Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan

Third set of Responses to Questions of Hearing Commissioners from the First Hearing Day (29 September 2020).

9 November 2020

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During the first day of the hearing for proposed Plan Change 7 to the Land and Water Regional Plan (PC7 LWRP), the Hearing Panel requested that Council Officers respond to questions regarding the connection between nitrogen losses in the Waimakariri Zone and nitrate-nitrogen concentrations at different receptors.

Questions

1. In the Joint Witness Statement for Groundwater Science (2020)[1], the experts agree that greater nitrogen loss reductions could be required to meet the new National Bottom Line requirements set out in the National Policy Statement for Freshwater Management 2020 (NPSFM 2020). What would the nitrogen loss reductions in the Waimakariri Zone look like to achieve the new bottom line requirements?
2. What would the nitrogen loss reductions in the Waimakariri Zone look like to achieve a nitrate-nitrogen concentration of 1 mg N/L in the deep aquifers of Christchurch?

Response to question 1

We have divided this question into three parts, which are discussed below:

- How do the NPSFM 2020 National Bottom Line[2] requirements for nitrate-nitrogen compare to the proposed PC7 LWRP limits and targets?
- Where the NPSFM 2020 National Bottom Lines for nitrate-nitrogen are lower than the proposed PC7 LWRP limits and targets, how much more do the nitrogen losses have to be reduced?
- What does this mean for future nitrogen loss rates and land use?

The response is based on the notified extent of the Nitrate Priority Area (NPA) and the waterbodies listed in Table 8-5.

[1] Paragraphs 55 and 56

[2] The NPSFM 2020 National Bottom Line requirements for nitrate-nitrogen are set out in Table 6 of Appendix 2A of the NPSFM 2020.

Proposed LWRP PC7 limits and targets versus NPSFM limits

Table 6 of the NPSFM 2020 [Nitrate-nitrogen toxicity] sets the National Bottom Line for nitrate-nitrogen concentrations in rivers at 2.4 mg N/L (annual median) and 3.5 mg N/L (annual 95th percentile).

Table 8-5 of PC7 LWRP proposes nitrate-nitrogen targets for surface water bodies in the Waimakariri Zone that represent an improvement to water quality. The proposed concentration targets for the streams in the Ashley River/Rakahuri Freshwater Management Unit (FMU) in Table 8-5 are lower[3] than the new National Bottom Line and the proposed concentration targets for the streams in the Northern Waimakariri Tributaries FMU in Table 8-5 are higher[3] than the new National Bottom Line (except for the Cam River/Ruataniwha, which has a proposed target of 1.0 mg/L).

The technical work supporting PC7 to the LWRP identified that four[4] of the streams in the Northern Waimakariri Tributaries FMU are projected to exceed the PC7 LWRP proposed targets under the Current Pathways Scenario[5]. This means that measures beyond those proposed in PC7, to reduce nitrogen losses from land use in the recharge area, would be required to achieve the new National Bottom Lines in those spring-fed streams.

For completeness, we note that recent analysis of surface water quality monitoring data has identified that nitrate-nitrogen concentrations in Southbrook at the monitoring site above Marshes Road have exceeded the annual 95th percentile NPSFM 2020 limit in all years when regular monitoring has been undertaken. We note that a nitrate-nitrogen target for this tributary of the Cam River has not been proposed in PC7 to the LWRP and its catchment area is outside of the notified NPA. However a limit has been proposed for the Cam River itself, and nitrate-nitrogen concentrations are lower due to dilution with lower nitrate-nitrogen water from Northbrook.

Our previous work (Kreleger and Etheridge, 2019) focused on achieving median nitrate-nitrogen concentrations in-stream. To assess if the annual 95th percentile nitrate-nitrogen National Bottom Line can be achieved in the spring-fed streams, we evaluated the ratio between annual median and annual 95th percentile nitrate-nitrogen concentrations in the measured data and compared it to the NPSFM 2020 ratio of 1.46 (i.e. 3.5 mg/l (95th percentile limit) / 2.4 mg/L (median limit) = 1.46).

If the measured ratio is less than 1.46, calculating nitrogen loss reduction requirements using a steady state model (which is likely to approximate the median concentration rather than the 95th percentile) and requiring the implementation of those reductions based on that model is likely to mean that both the median and 95th percentile National Bottom Line for nitrate-nitrogen would be achieved.

If the measured ratio is higher than 1.46, then a higher level of nitrogen loss mitigation would be required to achieve the 95th percentile National Bottom Line than that required to achieve the median National Bottom Line for nitrate-nitrogen.

[3] Concentrations that are 'lower' than the National Bottom Line are more protective for ecosystem health and those 'higher' are less protective for ecosystem health

[4] Kaiapoi River a.k.a. Silverstream (monitored at Harpers Road and Island Road), Courtenay Stream, Ohoka Stream and Cust Main Drain (being the modified form of the lower Cust River).

[5] The Current Pathways Scenario is explained in Section 4.4.2 of Kreleger and Etheridge (2019)

The measured 95th percentile/median nitrate-nitrogen concentration ratios for spring-fed streams in the Northern Waimakariri Tributaries FMU are plotted in Figure 1 below (with the exception of Courtenay Stream, as there is no monitoring data available after 2009).

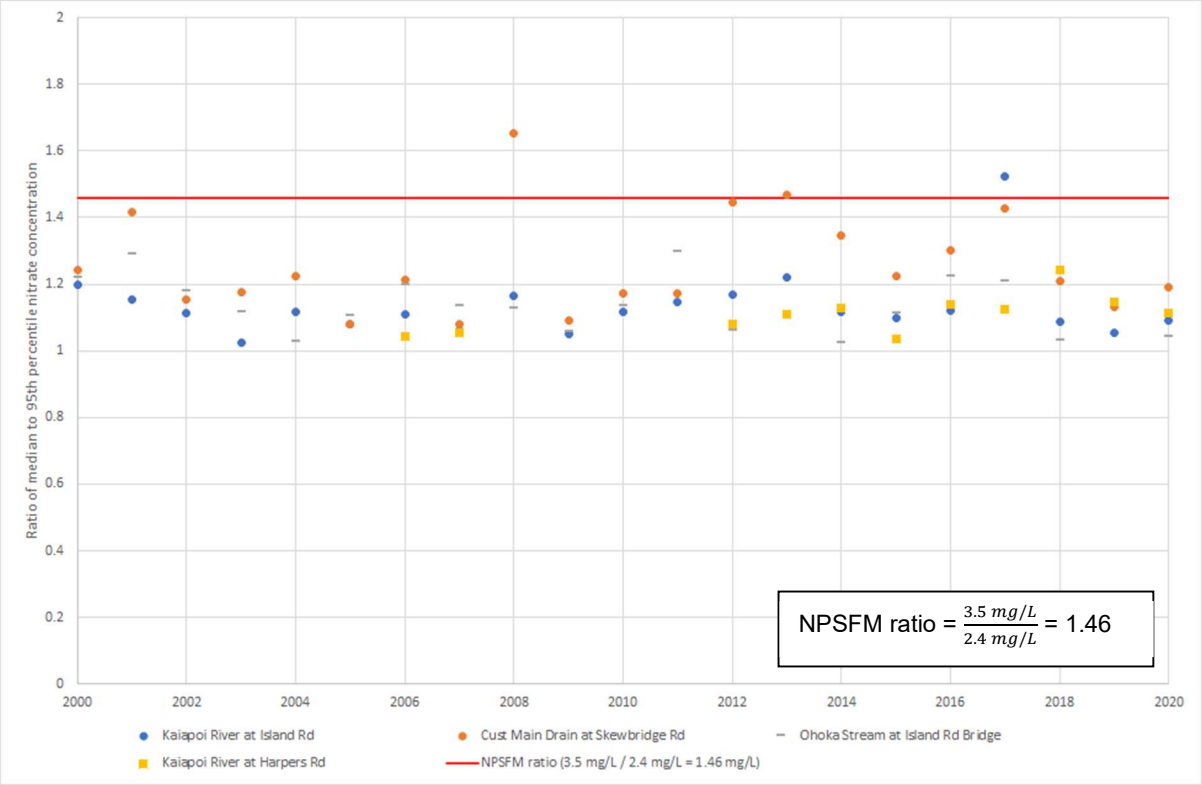

Figure 1 Ratio of annual median and 95th percentile stream nitrate-nitrogen concentrations

The results show that:

- Median and 95th percentile nitrate-nitrogen concentrations in the Kaiapoi River (aka Silverstream) at Harpers Road and Ohoka stream are similar, with the 95th percentile being 1.1 – 1.2 times the median value and always less than 1.46 times the median
- 95th percentile nitrate-nitrogen concentrations in the Cust Main Drain and Kaiapoi River (aka Silverstream) at Island Road have nearly always been less than 1.46 times the annual median concentration, except for 2008 (Cust Main Drain) and 2017 (Silverstream).

The data therefore indicate that defining and implementing nitrogen loss mitigations based on median nitrate-nitrogen concentrations is likely to be sufficient to also meet the 95th percentile nitrate-nitrogen toxicity limits.

Required nitrogen loss reductions

Table 1 below gives an overview of the required reduction in nitrogen losses (in 10-year stages) to meet the nitrate-nitrogen limits and targets under PC7 to the LWRP and the NPSFM 2020 National Bottom Lines. The number of 10-year stages required is based on the proposed PC7 boundary for the Nitrate Priority Area (NPA), the percentage of consented farmland within the groundwater recharge

area of the receptor and staged nitrogen loss reductions of 15% every 10 years for consented dairy farms and 5% every 10 years for other consented land use.

Table 1 Annual median nitrate-nitrogen concentration limits (50th percentile model results) and required nitrogen loss reductions and 10-year stages

Receptor	Current Pathways (mg/L)	PC7 target (mg/L)	Required reduction to achieve PC7 target	No. of stages required	NPSFM 2020 limit (mg/L)	Required reduction to achieve NPSFM 2020 limit	No. of stages required
Courtenay Stream	4.7	3.8	19.1%	1.9	2.4	48.9%	4.9
Cust Main Drain	6.2	3.8	38.7%	6.4	2.4	61.3%	10.6
Silverstream Harpers Rd	13.8	6.9	50.0%	3.4	2.4	82.6%	5.6
Silverstream Island Rd	9.5	6.9	27.4%	2.4	2.4	74.7%	6.5
Ohoka Stream	7	3.8	45.7%	6.2	2.4	65.7%	8.9

Given that each 10-year reduction stage requires a 15% nitrogen loss reduction from dairy farms and 5% for other consented land use activities, the implications of implementing the new NPSFM 2020 limits under PC7 to the LWRP as notified are as follows:

- 4.9 stages of nitrogen loss reductions for the Courtenay Stream catchment would require a 74% reduction in nitrogen losses for dairy farms and 25% for consented non-dairy land use;
- 5.6 stages of nitrogen loss reductions for the Silverstream at Harpers Road catchment would require an 84% reduction in nitrogen losses for dairy farms and 28% for consented non-dairy land use;
- 6.5 stages of nitrogen loss reductions for Silverstream at Island Rd would require a 98% reduction in nitrogen losses for dairy farms and 33% for consented non-dairy land use
- More than 6.6 stages would require a reduction above 100% for dairy farms (i.e. Cust Main Drain and Ohoka Stream), which is unachievable for this land use, using the methods set out in PC7 to the LWRP.

Note 3 beneath Table 8-9 in Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan states that:

The percentage reductions required by Table 8-9 are only to be applied to farming activities that require resource consent for farming land use and only where the required reduction for each stage is greater than 3 kg nitrogen per hectare for dairy, and 1kg per hectare for all other farming activities.

This effectively means that no further nitrogen loss reductions would be required for any consented farming activity once the nitrogen loss rate reaches 20kg/ha/year. For dairy farms, the 15% reductions required by Table 8-9 are only to be applied where the required reduction for each stage is greater than 3 kg nitrogen per hectare. A reduction of 3 kg nitrogen per hectare, based on a 15% reduction, equates to a nitrogen loss rate of 20kg/ha/year.

Similarly, in relation to all other farming types, the 5% reductions required by Table 8-9 are only to be applied where the required reduction for each stage is greater than 1 kg nitrogen per hectare. A reduction of 1kg nitrogen per hectare, based on a 5% reduction, also equates to a nitrogen loss rate of 20kg/ha/year.

Based on Table 17 in *Lilburne et al (2019)* we have estimated the following average annual nitrogen loss rates for different landuse categories in the Waimakariri Zone:

- Dairy – 60 kg N/ha/yr
- Sheep, Beef, Deer – 12 kg N/ha/yr
- Forestry – 2 kg N/ha/yr
- Lifestyle Blocks – 20 kg N/ha/yr
- DOC land – 0.2 kg N/ha/yr

Given that nitrogen loss reductions required by Table 8-9 are only to be applied to dairy farming activities where the required reduction of reach stage is greater than 3 kg nitrogen per hectare (which equates to an average nitrogen loss rate of 20kg/ha/year), the maximum nitrogen loss rate reduction that can be achieved for dairy farms, on average, is 67%. Considering that loss reductions on dairy farms of 74% or more are required, it is unlikely the NPSFM 2020 nitrate-nitrogen toxicity limits could be achieved under the rules proposed in PC7 to the LWRP.

Required nitrogen loss rates

In Table 2 we present the annual average nitrogen loss rate required within the recharge areas of the spring-fed streams to meet the NPSFM 2020 National Bottom Line for nitrate toxicity. The results show that average nitrogen loss rates of between ~8 and 10 kg/ha/year would be required for the Cust Main Drain, Silverstream and Ohoka Stream catchments. This is below the nitrogen loss rate that would be required after applying the exemption set out in note 3 of Table 8-9 and therefore adds strength to the conclusion that the NPSFM 2020 nitrate-nitrogen toxicity limits could not be achieved under the rules proposed in PC7 to the LWRP.

It is also noteworthy that the estimated nitrogen loss rate for lifestyle blocks (20 kg/ha/year, which includes estimated nitrogen contributions from onsite wastewater discharges) are significantly higher than the average nitrogen loss rates required to achieve the NPSFM 2020 National Bottom Line. This suggests that a much broader suite of interventions than those proposed in PC7 to the LWRP are likely to be required to implement the NPSFM 2020.

Table 2 Required annual average nitrogen loss rates within recharge areas of spring-fed streams to be able to meet NPSFM 2020 National Bottom Line for nitrate-nitrogen (toxicity)

Receptor	Size recharge area (ha)	Modelled GMP N-load (kg/yr)	N-loss rate under GMP (kg/ha/yr)	Current pathways (mg/L)	NPSFM 2020 National Bottom Line (mg/L)	Required reduction to achieve NPSFM 2020 National Bottom Line	Required N-loss rate (kg/ha/yr)
Courtenay Stream	6,837	261,196	38.2	4.7	2.4	48.9%	19.5
Cust Main Drain	17,052	356,199	20.9	6	2.4	61.3%	8.1
Silverstream Harpers Rd	6,847	396,934	58.0	14	2.4	82.6%	10.1
Silverstream Island Rd	25,463	905,167	35.5	9.5	2.4	74.7%	9.0
Ohoka Stream	15,523	348,296	22.4	7	2.4	65.7%	7.7

Response to question 2

The response to question 2 was provided to the panel in the memo "Assessment of nitrogen loss reductions in the Waimakariri sub-region for different land use and nitrate-nitrogen limits" dated 28 October 2020.

References

Joint Witness Statement for Groundwater Science (2020), for proposed Plan Change 7 to the Canterbury Land and water Regional Plan. https://ecan.govt.nz/document/download?uri=3939655

Kreleger, A. and Etheridge, Z, 2019: Waimakariri land and water solutions programme Nitrate Management Options and Solutions Assessment. Environment Canterbury Report No. R19/68.