BEFORE A HEARINGS PANEL OF THE GREATER WELLINGTON REGIONAL COUNCIL AND MASTERTON DISTRICT COUNCIL

IN THE MATTER	of resource consent applications to Greater Wellington Regional Council pursuant to section 88 of the Resource Management Act 1991
AND	
IN THE MATTER	of a Notice of Requirement to Masterton District Council pursuant to section 168, 168A and 181 of the Resource Management Act 1991
BY	Masterton District Council
FOR	the proposed upgrade of the Masterton Wastewater Treatment Plant

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SUPPLEMENTARY STATEMENT OF EVIDENCE OF STEVE GREEN ON BEHALF OF MASTERTON DISTRICT COUNCIL

RESPONSE TO OFFICERS' REPORT

Subject Area: Land Treatment Aspects and Storage Model

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1. INTRODUCTION

1.1 In this statement, I will address a number of issues that have been raised in the technical review reports and the Officer's Report relating to the modelling of the contaminant and nutrient losses following discharge to land of treated effluent from the ponds. My response to the stated concerns in the Officer's Report is set out below with reference to the report section numbers where relevant.

2. CERTAINTY OF MODELLING

2.1 In Section 12.4.2 of the Officer's Report it is concluded that::

> "*There is a high degree of uncertainty over the land irrigation operation and therefore the effects on the receiving environment given the uncertainty with the modelling, application rates, suitability of the soils, and the need for sound management….".*

2.2 I disagree with the suggestion that the modelling is highly uncertain. The officer's conclusion appears to be based on the technical review report prepared by Duffill Watts Consulting Group. I largely restrict my comments to the HortResearch modelling.

2.3 The HortResearch modelling has been conducted on the basis that discharges of pond effluent to land only occur when the soil has the capacity to receive it. The modelling is based on the appropriate soil transport properties that have been measured on-site. Furthermore, the HortResearch calculations take into account the observed variability in soil texture and drainage classes across the site. The model adjusts irrigation rates, as required, according to how the scheme is intended to work in practice. The model also takes account of the fact that irrigation will be cycled around the plots, with loading of different plots occurring on different days. Application rates for the proposed scheme will be adjustable, using bubble up valves and adjustable speed pumps as described in the evidence of Neal Borrie.

2.4 An expressed concern was whether the modelling took into consideration the 'possible future land treatment area' (107 ha) shown on the plans in the AEE. I can confirm that HortResearch re-ran the model for the proposed irrigated plots on both the 91 ha and the 107 ha sites. Our model scenarios are summarised in my statement of evidence (Table 3), and I have attached a schedule of the 'Paddock" numbers (shown on DWG C624 of the AEE) and their classification as to being 'free-draining' or 'clay rich' soils.

Model outputs for each land area were subsequently passed on to PDP for their evaluation of groundwater quality.

2.5 A further concern which is expressed is that:

> *"It is also essential to ensure that the claimed predicted effects are not exceeded, of which there is some question about given the uncertainty of the modelling and proposed management which has been presented to date."*

2.6 The officer's statement questions the proposed irrigation management at the site. Initially, HortResearch ran a number of scenarios to determine a practicable balance between pond size, river flow, and land discharge rates. The calculations used all of the available data including local climate and river flow records as well as soil sampling observations that determined the distribution of soils and land areas across both the proposed site and the possible future land treatment area. Rules for land discharge were then determined based on expert's opinions as to what is practically achievable. Those rules are described in Section 6.9 and Table 3 of my statement of evidence. The evidence of Neal Borrie further discusses the land application and he and Mr Archer discuss the proposed management of the land treatment system. To the extent that the authors of the report had uncertainties about either the modelling or the management system, I note that those could have been resolved by addressing the queries to the applicant's experts.

2.7 Section 12.4.3 (c) (i) of the Officer's Report raised the issue that:

> *"The AEE and HortResearch report (2007) indicate that an application volume of 70 to 150 mm (average 100 mm) may be used every 7 to 10 days. This is an extremely high volume given the conductivity of some of the soils are reported to be 0.5 to 4 mm/hr and brings into question the suitability of border irrigation on the heavier soils'*

2.8 The rates referred to above have been taken out of context and do not reflect the proposed scheme. The high rates referred to above (150 mm per irrigation event) were part of a sensitivity analysis that was carried out to investigate a 'worst case' scenario for nutrient and contaminant leaching. As part of this sensitivity analysis, the upper irrigation rates were applied only to the free draining sites and only when the soil had the capacity to hold or transport the water.

2.9 The proposed scheme (with a storage requirement of 275,000 m^3 including an operational margin) sets the **upper** (not average) irrigation limit at 100 mm per event (summer) and 50 mm per event (winter) with a minimum return period of 10 days on the poorly drained (clay rich) sites. In a wet winter, the actual return period could extend beyond 20 – 40 days. In some months the poorly drained soils will receive no irrigation at all.

2.10 In short, the modelling was conservative and the land discharge rules did take account of the lower discharge rates to poorly drained soils.

3. ARTIFICIAL DRAINAGE

3.1 In Section 12.4.3 (c) (ii) of the Officer's Report it is concluded that:

> *"The proposal includes artificial drainage, which will assist, but there will still be limitations to year round irrigation application"*

3.2 Graeme Proffitt has discussed the proposed artificial drainage on the 107 ha site. The HortResearch modelling concurred that, at certain times, it would not be possible to irrigate because soil conditions would not allow for it. At those times additional wastewater either goes into storage or is discharged to the river. These concerns have been addressed in the modelling since irrigation was not permitted during winter to the poorly drained soils. I am therefore confident that the modelling has addressed the issue of year round irrigation application.

4. STORAGE VOLUME

4.1 In Section 12.4(c)(ii) of the Officer's Report it is concluded that:

> "*The proposed storage volume is 275,000 m^3. If land irrigation is restricted and the river discharge not possible additional storage would be required. Consideration of the application regime in relation to storage is therefore critical to the assessment of the proposal.*"

4.2 As explained in my evidence (Section 7.1-7.3) a large part of the HortResearch study was a sensitivity analysis of storage requirements in relation to the application regime. The land discharge rules adopted for the proposed scheme meant that there were always going to be times when neither river or land discharge was possible and additional influent volumes would be directed into the pond storage. The HortResearch report describes numerous scenarios that were run to determine storage requirements

under a wide range of land discharge rules. The proposed scheme reflects a balance between what is practical in terms of pond size, given the current and future proposed land areas, and historical river flows. I am confident, on the basis of the current set of land discharge rules, that the proposed storage will accommodate the influent flows coming into the site, if the climate and river flow patterns follow the historical sequence. I have covered the issue of potential climate change effects in my evidence. I note that the officers report suggests reducing the maximum rate of discharge to the river from 1200L/s to 700L/s. That would have implications for storage volumes.

5. DRAINAGE OF WATER

5.1 In Section 12.4.3 (c) ii of the Officer's Report it is concluded that:

> " … *in reality, there will be a one-off slug of water entering groundwater on the day of irrigation, with lesser volumes on following days. It is unclear how this would change the … predictions* "

5.2 The HortResearch model outputs reflect both the pulse loading effects and the subsequent slower drainage of water that leaves the root-zone at 1.0 m depth. It is misleading to refer to a 'one-off slug" of water entering the groundwater on the day of irrigation. This is because the surface 'pulse' is naturally dispersed and broadened as it moves downwards through the soil profile. Some nutrients (e.g. nitrate) will travel rapidly through the profile, being carried downwards with the invading water with negligible sorption (sticking) to the soil material. It should be noted that nitrate concentrations in pond effluent are normally very low. Meanwhile other nutrients (e.g. ammonium and phosphorus) will be adsorbed to the soil's mineral and organic matter and therefore travel much more slowly, and be more broadly dispersed in the soil profile.

5.3 As explained in the HortResearch report (Appendix A) and in my evidence, the transient nature of water and nutrient movement has been modelled, and the results were subsequently passed on to PDP for inclusion in the groundwater modelling. Travel times in the surface soil layer are of the order of days to weeks, for nutrients, while travel times in the aquifer tend to be of the order of hundreds of days, as described by Graeme Proffitt.

5.4 It is acknowledged there are always uncertainties in any modelling exercise. Consequently, we have taken a precautionary approach with the nutrient modelling by choosing higher than expected values for some model inputs so that the predictions err

on the safe side. For example, the model predictions of nutrient and contaminant losses to groundwater are based on a 'one-day' surface application of pond effluent that is set at a maximum of 150% of the proposed application rate. The higher application rates were adopted for the nutrient modelling, in order to account for variability of infiltration down the border strip. I am therefore confident that this conservative aspect for modelling means that the predictions for nutrient and contaminant will be higher than observed in reality.

6. LEACHING RATE

6.1 In Section 12.4.3 (c) ii of the Officer's Report it is concluded that:

> *"The technical report also seeks clarification to identify exactly what the nutrient and pathogen leaching rate from the land irrigation area may be under the current design; in particular leaching as a result of a one-off application of up to 150 mm rather than daily applications of 10 mm. It is also unclear if this issue has been considered in both the HortResearch or PDP modelling, and taken into account when assessing the impact on the Ruamahanga River."*

6.2 This concern seems to arise though a misunderstanding of the way the HortResearch model applies the effluent. The HortResearch model runs on a daily time step sequence (using historical sequences of rainfall and other climate variables) and applies a maximum irrigation rate (up to 150 mm per event) with a minimum return period of 10 days. Irrigation is delayed if rain falls in that period or if pasture is due to be harvested. I can confirm that the HortResearch modelling takes the daily application rates into account when assessing the impact on both the soil and the Ruamahanga River.

Table 1. Zonal numbering, land area (ha) and classification for the 'clay rich' or 'free draining' soils on both the proposed and the future irrigation scheme. The locations of these zones are shown on DWG C624 of the AEE. (Zones equate to paddock numbers on DWG C624).

Proposed Irrigation Scheme			**Future Irrigation Scheme**		
Zone	Free draining Area [ha]	Clay rich area [ha]	Zone	Free draining Area [ha]	Clay rich area [ha]
1	4.47		1	4.47	
2	4.67		2	4.67	
3	5.56		3	5.56	
4	5.59		4	5.59	
5	5.60		5	5.60	
6	7.32		6	7.32	
7	4.85		7	4.85	
8	6.61		8	6.61	
9		5.25	9		5.25
10		5.08	10		5.08
11		5.57	11		5.57
12		5.55	12		5.55
13		4.44	13		4.44
14		4.45	14		4.45
29	8.20		29	8.20	
30	7.07		30	7.07	
31	7.14		31	7.14	
			15		6.74
			16		1.63
			17		7.48
			18		6.53
			19		4.81
			20		3.61
			21		2.47
			22		2.55
			23		3.97
			24		3.44
			25		2.54
			26		3.39
			27	2.71	
			28	1.24	
TOTAL	**67.06**	**30.34**	**TOTAL**	**71.02**	**79.49**
%age	68.8	31.2	%age	47.2	52.8

Note: (a) Zones 1 to 8 are on the 91 ha site
Zones 9 to 28 are on the 107 ha site
Zones 29 to 31 are in the area of the existing ponds

(b) refer to AEE table 23 for proposed pond effluent application rates to 'free draining' and 'clay rich' zones.

Dr Steve Green, Scientist, HortResearch

23 February 2009