IN THE MATTER	of the Resource Management Act 1991 (the Act)
And	
IN THE MATTER	of resource consent applications under section 88 for AFFCO NEW ZEALAND LIMITED for discharges from the AFFCO MANAWATU EXPORT MEAT PROCESSING PLANT

STATEMENT OF EVIDENCE OF HAMISH LOWE (PROJECT OVERVIEW, DEVELOPMENT AND DESIGN) ON BEHALF OF AFFCO NEW ZEALAND LIMITED

26 October 2016

BUDDLE FINDLAY
Barristers and Solicitors
Wellington

Solicitors Acting: **David Allen / Annie O'Connor**
Email: david.allen@buddlefindlay.com
Tel 64-4-499 4242 Fax 64-4-499 4141 PO Box 2694 DX SP20201 Wellington 6140

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INTRODUCTION

1. My name is **Hamish Lowe**. I am the principal of Lowe Environmental Impact Limited (**LEI**), a consultancy that specialises in providing technical assistance and advice for a range of environmental projects, particularly regarding the management of land application of wastes.

2. My evidence is given in relation to the application for resource consents for the AFFCO New Zealand Limited's (**AFFCO**) Manawatu Export Meat Processing Plant (**AFFCO Manawatu**).

EXECUTIVE SUMMARY

3. AFFCO Manawatu has lodged application with Horizons Regional Council for resource consents to authorise 5 activities, as follows:

   (a) Seepage of wastewater from the wastewater treatment ponds to groundwater;

   (b) Discharge of treated wastewater to land by sprinkler irrigation;

   (c) Discharge of contaminants to air as a result of sprinkler irrigation;

   (d) Discharge of treated wastewater to surface water; and

   (e) Construction of a combined discharge structure and bed level control in the bed of the Otoku Stream.

4. AFFCO Manawatu's wastewater discharge alternative options are described in general terms:

   (a) Off-site discharge options include piping the wastewater to either the Feilding or the Palmerston North municipal wastewater treatment plants. This would be very expensive and both plants already have many pressures as indicated in their recent consenting processes, such that it does not provide a superior discharge option to AFFCO.

   (b) Land discharge options include consideration of the suitability, availability and proximity of land for this purpose. In the case of a 100 % discharge to land option 250 ha (plus) area of land would be required along with 180,000 m3 of storage would be needed to avoid discharge the river while enabling year round production at the plant. The approximate cost of the land and storage would be in the order of $4.5 million.

   (c) A range of treatment options can assist overall compliance with the water quality targets in Horizons' One Plan. This can be achieved by either treating the wastewater to such a standard that it can be discharged to the river at any time, or by staging the discharge so that it does not result in water quality targets being breached. However, any direct river discharge, no matter how well treated, may not be acceptable to iwi.

5. The costs of discharging to the Feilding municipal WWTP and a range of enhanced on-site treatment options were investigated and assessed in 2012/13. The objective of the options explored was to ensure that the discharge to the river meets or works towards the water quality targets of One Plan. A more recent evaluation and refinement of options has shown that the present proposal, being enhanced land discharge system over a greater area and better use of storage, was found to be as environmentally sound and more cost effective than the alternatives. This would still meet or working towards the One Plan requirements.

6. The seepage from the WWTP pond system to shallow groundwater is assessed at a rate of 1×10^{-8} m/s, equivalent to a maximum of 50 m^3/d. Based on available monitoring information, changes in groundwater chemistry that could be attributed to the ponds do not appear to propagate beyond the AFFCO property. While the exact contribution of groundwater from pond seepage to the Oroua River is unclear, the direction of shallow groundwater movement has been demonstrated that it is unlikely that **all** groundwater enters the Oroua River near the plant. Further monitoring bores are proposed to confirm the contribution of contaminants made from pond seepage to the river.

7. The ponds are currently clay lined, and to reliably limit seepage would require the ponds to be re-lined with a liner that would achieve the permitted activity standard for wastewater ponds in the One Plan of 1×10^{-9} m/s. While lining would provide some certainty surrounding the seepage from the ponds, it would not address the potential for other contaminants from a range of historical and neighbouring activities to continue influencing groundwater quality. As a result of uncertainty over effects and their contributing source, and the reality that effects are not currently detected in groundwater beyond the site, AFFCO have not pursued a lining option.

8. AFFCO Manawatu's proposed land discharge system involves application of treated wastewater to land by way of an irrigation system, as part of an integrated Combined Land and Water Discharge ("**CLAWD**") system. The land application rates are designed using best practice, to ensure that neither hydraulic nor nutrient application rates exceed the capacity of the soil to receive and utilise them. The proposed system provides for more land than is needed, creating operational and management flexibility. The design considers soil type and farm management, and results in nutrient loading rates that are typical of those used in typical farming operations of this nature. Consequently, the effects are in keeping with those associated with a 'farming only' operation with no wastewater application. The farm area has been divided into a series of Land Management Units (LMU), which are summarised below.

	LMU 1	LMU 2	LMU 3	LMU 4
Description	Byreburn existing (rotorainer)	Byreburn existing	Byreburn new	ANZ and Dalcam
Ownership	Byreburn Limited	Byreburn Limited	Byreburn Limited	ANZ (9.2 ha) Dalcam Company Limited (4.2 ha)
Area (ha)	56	40	33	13.4
Dominant soil	Kairanga silt loam	Rangitikei sandy loam	Kairanga silt loam	Rangitikei sandy loam
Limiting	P load	Instantaneous	Instantaneous	N load

	LMU 1	LMU 2	LMU 3	LMU 4
parameter	(60 kg P/ha/year)	hydraulic / P load	hydraulic load	(100 kg N/ha/year)
Average application depth (mm/year)	152	152	152	59
Average N Load (/year)	203 kg N/ha	203 kg N/ha	202 kg N/ha	76 kg N/ha
Average P Load (/year)	34 kg P/ha	34 kg P/ha	33 kg P/ha	13 kg P/ha
Max volume (m^3/year)	114,000	109,000	98,700	10,075
Max application depth (mm/year)	250	250	300	75
Max N Load (/year)	360 kg N/ha	360 kg N/ha	400 kg N/ha	100 kg N/ha
Max P Load (/year)	60 kg P/ha	60 kg P/ha	66 kg P/ha	17 kg P/ha
# discharge events	Up to 7	Up to 20	Up to 25	Up to 7

9. The proposed discharge of treated wastewater to the Oroua River is intended to operate so as to exclude summer discharges (except in floods), and only when river flows exceed specified levels. Discharges will also only occur to the extent that One Plan's water quality target concentrations are not exceeded. The proposed discharge criteria for the river is detailed below.

Discharge criteria	**Date Range**	
Flow: Oroua River@Kawa Wool	**1 December – 31 March (Summer)**	**1 April – 30 November (Winter)**
Below median flow (0 – 7,590 L/s)	No discharge	No discharge
Median flow to 20th flow exceedance percentile (7,590 – 16,193 L/s)	No discharge	Discharge at rate based on DRP load to the river up to a maximum of 3,000 m^3/day.
Above 20th flow exceedance percentile (>16,193 L/s)	No discharge*	Up to 3,000 m^3/day.
* Emergency contingency above 3 x median (>20,913 L/s)	If land application is not possible and pond is 100 % full then up to 2,000 m^3/day.	NA

10. The proposed combined bed level control and discharge structure is for the purpose of providing a stable fish passage connection between the Otoku Stream and the Oroua River, and incorporating into it a rock filter discharge structure for the wastewater discharges before they enter the river. This structure was informed by consultation with Ngati Kauwhata and was considered to go some way to addressing concerns of the mauri and wellbeing of the Oroua River. Further design enhancements may be possible should iwi be interested.

11. The wastewater treatment plant is typical of industrial wastewaters, with a combination of anaerobic and aerobic processes used. The pond system produces consistent quality effluent and the large treatment volume assists in minimises seasonally (and daily) variability of the wastewater quality.

QUALIFICATIONS AND EXPERIENCE

12. I have the following qualifications and experience relevant to the evidence I shall give:

    (a) Bachelor of Agricultural Science (Honours); and

    (b) Master of Agricultural Science (Honours in Agricultural Engineering).

13. I am a member of a number of relevant associations including:

    (a) Water New Zealand;

    (b) New Zealand Land Treatment Collective;

    (c) Soil Science Society of New Zealand;

    (d) New Zealand Institute of Agricultural and Horticultural Sciences (NZIAHS); and

    (e) Environmental Institute of Australia and New Zealand (EIANZ).

14. I am an elected council member serving my second term on the Soil Science Society of New Zealand. I have served on the Biowaste Material National Research Programme advisory board for more than 6 years. I am a past Chairman of the New Zealand Land Treatment Collective technical committee, an elected position I held for four years, and served on the technical committee for 10 years. Following this long-standing relationship with the New Zealand Land Treatment Collective, I now support the Collective by providing management services in conjunction with ESR.

15. I am a Certified Environmental Practitioner, in accordance with the EIANZ accreditation programme. I am a certified Practicing Agriculturalist, in accordance with the NZIAHS accreditation programme. I am a Certified Nutrient Management Advisor in accordance with the CNMA programme. I am also a certified Hearing Commissioner (chair endorse) in accordance with the Ministry for the Environment's Making Good Decisions programme.

16. At a national level, I have been actively involved in participating in and facilitation of various industry debates about the appropriateness and management of community wastewater systems and the appropriateness of their application in a range of environments. This includes providing community wastewater guidance to Regional and District Councils throughout the country and the Ministry for the Environment. I have contributed to a number of waste management guidelines and am a contributing author to IPENZ Practice note 21 (PN21): Farm Dairy Effluent Pond Design and Construction.

17. I have helped to design and deliver a nationally accredited (NZQA) Onsite wastewater qualification and assist Massey University with delivering Farm Dairy Effluent training. I am a design accreditation panel member for both the DairyNZ Farm Dairy Effluent System Design Accreditation Programme and Irrigation Design Accreditation programme.

18. I have been involved in the investigation, design, consent preparation, consent review and consent decision making of in excess of 70 small community wastewater projects in the lower North Island alone.[1] I have also worked extensively around the country on other community and industrial wastewater[2] projects.

19. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

BACKGROUND AND ROLE

20. In preparing my evidence I have:

    (a) applied my knowledge of the layout, history and operation of the AFFCO Manawatu plant at Feilding, reflecting the provision of consenting assistance for a period of seven years;

    (b) was the principal designer of the revised discharge regime, for which consents are sought; and

    (c) considered, and in many cases authored or peer reviewed, the various professional reports that have been prepared for AFFCO in anticipation of this hearing.

SCOPE OF EVIDENCE

21. My evidence addresses the following matters:

    (a) activities for which consent is sought;

    (b) description of the AFFCO wastewater management system;

    (c) discharge regime and its timing;

    (d) wastewater storage;

    (e) land discharge;

    (f) river discharge;

    (g) structure in stream bed;

    (h) pond seepage;

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1 Some of these include: Ashhurst, Bulls, Carterton, Cheltenam Greytown, Dannevirke, Featherston, Foxton Beach, Halcombe, Himatangi Beach, Levin, Mahia Beach, Masterton, Martinborough, National Park, Piopio,Ohakune, Opunake, Otaki, Riversdale Beach, Sanson, Shannon, Taihape, Taumaranui, Tapapau, Te Kuiti, Waiouru, Wanganui, Woodville, Waipawa, Waipukurau, Waipatiki, Wairoa, Waitarere Beach,

2 Some of these include: SFF (Oringi, Takapau,), Fonterra (Hatapu, Lichfield, Edgecomb, Kapuni, Longburn, Paihatua, Takaka, Darfield, Studholme), AFFCO (Awarua, Manawatu, Imlay), Carter Holt Harvey (Ashley, ?), Pan Pac (Whirinaki).

(i) solids management;

(j) alternative options;

(k) pre-Hearing meeting;

(l) iwi issues; and

(m) s42A reports.

22. This evidence should be read in conjunction with evidence prepared by **Mrs Ann Nuku, Mr Peter Hill, Dr Olivier Ausseil** and **Mr Hywel Edwards**.

ACTIVITES FOR WHICH CONSENT IS SOUGHT

23. AFFCO Manawatu needs the grant of resource consents to authorise the following activities:

(a) Discharge to groundwater of wastewater by seepage from the AFFCO wastewater treatment ponds;

(b) Discharge of treated wastewater to land by way of an irrigation system;

(c) Discharge of contaminants to the air, arising from the sprinkler irrigation of wastewater onto land;

(d) Discharge of treated wastewater to the surface waters of the Oroua River; and

(e) Construction of a combined discharge facility and stream bed level control structure, in the bed of the Otoku Stream immediately upstream from its confluence with the Oroua River.

DESCRIPTION OF THE AFFCO WASTEWATER MANAGEMENT SYSTEM

24. AFFCO Manawatu processes over 100,000 head of cattle per year and currently uses water at the rate of about 1.5 m^3 per head for various cleaning purposes before and after slaughter. The number of stock processed varies with the season; being influenced by market and feed supply, with some years being potentially less than 100,000 and some years greater.

25. Wastewater production is linked to processing rates, with more stock generating a greater volume of wastewater. However, this rate is not proportional, with less water used per head with increasing stock being processed. Further, product recovery and processing efficiencies are typically the margins that keep the processing plants viable, which means that attempts are made by companies to continually strive to use less water for the same process. While AFFCO Manwatu currently use 1.5 m^3 of clean water per head processed, other plants use 2.5 m^3 per head. This improvement has been continually refined, so much so that when the discharge consent documents were prepared the wastewater generation rate was based on 2.5 m^3 per head. Further changes are being considered,

which may not only see further water use reduction, but also a reduction in the mass of contaminants/nutrients requiring treatment.

26. Some of the recent changes impacting on wastewater volume and contaminant load are discussed in the evidence of Mrs Nuku. While there may be a reduction in wastewater generated and contaminant load per head processed, maintaining a design maximum volume and contaminant load, and actually allowing for an increase of 20 % in this case, provides for operational flexibility that may see production increase significantly over time while maintaining the same volume and contaminant load discharged.

27. The first stage of wastewater management system is the collection from the various parts of the plant. The wash-down of yard surfaces and the initial part of the slaughter process sees water directed to a Solids Pond. The function of the Solids Pond is to allow solid material either to float to the surface, or to sink to the bottom as sludge.

28. The wastewater separated from solids in the Solids Pond is then combined with slaughter floor and general plant wash water and pumped to an Anaerobic Treatment Pond. In this pond organic material is broken down in the absence of oxygen.

29. From the Anaerobic Treatment Pond, wastewater flows under gravity to an Aerobic Treatment Pond, where a combination of mechanical aeration and exposure to air and sunlight further process the wastewater.

30. From the Aerobic Treatment Pond, the treated wastewater can be managed in one of three ways:

    (a) Pumped to an irrigation system, for application to land;

    (b) Directed by gravity to one of two storage ponds; or

    (c) Pumped to a river discharge.

31. Should the wastewater flow to the storage ponds it can then be pumped and directed to either the land application area or the river discharge.

Sources of Wastewater Through the Plant

32. The first source of wastewater is from the stockyards, where cattle awaiting slaughter defecate and are washed down by an overhead sprinkler system.

33. Within the processing plant, there is a separation of carcase components. Those components having a value are separated and blood is kept out of the wastewater. Paunch material, being partially digested feed, is washed to the Solids Pond.

34. Potentially troublesome material such as brain and spinal cord material is handled separately, so that none of it enters the wastewater stream. This is an important step in blocking any vector pathway for BSE-type diseases, in the unlikely event that they may be present in the livestock being processed.

35. Throughout the slaughter process the carcases (and components) are washed to remove any contamination such as hair, digestive juices, gut contents, and other solid and fluid material. Clean carcases are further processed, with cuts of meat boned out and packed for chilling or freezing. Much less wastewater is generated at this stage than on the Slaughter Floor.

36. There is no inclusion of human wastes in the AFFCO wastewater stream. Human wastes are separately managed, with discharge to a dedicated land treatment system located entirely within the AFFCO property and adjacent to the treatment ponds.

Wastewater Treatment

37. The wastewater treatment process at AFFCO involves Solids removal, anaerobic digestion, aerobic treatment, and discharge.

38. A summary of the treatment process and it operational efficiency is being prepared by Dr Albert van Oostrum[3].

39. Dr van Oostrum's report is expected to show the historical performance of the treatment plant has enabled consistent results in effluent quality. Even with recent modifications, both within the plant and around the ponds, effluent quality has been consistent. There is a high degree of certainty with the performance of the system, with both flow and contaminant load spikes being assimilated/buffered within the treatment process. This ensures consistent effluent quality and provides reassurance with the ability to maintain a sampling interval consistent with seasonal trends and not daily production spikes.

40. Based on the proposed operation of the plant, AFFCO does not intend to make any material modifications to the current treatment process, and as a result, the quality of the wastewater generated is expected to be consistent with the long-term results to date.

41. Recent years saw a slight increasing trend in suspended solids in the discharged wastewater. To manage this both the anaerobic and aerobic ponds were desludged in the 2015/2016 summer.

PROPOSED ACTIVITY

The Discharge Regime and its Timing

42. As stated above wastewater that has been treated through to the Aerobic Pond stage has three management options; it can be:

    (a) discharged to land, or

    (b) discharged to surface water, or

    (c) stored for discharge at a later time.

[3] A treatment summary report was to be attached to this evidence, but personal circumstances have meant the report could not be finished at the time this report was to be submitted. It is intended that it will be available prior to the hearing.

43. The land discharge involves the use of irrigation infrastructure to apply wastewater at a measured rate onto farm land on both the AFFCO property and neighbouring properties.

44. Irrigation of wastewater can take place when the receiving soil is dry enough to retain the applied wastewater without ponding, run-off, or direct through-flow (bypass flow). This is normally during dry weather in summer and at a time when the Oroua River is experiencing lower flow conditions.

45. The extent of suitable and available land is sufficient to take all the wastewater generated during the summer months. In fact, in summer there will not be enough wastewater to provide full irrigation to all the land set up to be irrigated. However, during the wetter winter months, irrigation of wastewater will not be undertaken, as it would create limitations on farm management, and over a large extent of the irrigation area has the potential to increase ponding, run-off, and bypass flow to groundwater. Storage is to be used to allow wastewater during these periods to be held until such time that either irrigation or river discharge is possible. However, there are limitations to the ability to provide large enough storage to hold all wastewater for irrigation. This issue is discussed in further detail later in my evidence.

46. A discharge of treated wastewater to the surface waters of the Oroua River has been used historically, and is proposed to continue. The discharge regime is discussed later in my evidence but a significant change is proposed and is demonstrated below in Table 1. Of note is the shifting of the discharged volume and contaminant load from conditions below the 20th Flow Exceedance Percentile (20FEP) to above the 20FEP. The impacts of this changing regime are detailed in the evidence of **Dr Ausseil**.

Table 1: Comparison of ANZ Discharge Volumes and Mass Loading - Current and Proposed River Discharge (reproduced from Table 5.6 of the AEE).

		Current	**Proposed**
Discharge volume (m^3/year) for average year	**Discharge Between MF and 20FEP**		
	Average	77,576	17,603
	Minimum	30,835	9,279
	Maximum	106,954	24,135
	Median	82,346	17,748
	Discharge over 20FEP		
	Average	38,624	108,862
	Minimum	16,789	70,248
	Maximum	77,204	150,056
	Median	35,213	107,355
Mass loading N (tonnes/year) for average year	**Discharge Between MF and 20FEP**		
	Average	9.54	2.17
	Minimum	3.79	1.14
	Maximum	13.16	2.97
	Median	10.13	2.18
	Discharge over 20FEP		
	Average	4.75	13.39
	Minimum	2.07	8.64
	Maximum	9.50	18.46
	Median	4.33	13.20
Mass loading P (tonnes/year) for average year	**Discharge Between MF and 20FEP**		
	Average	1.47	0.33
	Minimum	0.59	0.18

	Maximum	2.03	0.46
	Median	1.56	0.34
	Discharge over 20FEP		
	Average	0.73	2.07
	Minimum	0.32	1.33
	Maximum	1.47	2.85
	Median	0.67	2.04

47. Currently the surface water component of the discharge occurs by way of a pipe discharging into the Otuku Stream which then enters the Oroua River. This is proposed to change, whereby an overland flow system over the true left bank will be used.

48. The proposed discharge regime differs from the current regime in in the following key ways:

(a) Land discharge area has been increased from 96 ha to 133 ha;

(b) An annual average wastewater volume increase from 256,000 m3 to 307,000 m3 has been provided for;

(c) On average, 179,000 m3 of wastewater is to be discharged to land per year;

(d) The average actual days per year of river discharge are reduced from 166 (currently) to 127;

(e) The volume of MWE discharged below the 20th flow exceedance percentile reduces from 76,000 m3/year currently, to 18,000 m3/year (a 76 % reduction);

(f) The discharge during high river flows (>20FEP) increases from 39,000 m^3/year currently to 109,000 m^3/year (a 280 % increase);

(g) Existing river discharge is allowed down to half median flow (3,000 L/s), while the new river discharge will not occur below median river flows (7,590 L/s);

(h) The existing river discharge is allowed without Phosphorus content limitation, while the new discharge will be Phosphorus limited at river flows below 20 FEP; and

(i) The effects of the proposed discharge on in-stream dissolved nutrient concentrations (DRP and SIN) are predicted to be 87% less than under the current scenario despite an allowed 20 % increase in wastewater flows.

Wastewater Storage

49. The AFFCO wastewater treatment plant has a storage capacity of 64,500 m^3, which represents 92 days' production at an annual kill rate of 100,000, or 76 days' production at a kill rate of 120,000. Bearing in mind these rates were calculated at a water use of 2.5 m^3 head processed, and the current water use of 1.5 m^3 per head increases the number of days storage.

50. The storage facility is to be used to enable the plant to continue to operate at times when neither a land discharge nor a river discharge of wastewater are able to be undertaken.

51. It should be noted that during the winter period the kill is often less and as a result the daily volume of wastewater generated is less, reducing the need for any surface water discharge and allowing more water to be carried over to the summer irrigation period.

Land Discharge

52. The area of suitable and available land for irrigation of wastewater is 133 ha, as explained in Section 5.5.1 of the lodged AEE. This area is an increase over the current area of 96 ha. The area is made up of 119.6 ha of neighbouring property (Bryeburn), 4.2 ha of a second neighbouring property and 9.2 ha of AFFCO owned land.

53. The land discharge system that is proposed is described in detail in Section 5.5 of the lodged AEE, and in Appendix E to that document. The land discharge is part of an integrated Combined Land and Water Discharge ("CLAWD") system, that utilises the combined capacities of both the land and surface water receiving environments to minimise the potential adverse effects of each.

54. The irrigatable area has been divided into Land Management Units (LMUs). Each LMU has slightly different characteristics and resulting loading rates. These are summarised below in Table 2.

Table 2: LMU Summary

	LMU 1	LMU 2	LMU 3	LMU 4
Description	Byreburn existing (rotorainer)	Byreburn existing	Byreburn new	ANZ and Dalcam
Ownership	Byreburn Limited	Byreburn Limited	Byreburn Limited	ANZ (9.2 ha) Dalcam Company Limited (4.2 ha)
Area (ha)	56	40	33	13.4
Dominant soil	Kairanga silt loam	Rangitikei sandy loam	Kairanga silt loam	Rangitikei sandy loam
Limiting parameter	P load (60 kg P/ha/year)	Instantaneous hydraulic / P load	Instantaneous hydraulic load	N load (100 kg N/ha/year)
Average application depth (mm/year)	152	152	152	59
Average N Load (/year)	203 kg N/ha	203 kg N/ha	202 kg N/ha	76 kg N/ha
Average P Load (/year)	34 kg P/ha	34 kg P/ha	33 kg P/ha	13 kg P/ha
Max volume (m^3/year)	114,000	109,000	98,700	10,075
Max application depth (mm/year)	250	250	300	75
Max N Load (/year)	360 kg N/ha	360 kg N/ha	400 kg N/ha	100 kg N/ha
Max P Load (/year)	60 kg P/ha	60 kg P/ha	66 kg P/ha	17 kg P/ha
# discharge events	Up to 7	Up to 20	Up to 25	Up to 7

55. As mentioned above, the target of the land discharge system is to apply water under conditions that avoid runoff, ponding and bypass flow. On the soils available the intention is to operate a deficit irrigation approach, whereby the amount of water applied is determined by the water demand of the plants growing. More water could be applied (under non-deficit conditions) but the soils are of such a type that there would be an increased risk of bypass flow and run-off.

56. With all wastewater applications, it is important to identify the limiting factor, being the design element that will determine, and ultimately limit, how much can be applied. This is typically either a hydraulic or a nutrient limitation. A hydraulic limitation would be that at an increased rate of application there would be the risk of runoff or bypass flow. A nutrient limitation would be such that with additional applications there would be a greater risk of nutrients being leached from the site to the receiving environment.

57. For the proposed operation there are two limitations. Firstly, the soils on the farm(s) can get wet due to inherent drainage limitations. Secondly, the concentration of nutrients (particularly nitrogen and phosphorus) are such that applications over a critical rate/mass will exceed the soil's and plants' ability for them to be utilised and they will then be more susceptible to leaching.

58. Due to the need to apply wastewater throughout as much of the year as possible (in order to minimise the volume going to the river), care is needed to ensure that satisfying irrigation demand in summer does not result in an over-application of nutrients. Therefore, the irrigation applications need to be spread water over the nominated irrigation period as far as practicable. This may result in some years in a less than optimal (for pasture production) hydraulic application rate, to ensure that maximum nutrient application rates are not exceeded. This potential dilemma of wanting to apply more irrigation water in the summer, but not applying it to avoid nutrient limits being exceeded, is partially assisted by the fact that the production at the plant does not generate sufficient water to meet the typical irrigation demand of the extended land application area available.

59. The annual nitrogen loading proposed is 76 to 203, with a maximum of 360 kg N/ha/y. The annual phosphorus loading proposed is 13 to 34, with a maximum of 66 kg P/ha/y. The corresponding average annual hydraulic loading proposed is 59 to 152 mm/y.

60. There are a number of land use implications that need to be considered, which particularly revolve around the application of wastewater. There is a need to have a period of no grazing following application. There is also a preference to spread applications over several days, and not apply water say only once per month. Therefore, grazing management and irrigation need to be coordinated.

61. There is also the need to manage the discharges of odours and aerosols to the air arising from the land discharge system. The volume of water and pumping system currently used, and proposed, allows for the daily discharge to be applied in several hours per day (typically less than 10 hours). This means the time of the day can be targeted whereby the wind conditions are more favourable. Further, with the use of storage, irrigation on

any one day can be held over and irrigated the next day when conditions may be more favourable.

Assessment of Effects

62. The discharge of wastewater to land has been occurring for more than 30 years. In this time regular monitoring has not identified any adverse environmental effects, including on soil chemistry, soil infiltration rates and groundwater quality. Despite not having any adverse effects, these consent applications are to **increase** the land area and **reduce** the annual nutrient loading rate. A greater land area is to firstly allow, should conditions permit, a lesser volume to be discharge to the river. It secondly to provide operational flexibility to allow some areas to be rested or withdrawn from irrigation for a season for a range of management reasons.

63. It has been noted from historical monitoring by AFFCO that soil phosphorus levels in some paddocks are increasing. While not critically high enough that may induce significant drainage to groundwater, it is considered that a lower application rate will lessen the accumulation of phosphorus in the soils; thereby decreasing the risk of phosphorus leaching. While not critical and needing a condition to be imposed, on the area that has historically been used (IMU1) the use of forage crops is suggested to where possible reduce soil phosphorus levels.

64. It should be noted that the land application system is more than just the irrigation system; as it also includes the spreading of solids. Solids and wastewater will be applied to different areas in any one year.

65. The nutrient loading rates for both the solids (less than 50 to an average of 202 kg N/ha/yr) and wastewater are consistent with fertiliser application rates typically applied to pastoral land, being less than 150 to 300 kg N/ha/yr depending on the crop and land use. There are a series of mitigation steps to ensure overloading does not occur, including the use of a cut and carry system. These mitigation steps are reflected in consent conditions.

66. The application depth of the solids and the wastewater are such that excessive drainage and or surface run off will not occur.

67. The nutrient and hydraulic loading of the proposed application system will have a no more than minor impact on the receiving environment.

68. With regards to an impact on air quality, the various discharges to air from the operation of the AFFCO Manawatu are authorised by consents 105567 and 105664, which are not scheduled to expire until 2029.

69. The discharge of wastewater to land by spray irrigation and the application of solids may be expected to have effects parallel with those of farm dairy effluent application, which is already authorised on part of Byreburn Farm by consent (106705).

70. Potential effects arising from spray irrigation will be managed by the observance of buffer margins between irrigated areas and public roads or private properties. It is also proposed

to develop irrigation operation protocols to factor wind speed and direction into operational decision-making, with a view to avoiding as far as practicable irrigation at times and/or in places that may carry a greater risk of odour propagation into potential receptor environments. These measures are expected to ensure that any such effects will be no more than minor.

River Discharge

71. The river discharge system has evolved over many years, with this consent application principally proposing a river discharge that is confined to higher river flows, or more specifically that avoids lower river flows. A key aspect of the reconfigured river discharge criteria has been meeting or working towards Horizons' One Plan water quality targets (and satisfying the objectives), which is the key to One Plan allowing for wastewater to be discharged to surface water.

72. A summary of the new discharge regime is provided below in Table 3, with the volume and mass discharged under the current and proposed systems presented at paragraph 49.

Table 3: Proposed Criteria for ANZ River Discharge

Discharge criteria	**Date Range**	
Flow: Oroua River@Kawa Wool	**1 December – 31 March (Summer)**	**1 April – 30 November (Winter)**
Below median flow (0 – 7,590 L/s)	No discharge	No discharge
Median flow to 20th flow exceedance percentile (7,590 – 16,193 L/s)	No discharge	Discharge at rate based on DRP load to the river up to a maximum of 3,000 m^3/day.
Above 20th flow exceedance percentile (>16,193 L/s)	No discharge*	Up to 3,000 m^3/day.
* Emergency contingency above 3 x median (>20,913 L/s)	If land application is not possible and pond is 100 % full then up to 2,000 m^3/day.	NA

73. A detailed account of the impact of the discharge on the Oroua River is provided in the evidence of **Dr Ausseil**. From an operational perspective, I provide the following summary.

74. The Oroua River is recorded in Horizons' One Plan as being phosphorus limited; that is, Phosphorus is the nutrient that has been shown to be the key determinant in enabling the development of periphyton, coating the river bed cobbles in slimy growth. The river discharge has been designed to operate only when, and to the extent that, the Phosphorus content in the discharge will not cause Phosphorus content in the receiving waters to exceed One Plan's specified target concentration.

75. The system for the discharge of treated wastewater to the Oroua River that is proposed involves limiting the timing and rate of the discharge to ensure that the water quality targets for the Oroua River set in One Plan are not exceeded, and if they are, there is a clear improvement over and above the current regime to satisfy surface water discharge

objectives of lessening any water quality impact and working towards the target. The proposed river discharge regime is described in Section 5.7 of the lodged AEE, and the effects of the discharge regime are described in Section 8.6 and in Appendix G to that document.

76. In summary, during summer (1 December to 31 April) there will be no discharge to the Oroua River unless river flow exceeds 20 m^3/s, and unless the WWTP storage capacity is 100 % full. During winter, there will only be a discharge to the Oroua River if its flow exceeds the 20th FEP, or and to the extent that the concentration of Phosphorus in river water after mixing of the AFFCO discharge is close to the One Plan water quality target levels.

77. When the Oroua River is flowing at and above 20^{th} FEP levels, the river also receives a large volume of stormwater, including from Feilding. It is visibly dirty and not in a condition suitable for contact recreation. At times when the river is low (below median flow) and clean there will be no treated wastewater discharge to the river from AFFCO.

Structure in Stream Bed

78. It is proposed to construct a combined bed level control and discharge structure in the bed of the Otoku Stream immediately above its confluence with the Oroua River, as described in Section 5.9 of the lodged AEE, and in Appendix K to that document.

79. The proposed structure is to meet two purposes. First, it is to provide a bed level control to enable continuous fish passage between the Oroua River and the Otoku Stream while stabilising the steep lowest reach of the stream. Second, it is to provide a new rock filter outlet for the discharge of treated wastewater to the Oroua River.

80. Further details of the structure are provided by **Mr Hill**.

81. The discharge structure has been designed to be incorporated into the bank of the Oroua River in such a way that it will not be noticeable from the opposite bank. It was also intended to provide an opportunity to allow wastewater to have a degree of land passage prior to reaching the river in partial fulfilment of the preference of Iwi for land passage of wastewater prior to reaching surface water. While there have been some discussions with tangata whenua about the land passage aspects of the discharge, I appreciate it may not be viewed as an optimised land passage system in the way that a land treatment system is operated.

Pond Seepage

82. The wastewater treatment ponds occupy an overall footprint of about 6 ha. The pond system has been in place for more than 40 years, and in that time the accumulation of sludge is expected to have largely blocked the pore spaces in the clay substrate, through which some seepage is presumed to occur..

83. The pond seepage is described in detail in Section 5.6 of the lodged AEE, with Section 8.5 of that document describing the effects of the seepage.

84. The rate at which wastewater seeps from the pond system has had to be estimated from calculations, because it is too low to be measured directly and reliably. In this regard the limiting seepage rate adopted by Horizons and several other regional councils of 1×10^{-9} m/s equates to a drop in pond level of 0.6 mm per week. This is too small a difference to be measured by a drop test, and is heavily disguised by ongoing inputs of wastewater and rainfall, and by ongoing outputs of evaporation and discharge.

85. At this point it is worth noting that a 1×10^{-9} m/s rate is a requirement for permitted activities, whereby no monitoring and no assessment of the impact on the receiving environment is usually required. In this case a consent is being sought and an assessment of the effects has been carried out, including considerable investigations.

86. There is the likelihood of a seepage loss rate somewhere between 1×10^{-9} m/s and the threshold of detectability, expected to be up to 50 m^3/d, or 1×10^{-8} m/s, as described in detail in Section 5.6.2 of the lodged AEE.

87. In summary, we know the daily pond inflow is in the order of 800 m^3/d. While there is buffering due to storage, we also know outflows are of a similar magnitude. A practically measurable rate of leakage from the ponds would be a permeability rate of 1×10^{-7} m/s. This would equate to a daily loss of 8.64 mm/d or 518.4 m^3/d over the 6 ha ponds. Such a rate of loss from the ponds would equate to about 75 % of inflow and is unrealistically too high. At the other end of the spectrum a leakage rate of 1×10^{-9} m/s would be a daily loss of 0.0864 mm/d, or about 5.2 m^3/d.

88. Claiming a loss as minimal as 1×10^{-9} m/s is unrealistic. Stating a loss of 1×10^{-7} m/s is also unrealistic and contrary to the known discharge rates. Consequently, leakage in the order of 1×10^{-8} m/s is realistic, meaning that losses in the order of 50 m^3/d are feasible on a worst case basis.

89. In my view being very precise with the leakage rate is somewhat meaningless, especially if we consider the extent of the likely rate, in that we are not dealing with hundreds of cubic metres, nor are we dealing with parts of a litre.

90. There has been considerable groundwater quality monitoring in the vicinity of the ponds and further afield, the results of which are tabulated and described in Section 8.5.2 of the AEE. While there are elevations in some parameter concentrations in the vicinity of the ponds, these are not shown to propagate beyond the AFFCO property boundary, where they could potentially affect other uses of shallow groundwater. There are other bore sites in the neighbourhood demonstrating higher parameter concentrations than those adjacent to the ponds, so pond seepage cannot be regarded as the only source of such contamination.

91. It should be noted that past usage of the site has seen a burial of various materials. Care is needed when interpreting results from groundwater monitoring to ensure that observations of groundwater quality are linked to the relevant activity. Equally, it is clear that neighbouring activities are also influencing groundwater quality.

92. The direction of groundwater movement in the AFFCO locality has been assessed from measurements of the depth to the groundwater surface, and it has been demonstrated in Section 5.6.3 of the lodged AEE that there is not a direct path for contaminated wastewater seeping from the ponds to the surface waters of the Oroua River.

93. There may be a temptation to require the installation of an impermeable synthetic liner in the ponds to ensure that there is effectively no such seepage. Given the general poor water quality of the neighbouring area, and the limited effect of the pond seepage to groundwater being confined to the AFFCO site, installation may not necessarily lead to any change in the overall quality of shallow groundwater in the AFFCO vicinity. Considering the following factors:

(a) groundwater would appear to run parallel to Oroua River (such that there is no direct linkage),

(b) the discharge volume is relatively small (potentially 50 m3/day),

(c) there would be attenuation of contaminants in the groundwater system, and

(d) the general low water quality in the area

(e) the seepage is not expected to have any significant direct effect on the River.

94. Installation of pond liners could assist with mitigating leakage effects. They would cost approximately $1 to 2.5 million to be installed into the existing pond system, plus a lining process would disrupt the plant’s operation.

95. Accordingly, it is proposed that the existing rate of seepage from the ponds be authorised by the consent sought here, subject to a requirement to continue to monitor local shallow groundwater quality. If the additional monitoring can demonstrate there is a measurable impact on the river as a result of pond leakage, and that effect is considered significant with respect to meeting One Plan water quality targets, then it would be appropriate for AFFCO to reconsider the need to line the ponds.

96. Such monitoring would ideally follow a logical approach of firstly establishing an impact on groundwater away from the ponds, determination of the extent of the seepage from the ponds that actually enters the River and then establishing the resulting impact on the Oroua River.

Assessment of effects

97. While the ponds are lined using a clay lining, it is unclear exactly the extent of leakage. Despite this uncertainty, the approach taken by AFFCO has been to consider the impact on the environment and neighbouring property owners to ensure the environment is not being adversely impacted and there is no mass contaminant plume.

98. It is clear that down gradient monitoring in the direction of neighbouring properties does not show a contaminant plume, let alone one attributed to AFFCO. This is despite the plant being operational for some 100 years and the ponds being operational for 40 years.

99. It is also clear that there are multiple sources of potential contamination on and around the site, and the lining of the ponds will not impact on that contamination.

100. It is clear there is no adverse impact, let alone detectable impact, on down gradient groundwater users, and as a result it could be considered the impact is nil.

101. It is possible there may be some contribution to the nutrient load from pond seepage into the river, but the exact contribution is presently unknown. Further monitoring is proposed to identify any impact on groundwater from this seepage (if any) and to consider this impact (if any), along with developing a strategy to act if contamination is having a more than minor adverse impact on the Oroua River. Regardless of this potential impact on the river, the effects are not considered to be significant, as if that was the case it would be reasonable to expect significant contamination to have been detected in the existing monitoring bores, irrespective on confirmation in groundwater flow direction.

102. A requirement to line the ponds is in my view not warranted. Monitoring to date has shown no mass leakage that has resulted in contamination of the groundwater system that warrants remedial action. Further, of the contamination observed, it is possible to have been caused by a number of activities unrelated to the ponds. Therefore, while the ponds could be lined, at great expense to AFFCO, it may not result in any change in environmental outcomes.

103. Based on further monitoring, as proposed, any decision on lining ponds should be reviewed on a periodic basis.

Solids Management

104. The wastewater that is to be discharged to land and to the Oroua River is a result of a treatment process that has removed solids. The removal of solids from the wastewater stream has been described above, largely involving separation in the Solids Pond stage of the WWTP.

105. The Solids Pond sees the settling and natural filtration of yard and paunch material. This combined settled material is then removed from Solids Pond two or three times a year, by hydraulic excavator. The material is placed in the Paunch Pit, where it is allowed to dry out and mature as a form of compost. From this point it can be discharged, ideally spread on land.

106. In addition to the material removed from the Solids Pond, material settles in both the Anaerobic and Aerobic Ponds. This sludge material is also periodically removed and added to the Paunch Pit solids.

DISCHARGE ALTERNATIVES AVAILABLE TO AFFCO

107. Based on a projected water use of 2.5 m^3 per head, AFFCO Manawatu generates between 250,000 and 310,000 cubic metres of wastewater per year. This wastewater has to go somewhere, of which options are discussed below.

Alternative Treatment Plant Options

108. An issue raised by submitters has been whether or not alternatives to the proposed discharge to the Oroua River have been considered. Submitters have expressed concern that the proposed discharge may lead to an increase in pollution of the Oroua and Manawatu Rivers, and that insufficient attention has been paid to wastewater treatment options that could contribute to an improvement in river water quality.

109. To address this matter AFFCO had earlier (2012/13) engaged Cardno (engineering consultancy) to investigate and report on "issues and options for upgrading the AFFCO Manawatu Wastewater Treatment Plant to meet future consent conditions". Cardno considered that the two main options were either to pipe wastewater to the Feilding municipal wastewater facility, or to upgrade the AFFCO treatment facility in order that any discharge to the Oroua River under varying river flow conditions would meet the requirements of One Plan or achieve a significant reduction of contaminants to work towards achieving the target.

110. Cardno advised that connecting into the Feilding municipal wastewater system would cost $670,000 in up front capital, plus a recurring annual charge of $1.1M/year. The costs spread over a 10-year period would range between $8.3 M and $10.1 M, depending on how much pre-treatment was required by AFFCO before the wastewater got to the municipal plant.

111. Risks to AFFCO of going with the Feilding municipal system were found by Cardno to include:

(a) Issues of the Feilding plant's capacity;

(b) The effect of new consent limits on the Feilding discharge which were being considered at that time;

(c) Potential for escalation of annual Trade Waste fees beyond the then current $1.1M per year; and

(d) The difficulty of consenting a re-start of the AFFCO treatment plant discharge to the Oroua River if the Feilding municipal option proved, sooner or later, to be unworkable or uneconomic.

112. Cardno took the view that any discharge from AFFCO to the Oroua River would need a treatment plant upgrade in order to meet the water quality targets of One Plan. If wastewater was going to continue to be discharged to the river at flows above half median flow (i.e. the river flowing at more than 4.2 m^3/s) then the concentrations of phosphorus and nitrogen in particular were going to have to be reduced by additional treatment before discharge. Cardno expressed no significant concerns about the land discharge component of the existing system.

113. Five additional treatment options were considered, as tabulated below.

Option	Name	Capital Cost ($M)	Treatment Level
1	Anaerobic lagoon with in-ground sequencing batch reactor	3.3	Good
2	High rate pond system with clarifier	5.8	Average
3	Fixed film media biological nitrogen removal process	6.0	Good
4	MLE biological nitrogen removal process	6.6	V good
5	Membrane bioreactor nitrogen removal process	7.7	Excellent

114. Option 1, the anaerobic lagoon with in ground sequencing batch reactor, was recommended by Cardno as best for AFFCO because it was the least expensive ($3.3M) and Cardno considered that it had the capacity to meet One Plan water quality targets.

115. However, the proposal which is the subject of this consent application also meets, or works towards. One Plan requirements, not by the addition of expensive extra treatment, but by limiting the river discharge to only occur when the river flow exceeds median flow (7.59 m^3/s). It also only allows a discharge to the extent that it will not compromise the One Plan target for phosphorus, as could also be achieved by additional treatment. The current proposal provides for most discharges to occur predominantly at greater than the 20^{th} flow exceedance percentile, with no discharges when the river is at less than the median flow. This arrangement is to replace the currently authorised discharge, which is down to a limit of half the median flow.

Off-Site Options

116. AFFCO potentially has the options of sending its wastewater stream, with or without prior treatment, to a municipal wastewater treatment plant. Feilding and Palmerston North both have such plants, potentially close enough to AFFCO for the considerable costs of piping and the handling of the large extra volume of wastewater to be commercially viable.

117. Feilding municipal WWTP, operated on behalf of its community by Manawatu District Council, is the likelier of these two town options, by virtue of being just along the road. Earlier overtures to MDC to canvass the possibility were respectfully declined; MDC had its hands full with its existing wastewater supply without wanting to take responsibility for another 7 or 8 hundred cubic metres per day as well.

118. Time and people have moved on; Feilding municipal WWTP could again be considered a viable wastewater discharge option for AFFCO. However, as stated above the cost of reticulation to Feilding, trade waste charges, the issues raised during the Environment Court process and the short-term consent granted is such that it does not represent a viable option for all the flows at this stage.

119. Further down the track, Palmerston North City may reasonably be expected to give serious consideration to piping its own municipal wastewater down to the west coast, either for irrigation into sand country, or to an ocean outfall, either of which would be a significant environmental improvement on the present discharge into the Manawatu River. If and when that major public infrastructure development proceeds, there may well be efficiencies in having both Feilding and AFFCO wastewater included in the design.

120. But meanwhile, AFFCO has a business to run, and needs the certainty that its own discharge system can provide.

Land Discharge Options

121. Wastewater can be, and in many instances is, discharged to land. This has the immediately effect of avoiding an equivalent discharge direct to surface water. However, irrigation of wastewater onto land cannot be undertaken all the time, but only when the weather and the wetness of the soil are such that adverse effects onsite and offsite can be avoided.

122. A land discharge of wastewater can be regarded as either a discharge to waste, without consideration of any beneficial effects and treatment within the soil (land disposal), or as a discharge that is deliberately managed to as to deliver beneficial results to all concerned, including further treatment of the wastewater as it passes through the soil (land treatment). One of several advantages of the later approach is that it can be designed and managed to ensure that adverse wastewater effects are effectively neutralised by its passage through the soil.

123. Options for land discharge involve consideration of the moisture holding capacity of the soil, and the extent to which wastewater can be applied without causing surface ponding or run-off. They also involve consideration of the nutrient status of the soil, and the extent to which the soil may potentially become overloaded with nutrients, such as Phosphorus, over time.

124. Options also involve consideration of complementary land uses, avoiding potential conflicts between the perceived “Ugh” factor associated with wastewater, and the marketability of produce whose growth has been assisted by the addition of wastewater. They involve consideration of the distance, and therefore the transport costs, between the source and the land application site. Most of all, a land discharge option needs a landholder who sees the advantages of availing himself or herself of the benefits of irrigating with wastewater.

125. For AFFCO, land discharge of wastewater needs an optimal area of land; not an area that is too big, and not too small. Too small, and the wastewater is either applied more generously than is environmentally sustainable, or not enough wastewater is able to be discharged by that means. Too big, and through a dry summer there will not be enough wastewater to optimise the productive advantage that wastewater irrigation offers to a farming system.

126. There has been a perception, reflected in some of the submissions received, that a land discharge system using a larger area of land could remove the need for any wastewater to be discharged to surface water. Unfortunately, the issue is not that simple.

127. Land discharge of wastewater cannot happen all year round in the location around the AFFCO Manawatu plant. During the dry summer months, when river flows are at their lowest and river ecological systems are at their most stressed, it will be normal for the soil on the adjoining land also to be dry, and productively receptive to being irrigated.

However, during winter, with often higher rainfall and always lower evapotranspiration, most soils will not benefit from irrigation at all; indeed, unless carefully managed soil structure and consequent productivity can suffer if it is irrigated at that time.

128. During winter land discharge in the general area of the AFFCO Manawatu plant is not possible without increased damage to the receiving soil, or likely drainage to ground and surface waters. If a total land discharge system was to be used to take the entire annual production of wastewater, then it would need to include a storage capability sufficiently large to save all the wastewater that cannot be irrigated until such time as weather and soil moisture return to conditions where irrigation is possible. Such storage, while potentially possible, would require a significantly larger area and volume than is available and would be cost prohibitive to AFFCO i.e. millions of dollars. The storage volume and costs are discussed later in my evidence.

129. Simply making the discharge area larger does not necessarily increase the amount of wastewater that can be irrigated on any given day, as some days irrespective of the area available no irrigation will be possible.

130. Another important consideration is the need to design for a worst case, being a very wet year. There will be some times when even in summer irrigation is either not possible or limited due to soil moisture conditions. That being the case additional storage would be needed for these worst case times, which may happen only once in every 10 to 20 years (or even less frequently). This means that a very large storage pond would be needed to avoid surface water discharges, which would be used as infrequently as the worst case conditions occurred. The consequence is a very large storage pond used infrequently and at great cost.

131. The issue of utilising more land is not so much land availability, but appropriate land that can be used to reduce the storage volume to an extent that the costs of such storage are economically viable for AFFCO. Such decisions about economic viability of storage may change, and AFFCO have elected to revisit this issue of storage and optimising land application on a regular basis. This is discussed later in my evidence with respect to consent conditions.

Surface Water Discharge Options

132. Wastewater can be, and in many instances is, discharged to surface water. Indeed, the presence of the Oroua River right alongside was a factor in the original selection of the site for the construction of what is now AFFCO.

133. With time, community preferences have evolved with regard to the discharge of wastes into rivers. By far the main issue raised in submissions opposing the consent applications under consideration here has been the perceived and expressed adverse effect of the proposed surface water discharge on the receiving environment.

134. Options for a discharge to surface water are basically to discharge all of it, or some of it, or none of it to surface water. Theoretically there may be scope to consider other surface water bodies to receive the wastewater, but the Oroua River is the one that is closest to

AFFCO, and is the one for which a surface water discharge has been designed that will meet or work towards One Plan requirements.

135. In theory, it may be practicable to discharge all or much of the AFFCO wastewater to the Oroua River by staging the discharge rate against river flow so as to avoid times of the year or river flow rates when a discharge would lead to adverse effects. This may mean discharges occur when the river is in high flow and un-affected from a water quality perspective by the addition of the discharge to an already high sediment, nutrient and contaminant load. Such an approach to target high flow discharges only would need a large storage capacity to hold the wastewater produced during the plant's summer when river flows are typically lower.

136. Similarly, it may be practicable to discharge the entire wastewater production to land and to avoid a river discharge entirely. This also would require a large storage capacity (160,000 to 190,000 m^3) to carry over wastewater generated at times when irrigation is not possible.

137. An option that has received consideration was to enhance the standard of wastewater treatment at AFFCO to the extent that a discharge of wastewater to the Oroua River could be made at any time, and at any river flow rate, without breaching Horizons' One Plan water quality targets. To the extent that "meeting One Plan" is the objective of the wastewater discharge design, this option ticked all the boxes with regard to environmental result, however its cost, was very high at $3.3m (see reference to Cardno treatment options above).

138. AFFCO are of the opinion, and I concur, that One Plan targets can be achieved at a much lower cost by managing the surface water discharge of wastewater at its current level of treatment in such a way that when One Plan water quality targets would be breached, there is no discharge. There is only proposed to be a discharge to the river at such times as the resulting water quality in the river will then meet One Plan targets.

Preferred Option

139. AFFCO proposes a continuation of hybrid discharge system, that utilises the advantages of both a land discharge and a water discharge, using each to counteract the potential adverse effects of the other. This is a combined land and water discharge system (CLAWD).

Optimisation

140. The preferred option of a CLAWD system has been through an extensive optimisation process, as discussed in section 6 of the AEE. This has resulted in developing a system that lessens the impact of the irrigation system on soils and groundwater, maximises the use of storage and develops a criteria whereby a river discharge is undertaken at a time when the environmental effects, if any, are able to meet or work towards One Plan water quality targets and achieve the objectives.

Best Practicable Option

141. Resource consenting processes for a discharge should consider what is a Best Practicable Option (BPO). A BPO should consider the nature of the discharge, the sensitivity of the receiving environment, the applicant's reasons for its choice and other possible methods.

142. In my view the iterations that AFFCO have been through in the last five years to refine their discharge regime is consistent with a BPO process. In particular, this process has included:

(a) looking at alternative treatment options;

(b) evaluation of internal plant processes to minimise water usage and waste production; and

(c) development of a wastewater and water balance model to represent a range of options and discharge regimes.

PRE-HEARING MEETING

143. A pre-hearing meeting was convened by Horizons Regional Council in Feilding on 23 September 2015, attended by the applicant, about a dozen submitters, and representatives of Horizons Regional Council.

144. A number of issues were raised to which detailed responses could not be given on the spot, and it was agreed that responses to these issues would be provided in writing later. These issues included further consideration of cumulative effects of the proposed river discharge; the implications and options of increased storage; clarification of the dilution provisions of the river discharge proposal; the adequacy of land area and storage capacity.

145. A letter was provided to Horizons Regional Council dated 5 February 2016 providing explanation or clarification as appropriate on each of these issues; the letter is appended to this evidence as **Attachment 1**.

IWI ISSUES

146. As part of ongoing dialogue between AFFCO Manawatu and Ngāti Kauwhata, AFFCO offered assistance with the rehabilitation of the lower reaches of the Otoku Stream where it runs through the AFFCO property. This included AFFCO providing accessing, and agreeing to remove its surface water discharge of wastewater from the Otoku Stream, to clear weeds and debris from the vicinity of the stream, to assist with establishing fish passage between the Otoku Stream and the Oroua River, and to assist to re-establish a koura fishery in the stream, to be managed by Ngāti Kauwhata.

147. In its submission on the consent applications, Ngāti Kauwhata neither opposed nor supported the applications, but noted that all wastewater discharges must go to land, and wished to introduce cultural and environmental experts at the appropriate time.

148. In its submission, Ngati Whakatere expressed its opposition to the river discharge, saying that all wastewater must go to land. Pond seepage and the proposed riverbed structure were opposed as “totally unacceptable”. The proposed discharges to land and to air were given conditional support, “subject to prior meaningful consultation”.

149. In its submission, Tanenui-a-rangi O Manawatu (Rangitaane) expressed its opposition to the river discharge, noting that it was “fundamentally opposed to the discharge of effluent and contaminants to the Oroua River”. With respect to both the land discharge and the pond seepage, there was concern that contaminants may persist beyond the AFFCO site.

Cultural Impact Assessment

150. A CIA was presented to AFFCO in July 2016 on behalf of Ngāti Kauwhata. The CIA identifies 3 broad concerns: recreational prohibitions; absence of fish life; and impacts on the cultural integrity of Ngāti Kauwhata. These broad concerns relate to 3 values, being respectively culture, nutritional properties, and spirituality.

151. The CIA addresses matters relating to the effects of the proposed discharge of treated wastewater to the Oroua River, but does not address matters relating to the other activities for which consents have been applied.

152. The CIA does not acknowledge that for many years the AFFCO discharge has not occurred, and is not proposed to occur, at times and at river flow conditions when ecological, food production, or recreational uses of the river occur. It assumes that the poor condition of water quality in the river downstream from Feilding is contributed more by AFFCO and the Feilding municipal discharge than by non-point source discharges.

153. The CIA makes a distinction between the “science based targets for the river (water quality)” and “the cultural health of the river (which) goes beyond physical parameters to also encompass spiritual, cultural and emotional dimensions.”

154. The CIA describes at Section 6 the current relationship between Ngāti Kauwhata and the Oroua River, noting that “many Ngāti Kauwhata descendants do not use the river now, and have not used it for several years.” Reference is made to a rahui on the river since between the 1940’s and the 1960’s, effectively banning swimming and fishing below the freezing works and sewage treatment plant.

155. Unfortunately the report makes limited reference to recent water quality reports and does not acknowledge the likelihood that river water quality would have been substantially worse during the 40 to 60 year period prior to that, when discharges are understood to have been both untreated and unrestricted. **Dr Ausseil** discusses recent reporting that could have been used in the compilation of the CIA.

156. The key recommendations of the CIA include the request that “conditions need to be included that ensure dissolved reactive phosphorus in the discharge will meet One Plan targets, provide for periphyton and macroinvertebrate monitoring above and below the discharge, and guarantee the discharge will meet the One Plan targets for clarity.” With the exception that the One Plan targets relate to the receiving waters after reasonable

mixing rather than to the discharge itself, the AFFCO proposal includes conditions to that are effectively sought in the CIA. The proposal largely satisfies the request in the CIA with respect to meeting One Plan targets. Compliance with, and working towards, One Plan targets regarding surface water quality are discussed further by **Dr Ausseil**.

157. The other key recommendation of the CIA is that the river discharge be limited to a 10 year term, on the basis that the Environment Court granted consent for the Feilding municipal wastewater discharge for a 10 year term. The AFFCO discharge is a very different discharge to Feilding. In particular, the techniques used here and the data available is far more certain than at Feidling (the benefit of over 30 years of using and upgrading the system). It is also considered in the CIA that within 10 years sufficient time would have elapsed to have allowed AFFCO to have developed a 100 % discharge to land. As detailed in the evidence of Mrs Nuku, AFFCO are proposing to investigate the need for a surface water discharge and the optimisation of the land application system every 5 years, with consultation with tangata whenua during this process.

158. In relation to term this is not like the Feilding. In particular:

(a) the current performance of the system, and its robustness over thirty years of operation are well understood;

(b) there are no uncertainties as to the future performance of the system;

(c) the degree of effect is well understood and within or working towards One Plan targets and meets the objectives;

(d) the proposed conditions will ensure that One Plan targets are met or worked towards and are consistent with the objectives and these conditions can be effectively monitored;

(e) the effect on mauri of the water has been mitigated in the proposed consents by removing the current direct discharge into the Otuka Stream, using a lland passage system; planting the banks of the Otuka Stream and Oroua River within the AFFCO site; establishing fish passage between the Otoku Stream and the Oroua River; and to assist to re-establish a koura fishery in the stream, to be managed by Ngati Kauwhata, as explained in Ms Nuku's evidence; and

(f) Policy 5-11 of the One Plan does not apply in this case (as it is not a discharge of human wastewater).

159. Ms Nuku's evidence considers the cost, efficiency and uncertainty implication of a 10 year term for AFFCO and **Mr Edward's** evidence discusses the term in more detail.

S42A REPORTS

Horne

160. I have no comments on Dr Horne's report. However, I note he has drawn comparison with existing farming operations. He states at paragraph 46 *"Given the proposed irrigation regime, the soils at the site are well suited to wastewater irrigation."* He then says at paragrapgh 48 that *"A very conservative form of deficit irrigation will be practices. Deficit irrigation is the 'gold standard' for wastewater irrigation."* Further he notes at paragraph 49 that *"The nutrient load to the irrigated area in an average year is also modest and reflects standard farming practices in the region"*.

Thomas

Pond Leakage

161. Mr Thomas in paragraph 22 describes the direction of groundwater flow relative to the river, suggesting that groundwater flows 'sub-parallel or towards' the Oroua River. While I don't disagree with Mr Thomas interpretation, as it is similar and based on the same data we have used.

162. At paragraph 31 Mr Thomas notes that a *"seepage rate of 200 m^3/day is possible"*. This calculation is equivalent to a drop of some 3 mm/day, or some 21 mm over a week. Over a month, this would be close to a 80 mm drop. The potential loss of 200 m^3/day is unrealistically high. Firstly, such a loss would be noticeable in flow figures, between water use and that discharged. Based on observations at the site, and a review of monitoring information, such a high loss is very unlikely. Secondly, a loss of 200 m^3/d equates to 73,000 m^3/y. As noted previously, water usage is expected to be 250,000 to 310,000 m^3/y, meaning that leakage would be 24 to 30 % of water usage. This calculated loss based on 200 m^3/y is unrealistically high.

163. I estimated a loss of 50 m^3/day which I maintain as being realistic given what I know about the ponds.

164. It is likely that the leakage rate is greater than $1x10^{-9}$m/s, as used in the One Plan for pond leakage to be considered a permitted activity. In this case a consent is being sought as there isn't certainty this rate is being met. This requires the effects to be considered, and in this case based on the monitoring results the effect on current groundwater users is not detectable, or at least no effect can be attributed to pond leakage.

165. In paragraph 42 of Mr Thomas' evidence he is right to point out there is some form of contamination directly down gradient of the pond. He also notes that other bores, including upgradient bores also have elevated levels of contaminants. As mention in earlier in my evidence, the plant has history of past activity which, amongst other things, includes burial of organic material. While it is clear there is some form of contamination downgradient of the ponds, it cannot be confirmed with certainty at this stage if it is the ponds causing this contamination. Consequently, lining the ponds may have no impact on reducing contaminant levels as this one bore.

166. As stated earlier in my evidence, I believe not all groundwater from under the ponds flows towards the river. I note that Mr Thomas also acknowledges at paragraph 43 *"…that groundwater flow around the ponds is sub-parallel to the Oroua River,…".* Our respective opinions seem consistent, with the view being that only a portion of the leakage volume would find its way directly to the river.

167. It is clear that there is a localised adverse effect on groundwater. Mr Thomas at paragraph 46 states that *"the immediate area around the ponds is likely to be degraded as a result of seepage from the ponds"*. I agree that ponds may be contributing to an impact on groundwater quality, but it is not clear that they are the sole contributor, both on and off the AFFCO site. For example, the adjacent Wallace Corp operation has an impact on groundwater and historical burial around the AFFCO site is also likely to be impacting on groundwater.

168. Down gradient bores beyond the property boundary (of actual groundwater users) show no elevated contaminant concentrations that can be clearly traced back to the ponds, or the AFFCO site. There are isolated elevated levels of some contaminants, but they are not consistent within their spatial location and over time, suggesting that contaminant sources may in fact be localised i.e. there is no plume of contaminated groundwater emanating from the AFFCO site.

169. I appreciate the fact that the hydrological setting is complex, due to the heterogeneous condition of the strata and the historical burial practices at the plant. It is clear there are some 'gaps' in monitoring data, especially between the ponds and the river, as noted by Mr Thomas. These gaps reflect an iterative process where initial monitoring has suggested further monitoring bores are warranted. This is the reason why additional monitoring piezometers were suggested in the proposed consent conditions, a recommendation that Mr Thomas is supporting.

Irrigation

170. In paragraph 48 Mr Thomas notes that the *"land discharge system will increase the overall flux of contaminants to the underlying shallow groundwater."* Unfortunately, this statement is incorrect. While there may be additional wastewater applied to land, the land area is doubling and the nutrient and hydraulic loading regime is being improved i.e. impact sprinklers to be used and not a rotating boom. These later aspects have been specifically developed to lessen the flux of contaminants for groundwater.

171. In paragraph 52 Mr Thomas indicates *"…it would be reasonable to conclude the effluent discharges may have contributed to those effects"*, implying elevated concentrations are contributed to by wastewater applications. In the case of bore 325016 which is in the middle of the irrigation area, this is a fair conclusion. However, for bores 325413 and 325416B it is my opinion this conclusion is incorrect. It is possible that Mr Thomas is basing his view on the proposed irrigation area, which does extend closer to these bores. However, the <u>current</u> irrigation area is more than 500 m and 850 m away (and upgradient) from bores 325416B and 325413 respectively.

172. The purpose of the analysis provided by Mr Thomas in paragraph 55 is unclear. As noted above, bore 325416B is upgradient of the current irrigation area, yet it has an elevated nitrogen concentration. Mr Thomas correctly notes (paragraph 52) that high nitrate nitrogen concentrations *"may be caused by other activities".* While the process Mr Thomas has used is correct to determine the mass flux to the river, the groundwater concentration in my view is not influenced by the current irrigation operation. It is also not likely to be representative of nitrogen concentrations from typical farming operations in the area. Therefore, the calculation incorrectly implies a contribution, in paragraph 55, from the irrigation area. I note this is analysis follows through into the discussion in paragraphs 69 to 71 in Mr Browns evidence with respect to the selection of monitoring sites. Monitoring site selection is further discussed by **Dr Ausseil**.

173. Mr Thomas recommends on going monitoring around the existing ponds and the installation of new monitoring bores. He also recommends new bores be installed. I concur with this recommendation.

Manderson

174. At paragraph 108 Ms Manderson questioned whether AFFCO's approach to not line the ponds is the BPO. My understanding is that a BPO relates to the nature of the discharge, the sensitivity of the receiving environment, the effects of other options, the financial implications for the applicant and the state of the technology used. In this case the discharge has minimal adverse effects (and none offsite), the receiving groundwater is of general poor quality (typically worse than on the Affco site), there is no direct groundwater connection to the Oroua River, and the financial implications for AFFCO will be significant ($1-2.5 million).

175. At paragraph 128 Ms Manderson indicates that she has not seen evidence that pond costs for full storage and 100 % land application would be prohibitively expensive. Based on only providing storage for approximately 180,000 m^3, costs may be in the order of $1.5 million[4]. In addition, extra land would be required for irrigation, being something in the order of 250 ha. Assuming the land was not purchased, additional irrigation costs (rent and infrastructure) could be in the order of $3.0 million. Total costs could be in the order of $4.5 million. These are significant costs for no environmental gain based on compliance with One Plan requirements. In addition as stated above, given the large area of land used it could not all be efficiently irrigated such that the farming system benefits of land irrigation would be lost. Finally, the additional storage would need to be lined which given the significant extra volume

Conditions

176. As noted in the evidence of **Mr Edwards**, several monitoring conditions require further discussion with HRC staff to ensure there is a common understanding of their requirements.

[4] 180,000 m^3 required and with a depth of 4 m would require a surface area of 45,000 m^2. Potential earthworks may see movement of 20,000 m^3 of material. Based on costs presented by Mr Corlett, at $12/$m^2$ the liner would cost $540,000 and at $5/m3 the earthworks stripping would cost $100,000, with possibly an additional $500,000 for other related earthworks including importation of material. It would be reasonable to allow additional costs of 30 %, making a total of in excess of $800,000.

177. Some of the monitoring requirements suggested on the proposed conditions are at odds with the technical reports. Firstly, Dr Horne has concluded (paragraphs 46, 48 and 49 of his evidence) that the effects of the proposed irrigation system are consistent with farming practices in the region. This implies that nutrient losses and drainage in particular, would be consistent with farming operations. I note these farming operations do not require environmental monitoring.

178. However, Mr Thomas seems to take the view that additional monitoring is needed to conclude the effects of the land application system, despite Dr Horne noting consistency with farming practices. Mr Thomas then erroneously uses upgradient groundwater quality information to calculate a potential impact of land drainage on the Oroua River.

179. Mr Brown then picks up Mr Thomas (erroneous assumption) and recommends that additional monitoring sites to (at paragraph 71) *"…capture the effects of the land discharges on the river".*

180. Further, the additional river monitoring as suggested by Mr Brown is then not reflected in land discharge consent, but appears to be in the pond seepage consent at condition 12c. Then, despite the inclusion of surface water monitoring in the pond seepage consent, I cannot find any suggestion in Mr Browns evidence that he is recommending surface water monitoring to capture pond seepage effects on the Oroua River.

Hamish Lowe

26 October 2016

Attachment 1: Letter from AFFCO to Horizons Regional Council (5 February 2016)