IN THE MATTER OF	The Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010
AND	Submissions and Further Submissions in relation to proposed Variation 1 to the proposed Canterbury Land and Water Regional Plan.
AND	**North Canterbury Province of Federated Farmers of New Zealand** A Submitter and Further Submitter

Memorandum of Counsel for North Canterbury Province of Federated Farmers

Dated 17 October 2014

North Canterbury Federated Farmers (Inc)
PO Box 20448 Bishopdale,
Christchurch 8543
Solicitor R Gardner
Counsel Acting D van Mierlo

MAY IT PLEASE THE COMMISSIONERS

1. At the hearing of this matter on 18 September 2014, leave was granted for North Canterbury Federated Farmers Inc (Federated Farmers) to file further information regarding modelling of the impact on total catchment load limits, of an increase in the permitted nitrogen allocation limit for light and very light soils within the Selwyn Waihora catchment, from 15kg/ha/yr, to 20kg/ha/yr.

2. Leave was requested and granted, in response to questioning from Commissioner van Voorthuysen about the impact of the increase proposed in the relief sought in the submission of Federated Farmers on Variation 1, in relation to the total catchment load allocation, and in particular, whether such an increase had been modelled.

3. Federated Farmers has obtained independent expert modelling of the impact on total catchment load limits, of an increase in the permitted nitrogen allocation limit for light and very light soils within the Selwyn Waihora catchment, from 15kg/ha/yr, to 20kg/ha/yr. The outcome of that modelling is annexed to this memorandum and is filed herewith.

4. The independent modelling by Jacobs Consultants confirms that the increase from 15kg to 20kg permitted nitrogen allocation limit on light and very light soils would result in only a 2% difference in total dissolved inorganic nitrogen (DIN) load to Lake Ellesmere Te Waihora.

5. Furthermore, taking into account the CPW irrigation scheme, and the increase in agricultural intensification within the CPW command area, the modelling confirms that the increase in permitted nitrogen allocation limit sought by Federated Farmers "does not appreciably alter the increase in DIN loads to the lake or DIN in-stream concentrations compared to the current instalment of Variation 1 ..."

6. It is submitted that the results of this modelling confirm the position of Federated Farmers presented on 18 September that an increase from 15kg to 20kg/ha/yr on light and very light soils can be accommodated without materially undermining the ability to meet the total proposed nitrogen catchment load allocation for farming activities.

7. It is noted that while the Jacobs modelling report (Annexure 1) is dated 26 September 2014, a first draft was not received by Federated Farmers, by email, until 3.34pm on Wednesday 8th October.

8. A copy of this memorandum, and annexure is being provided to the other parties to this hearing, where an email address is known to Federated Farmers.

D van Mierlo

Counsel for North Canterbury Federated Farmers Inc.

17 October 2014

Annexure 1: Jacobs memo Scenario results: Alternative nitrogen allocation for Light Soils at 20kg/ha/yr

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Date	26 September 2014
Project No	AE04619/VW07479
Subject	**Scenario results: Alternative nitrogen allocation for Light soils at 20kg/ha/yr**

The scenario results presented below explore the option of increasing the nitrogen allocation limit under 11.4.14(a) from 15 kg/ha/yr to 20 kg/ha/yr for agricultural land on light, very light and extra light soil classes. Agricultural land on "other" soils classes remain at 15 kg/ha/yr N allocation. "Light" soils include Light, Very Light and Extremely Light soil classifications as used by ECan's modelling and in previous Source modelling as presented in our evidence. There was no change to soil groupings or ECan soil classes from Source modelling presented in previous evidence.

The alternative N allocation was applied to Scenario 2b and 3a:

- **Scenario 2b** - models the combined influences of an additional 30,000 ha in the catchment under irrigated agriculture (CPW Command Area), an associated switch from groundwater to surface water supply for the additional irrigated area and increasing leaching rates for agricultural landuse classes that are currently discharging less than 15 kg TN/ha/year to the 15 kg TN/ha/year limit. The total volume of irrigation from groundwater was restricted based on the limit imposed in Schedule 10 of proposed Variation 1 (estimated to have an annual reliability of 8.5 years out of 10).
- **Scenario 3a** – Based on scenario 2b with the application of "claw back" mitigation measures on allowable nitrogen leaching rates by specified percentages, as specified in policy 11.4.14(b) of proposed Variation 1.

Scenario $2b_{Alt20}$ and Scenario $3a_{Alt20}$ indicate the scenario has been amended to include an N allocation cap of 20 kg/ha/yr for agricultural land uses on "Light" soils. The total area for which the alternative N allocation of 20kg/ha/yr was applied was 223,712 ha or 40% of the total catchment area.

1. Results

1.1 Water Quality in Lowland Streams

Simulation results of in-stream DIN concentrations are presented for the modelled scenarios, with median simulated concentrations presented in Table 2 and 95th percentile simulated concentrations presented in Table 3.

Comparison of simulated changes for in-stream DIN concentrations for the CPW Scenario 2b were relatively similar to those simulated for Scenario $2b_{Alt20}$. Changes in both median and 95th percentile in-stream DIN concentrations between the two allocation rates under implementation of CPW irrigation scheme was between 1-3%.

Implementation of the alternative N allocation rate of 20 kg/ha/yr for "Light" soil agricultural areas under scenario $3a_{Alt20}$ (with "claw back" policy 11.4.14(b) in place) also resulted in only a small change to lowland stream DIN concentrations of 1-3% for both median and 95th percentile DIN concentrations.

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1.2 Total Nitrogen and Nitrate Nitrogen Loads Delivered to Lake Ellesmere / Te Waihora

The Source model was used to simulate the total flow of water, TN load and Nitrate load delivered to Lake Ellesmere / Te Waihora. The flows and loads were delivered in the Source model via the lowland streams draining to the lake, with those flows coming via a combination of surface and groundwater flow pathways.

Table 4 shows the simulated contributions to the DIN load to Lake Ellesmere / Te Waihora from each stream flowing into the lake for Scenario $2b_{Alt20}$. Table 5 shows the simulated contributions to the DIN load to Lake Ellesmere / Te Waihora for scenario $3a_{Alt20}$.

The differences in total DIN loads to Lake Ellesmere / Te Waihora under each of the scenarios are summarised in Table 1. For comparison, the current conditions scenario (Scenario 1) estimates the mean annual DIN load to the lake is 973 t/year, under Scenario 2b with a catchment wide 15kg/ha/yr cap on agricultural land the mean annual DIN load to the lake is 1132 t/year and for Scenario 3a with "claw back" implemented the DIN load to Lake is 1033 t/year. The total DIN load to the Lake under scenario $2b_{Alt20}$ is 1154 t/year and for scenario $3a_{Alt20}$ is 1053 t/year. This equates to a difference from Scenario 2b and scenario 3a of 2%, respectively.

Table 1 Comparison of total contribution of Dissolved Inorganic Nitrogen load to Te Waihora / Lake Ellesmere between scenarios modelled

Scenario Number	Scenario Description	Mean Annual Load to Lake (t/year)		
		NNN	Ammonium	DIN
1	Existing landuse	857	115	973
2b	Implementation of CPW Stage 1 (30,000 ha) with 15 kg/ha/year TN allowance	993	139	1132
3a	Existing landuse but with 15 kg/ha/year TN allowance and clawback of loading rates proposed under Variation 1	908	125	1033
2bAlt20kg	Implementation of CPW Stage 1 (30,000 ha) with 20 kg/ha/year TN allowance on light soils & 15 kg/ha/year TN allowance on other soils	1011	143	1154
3aAlt20kg	Existing landuse but with 20 kg/ha/year TN allowance on light soils & 15 kg/ha/year TN allowance on other soils and clawback of loading rates proposed under Variation 1	925	128	1053

Scenarios to Compare	Percentage Difference in Mean Annual DIN Load to Lake
2b with 1	16%
3a with 1	6%
2bAlt20kg with 1	19%
3aAlt20kg with 1	8%
2bAlt20kg with 2b	2%
3aAlt20kg with 3a	2%

2. Conclusion

Taking into account the establishment of the CPW irrigation scheme and a corresponding increase in agriculture intensification within the CPW command area, implementing an N allocation cap of 20 kg/ha/yr for agricultural land uses on “Light” soils does not appreciably alter the increase in DIN loads to the Lake or DIN in-stream concentrations compared to the current instalment of Variation 1 policy 11.4.14(a). “Light” soils include Light, Very Light and Extremely Light soil classifications as used by ECan’s modelling and in previous Source modelling as presented in our evidence.

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Table 2 Median Dissolved Inorganic Nitrogen (DIN) concentration simulated in Source model within lowland streams for different scenarios (NB. "Light" soils = light, very light and extra light soil classes)

Site Name	50th Percentile DIN Concentration (mg/L)							% Difference in DIN Concentration Scenario 1					
	Scen 1	Scen 0	Scen 2a	Scen 2b	Scen 2b 20kg/ha/y on Light Soils	Scen 3a	Scen 3[a] 20kg/ha/y on Light Soils	Scen 0	Scen 2a	Scen 2b	Scen 2b 20kg/ha/y on Light Soils	Scen 3a	Scen 3[a] 20kg/ha/y on Light Soils
Harts Creek Timberyard Road	4.66	3.35	4.75	4.49	4.52	3.93	3.96	-28%	2%	-4%	-3%	-16%	-15%
Selwyn River Coes Ford	2.59	2.37	2.92	3.04	3.13	2.76	2.84	-9%	13%	17%	21%	6%	9%
Boggy Creek Lower Lake Road	4.19	3.10	4.36	4.33	4.35	3.93	3.96	-26%	4%	3%	4%	-6%	-5%
Halswell River Ryans Bridge	3.23	2.78	3.82	3.75	3.83	3.47	3.54	-14%	18%	16%	19%	7%	10%
Halswell River Hodgens Bridge	2.90	2.52	3.41	3.38	3.46	3.11	3.18	-13%	18%	17%	19%	7%	10%
Halswell River Neils Road	3.12	2.69	3.68	3.63	3.70	3.35	3.42	-14%	18%	16%	19%	7%	10%
Hanmer Road Drain Lower Lake Road	3.06	2.51	3.19	3.26	3.31	2.83	2.87	-18%	4%	7%	8%	-8%	-6%
Irwell River Lake Road	2.26	2.10	2.40	2.43	2.49	2.17	2.23	-7%	6%	7%	10%	-4%	-2%
Lee River Te Moana	3.60	3.12	3.68	3.69	3.73	3.32	3.36	-13%	2%	2%	4%	-8%	-7%
LII River Pannets Road	2.14	1.44	2.28	2.26	2.33	2.07	2.14	-33%	7%	6%	9%	-3%	-0.2%
Doyleston Drain Lake Road	3.92	2.41	4.05	3.95	3.98	3.60	3.63	-38%	3%	1%	2%	-8%	-8%

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Table 3 Dissolved Inorganic Nitrogen (DIN) concentration not-exceeded on 95% of days simulated in Source model within lowland streams for different scenarios (NB. "Light" soils = light, very light and extra light soil classes)

Site Name	95th Percentile DIN Concentration (mg/L)							% Difference in DIN Concentration Scenario 1					
	Scen 1	Scen 0	Scen 2a	Scen 2b	Scen 2b 20kg/ha/y on Light Soils	Scen 3a	Scen 3a 20kg/ha/y on Light Soils	Scen 0	Scen 2a	Scen 2b	Scen 2b 20kg/ha/y on Light Soils	Scen 3a	Scen 3a 20kg/ha/y on Light Soils
Harts Creek Timberyard Road	6.53	4.67	6.58	6.22	6.24	5.55	5.57	-28%	1%	-5%	-4%	-15%	-15%
Selwyn River Coes Ford	4.03	3.18	4.35	4.71	4.83	4.17	4.29	-21%	8%	17%	20%	3%	6%
Boggy Creek Lower Lake Road	4.93	4.24	5.17	5.07	5.11	4.55	4.57	-14%	5%	3%	4%	-8%	-7%
Halswell River Ryans Bridge	3.89	3.19	4.46	4.42	4.50	4.02	4.10	-18%	15%	14%	16%	3%	5%
Halswell River Hodgens Bridge	3.40	3.00	3.85	3.81	3.89	3.52	3.60	-12%	13%	12%	14%	4%	6%
Halswell River Neils Road	3.69	3.10	4.19	4.15	4.24	3.79	3.87	-16%	14%	13%	15%	3%	5%
Hanmer Road Drain Lower Lake Road	5.00	3.14	5.03	4.99	5.02	4.27	4.30	-37%	1%	0%	1%	-15%	-14%
Irwell River Lake Road	3.67	2.92	3.89	3.67	3.76	3.25	3.33	-20%	6%	0%	2%	-11%	-9%
Lee River Te Moana	5.46	3.60	5.55	5.38	5.44	4.69	4.74	-34%	2%	-1%	0%	-14%	-13%
LII River Pannets Road	3.64	2.10	3.75	3.73	3.81	3.42	3.51	-42%	3%	2%	5%	-6%	-4%
Doyleston Drain Lake Road	4.95	3.99	5.10	5.01	5.05	4.46	4.47	-19%	3%	1%	2%	-10%	-10%

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Table 4 Total contribution of flow and Dissolved Inorganic Nitrogen load to Te Waihora / Lake Ellesmere for Scenario 2b with 20kg/ha/yr on agricultural land with "light" soils conditions scenario (NB. "Light" soils = light, very light and extra light soil classes)

Stream Name	Mean Annual Flow to Lake (GL/year)	Mean Annual Flow to Lake (m^3/s)	Mean Annual DIN Load (tonnes/year)
Selwyn River	119.7	3.79	206
Waikekewai Creek	0.0	0.00	0
Harts Creek	64.4	2.04	280
Doyleston Drain	4.5	0.14	16
Boggy Creek	3.0	0.09	11
Irwell River	3.3	0.10	7
LII River	42.4	1.34	87
Halswell River	76.1	2.41	306
Kaituna River	26.8	0.85	144
Prices Stream	15.5	0.49	89
Waikoko Stream	1.5	0.05	8
Total of All Inflows to Lake	**357.1**	**11.32**	**1154**

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Table 5 Total contribution of flow and Dissolved Inorganic Nitrogen load to Te Waihora / Lake Ellesmere for Scenario 3a with 20kg/ha/yr on agricultural land with "light" soils conditions scenario (NB. "Light" soils = light, very light and extra light soil classes)

Stream Name	Mean Annual Flow to Lake (GL/year)	Mean Annual Flow to Lake (m^3/s)	Mean Annual DIN Load (tonnes/year)
Selwyn River	119.7	3.79	195
Waikekewai Creek	0.0	0.00	0
Harts Creek	64.4	2.04	247
Doyleston Drain	4.5	0.14	15
Boggy Creek	3.0	0.09	10
Irwell River	3.3	0.10	6
LII River	42.4	1.34	80
Halswell River	76.1	2.41	282
Kaituna River	26.8	0.85	130
Prices Stream	15.5	0.49	80
Waikoko Stream	1.5	0.05	8
Total of All Inflows to Lake	**357.1**	**11.32**	**1053**