Waiau and Jed rivers are managed to:

- (a) *protect the mauri of the waterbodies;*
- (b) *protect natural biota including riverbed nesting birds, native fish, trout, and their associated feed supplies and habitat;*
- (c) *control periphyton growth that would adversely affect recreational, cultural and amenity values;*
- (d) *ensure aquatic species are protected from chronic nitrate toxicity effects; and,*
- (e) *ensure concentrations of nitrogen do not result in water being unsuitable for human consumption.*

Objective 5.2

Concentrations of nutrients entering tributaries to the Hurunui, Waiau and Jed rivers are managed to ensure they do not give rise to:

- (a) *chronic nitrate toxicity effects on aquatic species; and,*
- (b) *water being unsuitable for human consumption.*

5. Method

Question 1: What is the predicted increase in nutrient loss under the Plan Change 1 proposal compared to the existing HWRRP rules?

I have followed the same approach developed for use in the Hurunui and Waiau catchments (e.g., Norton, April 2018); that is to identify the “plausible worst case” increase in area of winter grazing under the proposed new rules and from that estimate the plausible worst case increase in nutrient losses, all compared to a nominal 10% increase if all dryland farmers increased their OVERSEER-estimated property losses by 10%. To do this I have drawn on several pieces of work developed during the Hurunui Science Stakeholder Group (SSG) process summarised in Norton (April 2018) and in particular an assessment by Brown (February 2018) titled “*Likely trends for dryland farming as a permitted activity in the Hurunui and Waiau Zone*” and a more recent supplementary memo by Brown (September 2018) assessing the Jed catchment specifically.

Question 2: Does the predicted increase in nutrient loss from low intensity dryland farming (if any increase) compromise relevant limits, policies and objectives in the HWRRP?

I have used a report titled "*Water Quality State of Jed River and tributaries 2010-11: Summary Report*" (Robinson and Stevenson 2012) together with some more recent unpublished ECan water quality data to summarise our understanding of the current state of water quality in the Jed River and tributaries. I used this as a basis to assess the current state against HWRRP Objectives 5.1 and 5.2, and then likelihood of change under the existing and proposed new permitted dryland farming rules.

5. Results

Question 1: What is the predicted increase in nutrient loss under the Plan Change 1 proposal compared to the existing HWRRP rules?

In my earlier assessment for the Hurunui River (Norton, April 2018 and March 2018) I used the findings of Brown (February 2018) to estimate that the "plausible worst case" increase in winter grazing on low intensity dryland properties (as a group) was a 50% increase over the long-term average of 1.9% of total farm area (i.e., an increase up to an average of approximately 2.9% of total farm area), and that this could produce an increase in nitrogen root zone losses from those farms of about 14% compared to the nominal 10% increase allowed for under current HWRRP permitted activity rules. For context that 14% increase on dryland properties (as a group) in the Hurunui catchment was estimated to equate to about 38 t/year source nitrogen load and about 18 t/year in-river load, which is about 1.8% of the in-river nitrogen load limit in the Hurunui River at State Highway 1 (963 t/year).

When Brown (September 2018) assessed dryland farming and the likelihood of increased winter forage specifically for the situation in the Jed catchment he reported very similar results to those he found earlier for the Hurunui and Waiau catchments. He concluded that while continued fluctuation in dryland winter grazing area is expected, there is unlikely to be an increase in the long-term average area due to the same climate-related constraining factors identified for dryland properties previously. From his results I can see no good reason to depart from the method of estimating a "plausible worst case" increase in dryland winter grazing of 50% and an associated plausible worst case increase in nitrogen root zone losses from those dryland properties of about 14%, as used for the Hurunui and Waiau catchments described above.

Note that this "plausible worst case" estimate is precautionary in respect of it being conservative, given Brown's (February and September 2018) prediction of no long-term increase in average dryland winter grazing area. To explore this further I note Brown's September 2018 assessment that winter grazing expansion would be most plausible on the flatter land (less than 15 degree slope) and unlikely on steeper land greater than 15 degrees, of which there is a large proportion (37%) in the Jed catchment (Figure 1 and Attachment 1). If I recalculate the nitrogen loss estimate assuming the worst case 14% increase in nitrogen loss occurs on the flatter (<15 degree) land only and no increase occurs on the steeper land, then the estimated increase across all of the dryland area as a whole becomes 8%. From this

I conclude that a plausible worst-case increase in nitrogen loss in the Jed is probably in the order of 8-14% for the Jed catchment.

For the Jed catchment I am unable to express and compare this 8-14% increase as an in-river tonnage like I did for the Hurunui because there is no nitrogen load limit set for the Jed catchment, nor do we have sufficient data (nitrogen concentration and flow) to calculate a reliable estimate of current in-river nitrogen load for the Jed River. What I can say is:

i) The plausible worst case increase of 8-14% nitrogen loss is potentially slightly higher than the nominal 10% increase allowed for under current HWRRP permitted activity rules, but the worst case appears unlikely to occur.

ii) For phosphorus the management approach in Plan Change 1 relies on compulsory Farm Management Plans (FMPs) and associated adoption of best practices to minimise the risk of surface runoff and associated phosphorus loss. This same reliance is made under the current HWRRP rules and I would expect the risk of increased losses to be the same (i.e., less than 10% increase) provided FMPs are well implemented. It is possible that there will be better uptake of FMPs by dryland farmers under the simpler permitted activity approach proposed in Plan Change 1 that was developed collaboratively with dryland farmer input.

iii) Without irrigation water farmers in the Jed catchment are constrained by climatic risk which constrains the likelihood of winter grazing to a relatively small proportion of the catchment area (e.g., in the order of 55 ha which is around 0.5% of the catchment area; Brown September 2018).

iv) Despite the likely area of winter grazing being relatively small there is a risk of localised increases in nutrient (both nitrogen and phosphorus) losses in those small areas, that could have localised water quality effects even though the increases are small at a whole catchment scale. This would be most likely in the flatter areas (less than 15 degree slope) shown in Attachment 1. The approach proposed in Plan Change 1 relies on compulsory Farm Management Plans and associated adoption of best practices to manage this risk of localised effects.

v) The predicted increase in nutrient loss from low intensity dryland farming is small compared to increases that would arise from intensive irrigated land uses. The greatest risk of significant nutrient increases would arise under new irrigation if it became economically viable to bring water from the Waiau into the Jed catchment. There is currently only one irrigated property in the Jed irrigating about 31 ha (Figure 1; Brown September 2018). There is a significant area of potentially irrigable land around Cheviot, but it appears unlikely to be economically feasible to bring water in, at least at this time (e.g., as assessed by Potts 2012). Any new irrigated land use would be subject to the need for resource consent and an associated assessment of effects on nutrients, as it would not fit under the definition of “low intensity dryland farming” proposed in Plan Change 1.

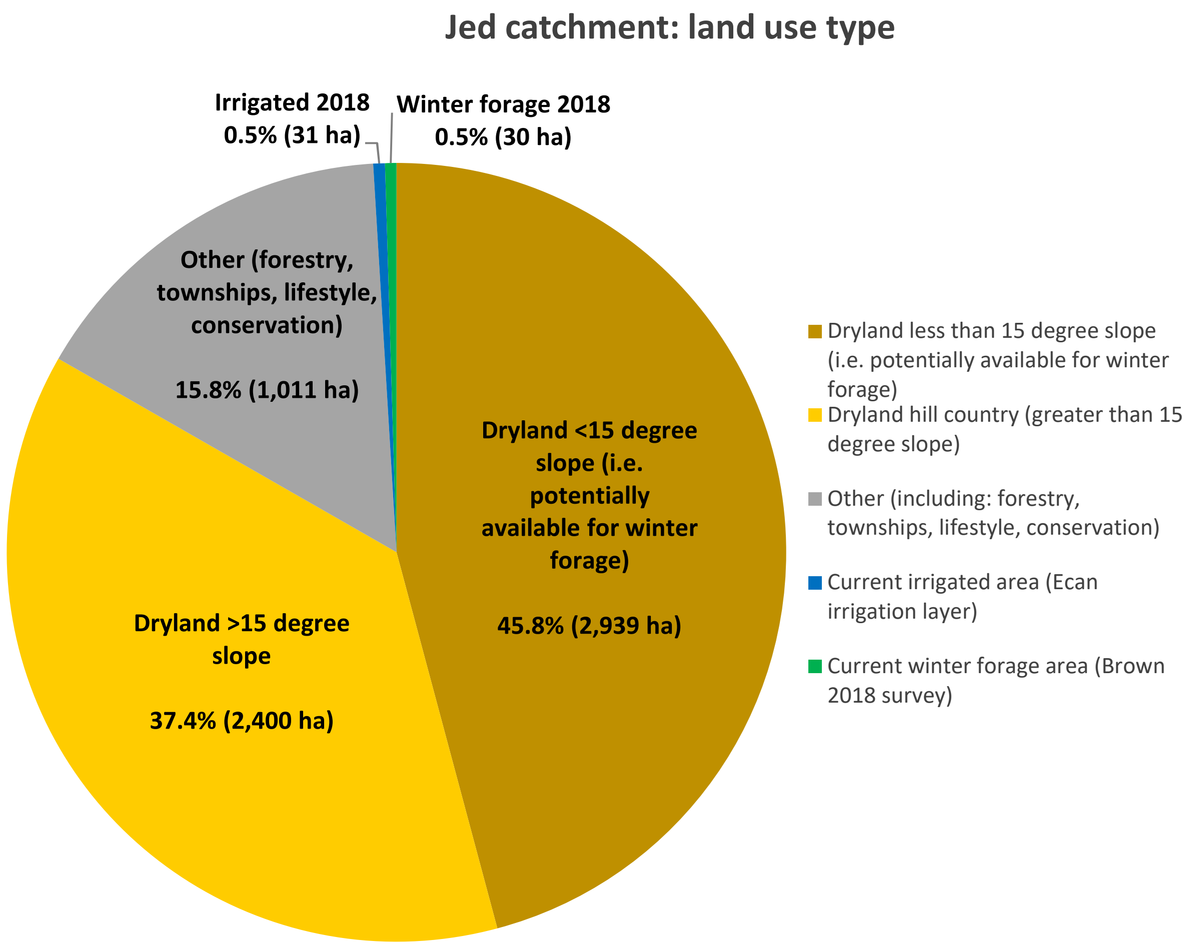

Figure 1: Jed catchment dryland land use types by area (in ha) and proportion (%). The total Jed catchment area is 6,411 ha. Data are from Brown September 2018. See also the map showing areas with different slopes shown in Attachment 1.

Question 2: Does the predicted increase in nutrient loss from low intensity dryland farming compromise relevant limits, policies and objectives in the HWRRP?

In the assessment that follows I use the report by Robinson and Stevenson (2012) together with some more recent unpublished ECan water quality data to summarise the current state of water quality against HWRRP Objectives 5.1 and 5.2, and then the likelihood of change under the existing and proposed new permitted dryland farming rules.

I note that the available monitoring data is limited, with 13 monthly samples of five sites in 2010-11 for the Summary Report (Robinson and Stevenson, 2012) and raw data from 7 monthly samples of the same five sites from July 2018 to January 2019, so we have limited understanding about year to year variability and only modest confidence that this assessment will reflect the water quality state most of the time. The monitoring sites are shown in Attachment 2.

Assessment against Objective 5.1 (Jed mainstem)

(a) Protect the mauri of waterbodies

The HWRRP definitions describe mauri as the "*essential life force inherent in all things and includes:*

- *"Aesthetic qualities e.g. water clarity, natural character and indigenous flora and fauna;*
- *Life supporting capacity and ecosystem robustness;*
- *Depth and velocity of flow;*
- *Continuity of flow from mountains to the sea;*
- *Fitness for cultural usage; and,*
- *Productive capacity."*

I am not qualified to directly assess current state of the Jed with respect to mauri or likely change as a result of the risk of nutrient increase described above. However, I note that the HWRRP definition above describes some elements of physical health which Ngāi Tahu use to reflect the status of mauri and some of these can be partly informed by the other assessments I make below, such as for example the heath of natural biota and periphyton, chronic nitrate toxicity and suitability for human consumption.

(b) Protect natural biota including riverbed nesting birds, native fish, trout, and their associated feed supplies and habitat

Plan Change 1 proposes an alternative way of permitting "low intensity dryland farming" to the current HWRRP "10%" rule and primarily affects the way high nutrient loss risk activities (i.e. winter grazing) are constrained and nutrient losses accounted for. The effects of these changes on natural biota are largely covered under the following assessments against the periphyton objective (5.1c), chronic nitrate toxicity (5.1d) and suitability for human consumption (5.1e). If effects of Plan Change 1 on those three objectives below are acceptable then to a large extent the effects of Plan Change 1 on natural biota are likely to be acceptable.

Potential effects of farming on natural biota other than water quality effects (e.g., effects on river flow, bed, banks and riparian habitat, terrestrial biodiversity) are either unaffected by Plan Change 1 (e.g. water takes and river flows) or are proposed to be managed in the same way under Plan Change 1 as the current HWRRP, through the mandatory requirement for Farm Management Plans.

(c) Control periphyton growth that would adversely affect recreational, cultural and amenity values

Periphyton was not sampled for the 2010-11 Summary Report and so I am reliant on the unpublished ECan periphyton data from seven observations (July 2018 to January 2019) of the five sites shown in Attachment 2. I have also visited the sites myself on 28 February 2019. From these my assessment is:

- There have been no observations of nuisance cyanobacteria or didymo at any of the five sites.
- There was nuisance periphyton growth at times in the very lower reaches of the mainstem Jed River where the channel is wide, shallow, unshaded, slow flowing and therefore vulnerable to nuisance periphyton growth (e.g., the sampling site just above tidal influence approximately 0.5km upstream from the coast – see Attachment 2). At this site there has been a mixed “sludge” periphyton community (a loose mixture of short filament and unicellular algae) covering between 30 and 60% of the bed on five of the seven sample dates.
- No other sites showed nuisance levels of periphyton (e.g. greater than 30% cover of filaments longer than 20mm, or 50% cover of cyanobacterial mats[1]).
- The Jed River (70m downstream of SH1) site showed 20% cover of short green filaments on one occasion and Woolshed Creek (at the Botanical Gardens) showed 25% cover of short filaments on one occasion, (both on 8 November 2018).
- It is often difficult to make periphyton observations at some of the sites due to low water clarity apparently from fine sediment in the water (particularly the Crystal Brook and Jed River downstream of Woolshed Creek confluence sites) and the cause of this is unknown.

With regard to using nutrient (nitrogen and phosphorus) data to assess the risk of conditions being favourable for nuisance periphyton, Robinson and Stevenson (2012) analysed the

[1] I have taken these criteria from the Freshwater Outcomes Table 1a of the Canterbury Land and Water Regional Plan (LWRP) for “hill-fed lower” rivers, to use as indicators of thresholds for “nuisance levels” of periphyton in the Jed catchment. Meeting these criteria means meeting the Freshwater Outcomes of the LWRP.

available nutrient data and found that dissolved inorganic nitrogen (DIN) concentrations were very low in Woolshed Creek (median 0.018 mg/L) but were higher in Crystal Brook (median 0.138 mg/L) and the Jed mainstem (medians of 0.442, 0.371 and 0.025 for sites moving downstream respectively), frequently exceeding the guideline value (MfE 2000) for controlling nuisance periphyton for maintaining biodiversity. These median concentrations are reasonably consistent with the median DIN for all hill-fed lower rivers in Canterbury (0.321 mg/L). Robinson and Stevenson (2012) noted that contributors to DIN likely included the treated Cheviot wastewater discharges spray-irrigated to land near Crystal Brook, as well as agriculture in the catchment.

Robinson and Stevenson (2012) found that dissolved reactive phosphorus (DRP) concentrations were lowest in Woolshed Creek (median 0.013 mg/L) but again were higher in Crystal Brook (median 0.078 mg/L) and the mainstem Jed (medians of 0.24, 0.067 and 0.058 for sites moving downstream respectively), again frequently exceeding the guideline value (MfE 2000) for avoiding nuisance periphyton. They noted that these median DRP concentrations are well above the median DRP of 0.005 mg/L for all hill-fed lower rivers in Canterbury, and that this is probably explained by a naturally high phosphorus contribution from the soft sedimentary geology in the catchment. They also noted that the treated town wastewater discharges spray-irrigated to land near Crystal Brook were a likely contributor and a greater risk than diffuse agricultural sources of phosphorus.

Overall, despite the observed concentrations of DIN and DRP exceeding MfE (2000) guidelines for avoiding nuisance periphyton growth, there does not appear to be a persistent periphyton problem in most of the Jed catchment currently, except for the lower reaches of the mainstem near the coast where it appears there is frequently a mixed "sludge" periphyton community covering between 30 and 60% of the bed. This suggests to me that nutrients are not currently limiting periphyton growth in the Jed system but shading from riparian vegetation is currently probably constraining nuisance growth along much of the stream length. During my site visit on 28 February the low summer flow conditions were probably near to the worst time of year for growth and I observed the aforementioned "mixed sludge" periphyton community at the lower Jed site near the coast, but I did not see nuisance periphyton[2] at numerous shaded locations I visited upstream from there such as for example at the Cheviot Hills Reserve. Stream shading also likely improves the resilience of aquatic communities to warm temperatures from the naturally low summer flows in the Jed.

Any increase in nutrient (DIN and/or DRP) concentrations would be negative in terms of increasing the risk of nuisance periphyton growth generally, and potentially worsening the current situation in unshaded parts of the lower Jed. The greatest risk of increases from agricultural sources would come with increased irrigated intensification, an activity requiring consent and specifically excluded from the proposed Plan Change 1 permitted activity rules. It seems unlikely that the small, if any, nutrient increases that would arise under the proposed Plan Change 1 permitting of "low intensity dryland farming" would lead to measurable change

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[2] i.e., exceeding the previously mentioned LWRP criteria for "hillfed lower" rivers.

to nuisance periphyton, provided Farm Management Plans are prepared and associated best practices implemented, and provided the current extent of stream shading is maintained or improved. Winter grazing on dryland farms is a key nutrient loss risk activity that requires careful on-farm management.

Consistent effective management of the spray-irrigated Cheviot town wastewater discharges will also assist with maintaining an acceptable periphyton state. Restricting stock access and riparian planting to reduce run-off reaching streams and to provide stream shade would also help.

(d) Ensure aquatic species are protected from chronic nitrate toxicity effects

The nitrate data reported by Robinson and Stevenson (2012) and the more recent unpublished ECan data all show median nitrate concentrations less than 1.0 mg/L and 95th percentile concentrations less than 1.5 mg/L (see Attachment 3), which places these sites in the "A band" category[3] for nitrate toxicity – meaning there is unlikely to be nitrate toxicity effects even on sensitive species (NPSFM). This is similar (in fact slightly better) than the level of nitrate toxicity protection set in the HWRRP for the mainstem of the Hurunui and its tributaries above Mandamus (median and 95th percentile limits of 1.1 and 2.0 mg/L respectively) and better than the level of nitrate toxicity protection set in the HWRRP for the mainstem of the Hurunui and its tributaries below Mandamus (median and 95th percentile limits of 2.3 and 3.6 mg/L respectively). This situation is unlikely to change as a result of the small, if any, increase in nutrient loss under proposed Plan Change 1 permitting of "low intensity dryland farming".

(e) Ensure concentrations of nitrogen do not result in water being unsuitable for human consumption

The in-stream nitrate concentrations described above are well below the Maximum Acceptable Value (MAV) of 11.3 mg/L described in the New Zealand Drinking Water Standards and set as a region-wide maximum limit for groundwater in the Land and Water Regional Plan (LWRP Schedule 8). They are also well below the half MAV (5.65 mg/L) limit set for groundwater as an annual average concentration in the LWRP. In this respect they do not compromise suitability for human drinking and the current state meets HWRRP objective 5.1(e). It is unlikely that the small, if any, nutrient increases that would arise under the proposed Plan Change 1 permitting of "low intensity dryland farming" would lead to measurable change at the catchment scale and compromising of HWRRP objective 5.1(e) in streams.

[3] Under the banding system defined in Appendix 2 of the National Policy Statement for Freshwater Management (NPSFM)

However, I note that ECan groundwater quality data does include a site in the Jed catchment (Site no. O33/0049) where groundwater has exceeded the nitrate MAV of 11.3 mg/L several times (maximum 11.9 mg/L) in the last five years and another site (site no. O33/0061) which has approached half MAV at times, with a maximum of 4.8 mg/L. I do not know the causes of elevated nitrate concentrations in these particular wells but they may indicate the risk of localised effects of high nutrient loss activities on groundwater, which could in turn affect local stream quality. As noted already, winter grazing on dryland farms is a key nutrient loss risk activity that requires careful on-farm management; proposed Plan Change 1 constrains the amount of winter grazing and requires mandatory FMPs. Effective implementation of FMPs is critical. It is possible that there will be better uptake of FMPs by dryland farmers under the simpler permitted activity approach proposed in Plan Change 1 that was developed collaboratively with dryland farmer input.

Assessment against Objective 5.2 (Jed tributaries)

(a) Ensure nutrients do not give rise to chronic nitrate toxicity effects on aquatic species

The assessment for HWRRP objective 5.1 (d) above also covers objective 5.2 (a). In short, there is unlikely to be nitrate toxicity effects in Jed tributary streams currently (i.e., Crystal Brook and Woolshed Creek), and this is unlikely to change under proposed Plan Change 1 permitting of “low intensity dryland farming”.

(b) *Ensure nutrients do not give rise to water being unsuitable for human consumption*

The assessment for HWRRP objective 5.1 (e) above also covers objective 5.2 (b). In short, nutrients do not currently make water unsuitable for human consumption in Jed tributary streams (i.e., Crystal Brook and Woolshed Creek), and this is unlikely to change under proposed Plan Change 1 permitting of “low intensity dryland farming”. However, the same cautionary comment applies regarding winter grazing being a key dryland farming activity that carries risk of nutrient loss effects on groundwater. This will require careful on-farm management; proposed Plan Change 1 constrains the amount of winter grazing and requires mandatory Farm Management Plans.

References

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Brown, J. (September 2018). “Winter forage area in the Jed catchment”. On behalf of Hurunui District Landcare Group. Memo prepared for Environment Canterbury, September 2018; 7p. “

Ministry for the Environment (2000). *New Zealand periphyton guideline: detecting, monitoring and managing enrichment of streams*. Ministry for the Environment, Wellington.

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Norton, N. (12 April 2018). Summary of process to estimate the nitrogen load increase that would need to be offset in the Hurunui catchment as part of fixing the dryland farming “10% rule” issue” Environment Canterbury Memo. 7p.

Norton, N. (28 November 2018). Nitrogen allocation in the Hurunui catchment and its relevance for dryland farming and a draft plan change to “fix the 10% rule”. Environment Canterbury Memo. 10p.

Potts, R. (2012). Statement of evidence of Robert Potts: in the matter of a submission on the proposed Hurunui and Waiau River Regional Plan and Plan Change 3 to the Natural Resources Regional Plan under the Resource Management Act 1991; 12 October 2012. 33p.

Robinson, K., and Stevenson, M. (2012) *Water Quality State of Jed River and tributaries 2010-11: Summary Report*. Environment Canterbury Memo. 15p.

Attachment 1: Jed catchment land slope copied from Brown (September 2018)

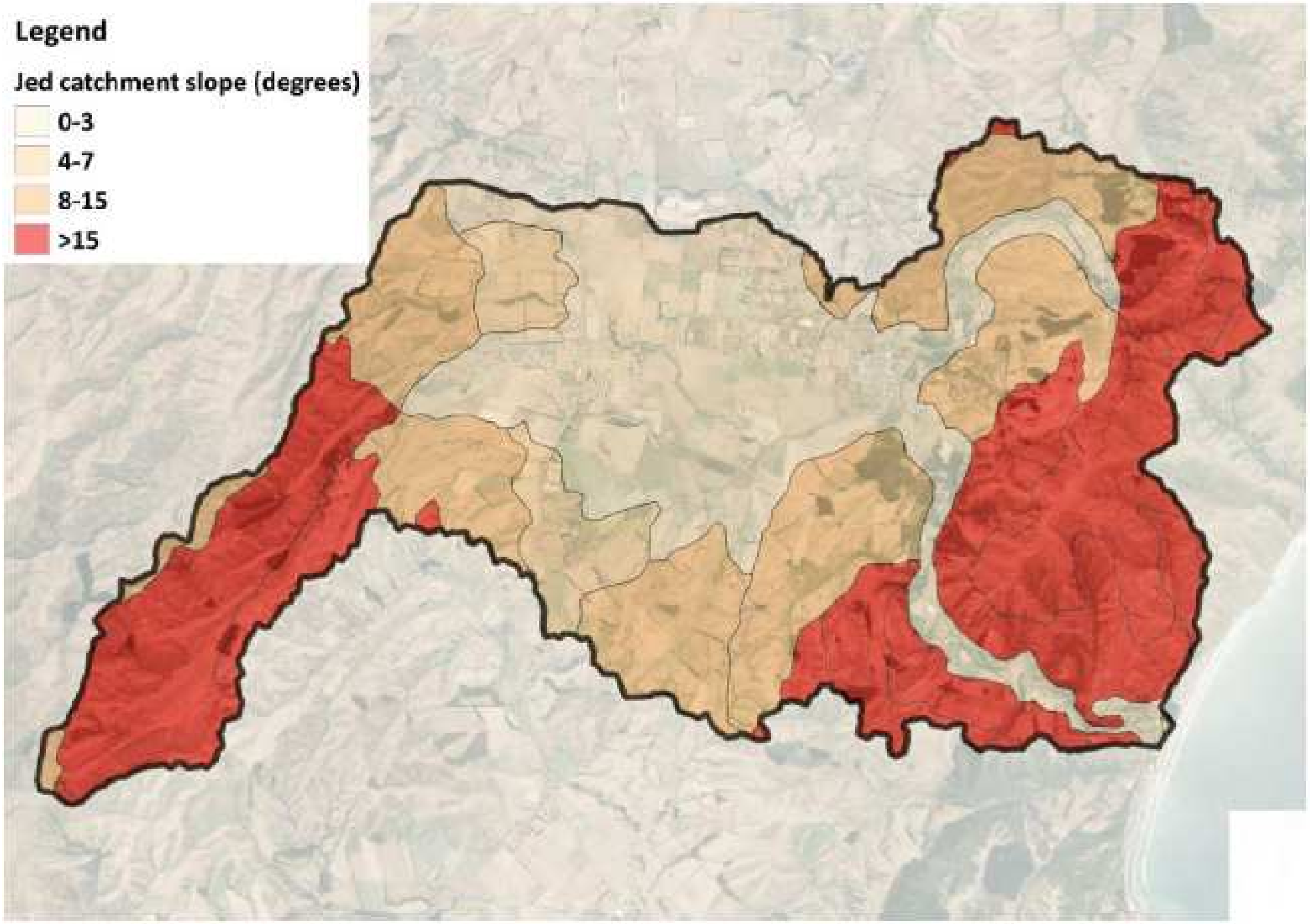

Figure 3. Jed catchment land slope

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Attachment 2: Water quality monitoring sites – copied from Robinson and Stevenson (2012)

Table 1: Water quality monitoring sites for the Jed River and tributaries.

Site ID	Source	Site Name	East	North
SQ35710	Crystal Brook	50 m upstream of Cheviot effluent discharge	2531845	5821101
SQ35712	Jed River	Below SH1, approximatley 70 m downstream of bridge	2532274	5821119
SQ35713	Woolshed Creek	at Botanical Gardens	2532603	5821586
SQ35717	Jed River	Down stream woolshed Creek confluence	2532969	5820844
SQ35711	Jed River	Upstream of tidal influence	2535225	5817631

Jed River and Tributaries Monitoring Sites

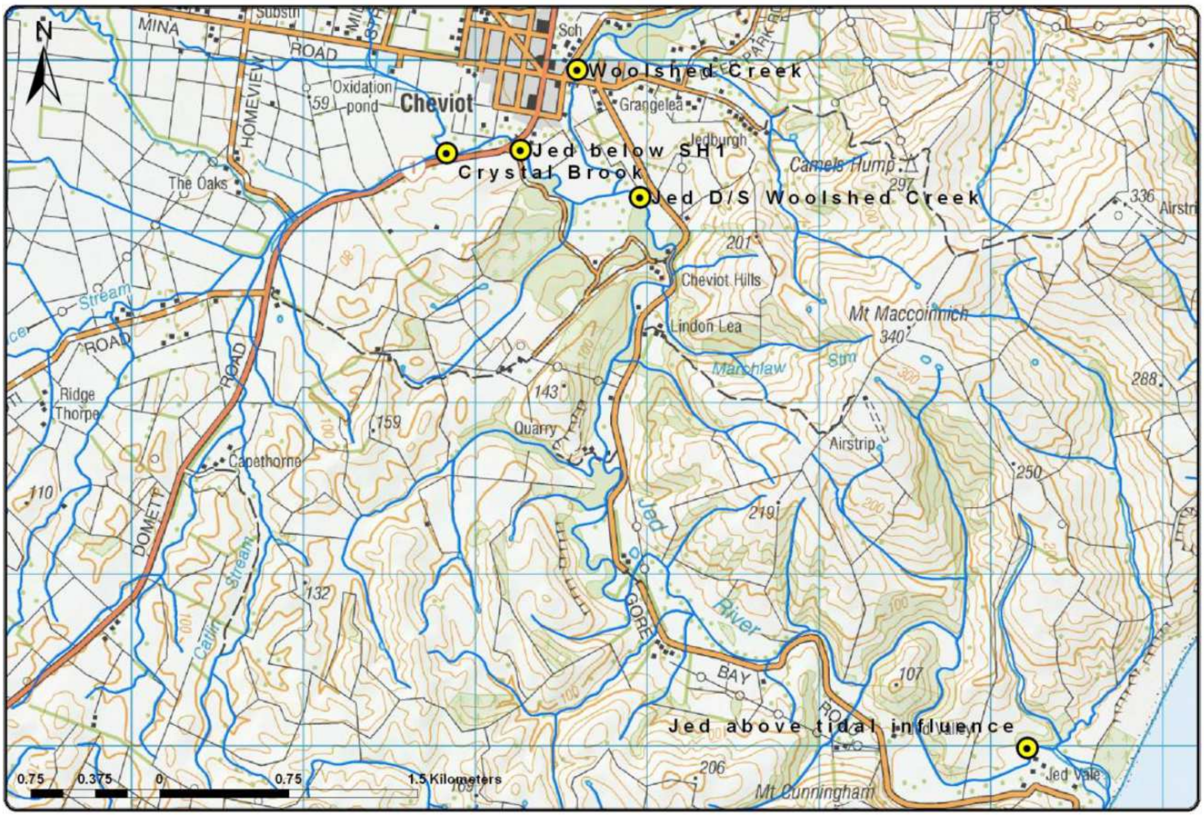

Figure 1: Location of water quality monitoring sites for the Jed River and tributaries

Attachment 3: Water quality monitoring data summary – copied from Robinson and Stevenson (2012)

		Cond	pH	Clarity Tube	NH3-N	NNN	DIN	TN	DRP	TP	BOD5 (total)	E coli
		mS/m		cm	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	MPN/100mL
Woolshed Creek	Median	78	8	78	0.009	0.0025	0.018	0.22	0.013	0.052		30
	Mean	71.1	8.0	78.5	0.016	0.079	0.095	0.405	0.018	0.062		36
	Max	85	8.1	100	0.078	0.9	0.978	2.6	0.077	0.17		96
	Min	38	7.5	47	0.0025	0.001	0.005	0.09	0.004	0.023		5
Crystal Brook	Median	80.5	7.85	35	0.0255	0.0455	0.1375	1.15	0.0775	0.18	3	82
	Mean	76.7	7.8	35.6	0.037	0.304	0.341	1.569	0.102	0.345	3.1	112
	Max	120	8.1	59	0.14	1.3	1.339	4.4	0.32	0.87	10	520
	Min	45	6.9	18	0.006	0.002	0.015	0.58	0.004	0.058	1	1
Jed River Below SH1	Median	74	7.8	36	0.056	0.091	0.442	1.4	0.24	0.52	3	78
	Mean	63.5	7.7	32.2	0.261	0.309	0.570	1.705	0.296	0.657	4.1	281
	Max	84	8.1	52	1.5	1.3	1.66	3.6	0.96	2.2	12	1700
	Min	26	7.4	10	0.0025	0.0025	0.005	0.42	0.022	0.068	1	29
Jed River D/S Woolshed Creek Confluence	Median	78	8	21.5	0.12	0.029	0.371	1.1	0.067	0.18		2000
	Mean	75.1	8.0	24.8	0.199	0.196	0.395	1.119	0.087	0.278		1479
	Max	86	8.1	51	0.65	1.1	1.22	2	0.25	0.64		2420
	Min	49	7.8	8	0.0025	0.001	0.005	0.5	0.029	0.1		71
Jed River Upstream of tidal influence	Median	94	8.2	90	0.008	0.006	0.0245	0.54	0.058	0.091		140
	Mean	228.8	8.1	78.0	0.016	0.093	0.109	0.590	0.067	0.108		180
	Max	1400	8.3	95	0.047	0.74	0.779	1.6	0.17	0.2		613
	Min	45	7.7	34	0.0025	0.001	0.005	0.21	0.024	0.049		1