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

[GWRC Ref: WAR 070077]

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 CHRIS HICKEY ON BEHALF OF MASTERTON DISTRICT COUNCIL

RESPONSE TO OFFICERS' REPORT

Subject Area: Effects on Water Quality

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1. DILUTION RATIO

(Officers' Report Section 12.4.2 (p28))

The proposed minimum river flow to effluent dilution ratio of 30:1 will provide less dilution in the river than at present and is insufficient to ensure that dissolved reactive phosphorus (DRP) receiving water quality guidelines can always be met.

Response:

1.1 I acknowledge that the proposed dilution ratio is less than at present, however, the nature of the new proposed intermittent discharge regime means that the level of dilution provides good guideline protection. I therefore do not agree that the proposed minimum effluent dilution ratio of 30:1 is an issue of concern, and furthermore that it is inappropriate to apply the site-specific DRP guideline to the effluent discharge situation. The reasons for my opinion are set out below.

1.2 The site-specific guideline for DRP is suitable for low flow conditions, when the direct discharge is not occurring, and is not applicable to the period of high flows when the discharge is initiated. The combined effects of bed scour, and high turbidity high flows will prevent effective nutrient use by algae during. Time is also required for establishment of nuisance growth levels of algal periphyton to occur following scouring flood events. Thus, any requirement that "…*dissolved reactive phosphorus (DRP) receiving water quality guidelines can always be met.*" is not compatible with the other factors which in combination affect the abundance of algal periphyton. For these reasons, my evidence annotates the predictive tables for DRP as 'Not applicable (NA)" for guideline comparisons during discharge at greater than median flow.

1.3 Specific response:

(a) the existing effluent compliance concentrations and discharge volumes were based on discharge to the Makoura Stream and so are not directly relevant to assessment of effects of the proposed intermittent discharge regime on the Ruamahanga River;

(b) our proposed effluent concentrations for compliance have been based on the existing consent conditions, with modification of the faecal bacterial (*E.coli*) concentrations to reflect expected improved pond treatment performance (AEE, Table 25). The revised effluent dilution above the trigger flow has been used as the basis of calculations to show compliance with all water quality guidelines after reasonable mixing (ie 20x dilution) and full mixing (ie 30x

dilution), except when upstream conditions cause prior exceedance for clarity and *E.coli*;

(c) the basis for the 30:1 dilution is addressed below (see response to Technical Report) in relation to ecological (macroinvertebrate) protection and aesthetic (clarity) effects, and health risk (*E.coli*);

(d) the basis of the site-specific DRP guideline derivation to limit filamentous periphyton growths in the Ruamahanga River are described in my evidence sections 8.14 to 8.20, with reference to the various NIWA reports to support the derivation procedure. The site-specific DRP guideline is applicable to low river flows, and was derived on the basis of experimental field data demonstrating the effect of floods scouring periphyton growths, which I address in more detail below (response to Surface Water Quality Technical Report in section 17 and following below).

2. DISCHARGE RATE

(Officers' Report Section 12.4.2 (p28))

The proposed maximum instantaneous discharge rate of 1,200 L/s is significantly higher than the existing 700 L/s and will enable a greater contaminant load to be discharged to the river.

Response

2.1 I do not consider that that increased discharge rate to the Ruamahanga River will result in any significant adverse effects to the receiving water communities. My opinion is based on my assessments I have undertaken in comparison to water quality guidelines, and consider that the intermittent discharge will additionally reduce any potential for effects.

2.2 As noted in my response above (1(i) & 1(ii)), the 700 L/s limit was based on a continuous discharge to the Makoura Stream with subsequent discharge to the larger Ruamahanga River. As such, the increase in maximum volume must be considered for the new proposed discharge regime, specifically: (i) river concentrations compared with all relevant water quality guidelines; and (ii) the intermittent flow-triggered discharge. These assessments have been comprehensively made in the AEE and presented in my evidence in relation to both water quality guidelines (summarised in Table 25) and the effects on aquatic communities (algal periphyton, macroinvertebrates & fish). The

greatest effects of the proposed scheme will be seen with the elimination of the discharge in summer below median flow and in moving the discharge upstream from Wardells Bridge.

2.3 The "load" of nutrients is not an issue to the response of any of the aquatic communities in the Ruamahanga River. Rather it is the **concentration** of contaminants and the timing of their discharge which will affect the potential for the development of nuisance algal growths. My evidence addresses changes in DRP (the limiting nutrient) concentration and the other factors which affect periphyton proliferation (including scour and turbidity) during flood events.

3. NUTRIENT INPUTS – SEEPAGE

(Officers' Report Section 12.4.2 (p28))

There is significant potential for greater than anticipated nutrient inputs into both the Makoura Stream and the Ruamahanga River via seepage through groundwater underneath the proposed land irrigation area and the base of the new oxidation ponds.

Response

3.1 I do not agree that there is "significant potential for greater than anticipated nutrient inputs" as stated in the Officers Report. I consider that the approach taken was both comprehensive and robust in providing predictions of nutrient seepage loads and the interpretation of potential environmental effects. The reasons for my opinion are set out below.

3.2 The combined effects of nutrient leakage from ponds and groundwater (from irrigation) inflows are only of concern at low river flows when periphyton growth is high and nuisance growths may occur. I have summarised the predicted DRP mass loads and resulting Ruamahanga River concentrations in my evidence for just above median flow (Tables 6 & 7) and the updated scheme to low flow (5 percentile flow, Table 8). At low flows the leakage and groundwater inputs are small, but an important addition to the river DRP concentration. The mass load calculations for leakage were based on median pond concentrations and the maximum pond leakage for a clay liner, which I consider appropriate and conservative. Because of attenuation on passage through soil and in groundwater, the use of the median DRP values (rather than 95 percentiles) is appropriate. I have used the mass load data as generated by the HortResearch model runs and groundwater hydrology flow predictions for the summer period. These models are conservative in that high hydraulic loadings (ie maximum application rate rather than the average) and applications to the whole irrigable area have been used. The response

evidence of Steve Green and Graeme Proffitt address the assumptions in the model development and predictions.

3.3 The elimination of the point source discharge below summer median flow will have the greatest influence on Ruamahanga River nutrient status and periphyton growth at Wardells Bridge. Diffuse inputs of nutrients will stimulate algal periphyton at low river flows, but the levels are predicted to be below nuisance levels for the majority of the time. Nutrient concentrations in the Makoura Stream are already elevated upstream and will not significantly respond to additional nutrients downstream of the treatment area, because of the high degree of shading by overhanging vegetation limiting growth. The proposed comprehensive monitoring programme as proposed in the AEE (Section 12) includes periphyton abundance in the Ruamahanga River upstream and downstream of the irrigation area, which will provide an effects-based compliance assessment for the scheme. I consider that efficacy of the scheme will be demonstrated by this monitoring programme. Some additional special investigations may be targeted at summer low flow periods.

4. EXTENT OF EFFECT ON RUAMAHANGA RIVER

(Officers' Report Section 12.4.3(c)(v) (p34))

The impact of the discharge operation on the Ruamahanga River is a critical component of the proposal and assessment. The predicted effects are close to only marginally acceptable, which means that any underestimates on the leaching of nutrients from the land application area could result in a reassessment concluding there is a significant adverse effect on the Ruamahanga River.

Response

4.1 I disagree with the above statement. The reasons for my opinion are set out below.

4.2 I have concerns with the use of “impact”, “effects” and “significant adverse effect” in this statement. This implies that the uncertainty in nutrient concentrations from the irrigation scheme will result in adverse effects if the concentrations were (slightly) higher than the model-predicted. This is not the case based on the existing situation. As presented in the AEE and my evidence, there is currently minimal exceedance of nuisance periphyton growths at Wardells Bridge, but there is settling of pond algae and aesthetic degradation. The setting of a site-specific DRP guideline applicable to low flows, moving of the discharge location and intermittent discharge will largely eliminate the nuisance growths and settling. An increase in nutrients, by itself, does not constitute a “significant adverse effect” as implied by this statement.

5. SECOND MIXING ZONE

(Officers' Report Section 12.4.4(a) (p35))

The water quality technical report considers that two mixing zones should be considered: when there is a direct discharge to the river and at times of no direct discharge to the river. This approach is considered necessary given the leaching of nutrients that will occur underneath the land irrigation area ultimately flowing towards the river. There is concern that the nutrient inputs into the river from the ponds and groundwater seepage may be higher than modelling undertaken by the applicant.

During the summer months when there is no direct discharge it is also recommended that a mixing zone is needed to safeguard against unacceptable effects of nutrients leaching into the river via groundwater seepage

5.1 I disagree with the above statement. The reasons for my opinion are set out below.

5.2 I do not consider that the inclusion of a notional second mixing zone to allow for leaching nutrients is either required or practical. We have proposed monitoring at the Wardells Bridge site, which will include intermittent fully mixed effluent discharge and the diffuse source nutrients and Makoura Stream inflows. The proposed periphyton abundance and macroinvertebrate monitoring at this site will, when combined with a suitable upstream reference site, provide an integrated effects monitoring programme which will be suitable for compliance. Additional comments are made by Dr Jim Cooke in relation to this suggestion.

6. MONITORING LOCATION

(Officers' Report Section 12.4.4(a) (p35))

It is noted that the applicant considers that Wardell's Bridge is the most appropriate location to monitor the effects. However, this does not mean that there should be unsightly periphyton growth upstream of the bridge.

Response:

6.1 I agree and propose that appropriate compliance monitoring should be undertaken both at Wardells Bridge and downstream of the reasonable mixing region. However, it should be noted that sampling of the river in the vicinity of 300 m downstream of the discharge, may be difficult during high river flows because of depth and high velocity. I note in my evidence that routine periphyton sampling at Wardells Bridge could not be undertaken on 28% of occasions because of flood conditions (section 7.8). The missing data from such occasions will reduce the effectiveness of compliance assessment, though in these

situations there will be a general absence of periphyton. We do not expect that unsightly periphyton growths will occur upstream of the Bridge. However, it is not clear what constitutes "unsightly" in the Officers usage in relation to monitoring compliance. We have proposed the nuisance growth guidelines for visual assessment of filamentous and mat algal abundance (MfE 2000) as the basis of our assessment and proposed monitoring programme.

7. DILUTION FACTOR

(Officers' Report Section 12.4.4(b)

While it is agreed that a minimum dilution factor should be adopted, further explanation by the applicant regarding the rationale for the factor of 30 is required as it may not result in an improvement from the current situation.

Response:

7.1 I have addressed the basis of the 30:1 dilution factor in Section 1 of this response.

8. AMMONIACAL NITROGEN

(Officers' Report Section 12.4.4(b) (p36))

It may also, in some circumstances during discharges at just above half median river flows, affect the ability of ammoniacal nitrogen toxicity guidelines to be met after reasonable mixing.

Response:

8.1 I disagree with this statement. The reasons for my opinion are set out below.

8.2 I present comparisons of predicted concentrations with compliance standards in my evidence (Table 3, AEE Table 32), which shows that the Ruamahanga River with summer and winter ammoniacal-nitrogen concentrations after reasonable mixing (ie 20-fold dilution) will maximally reach 34% of the guideline value for discharges to median flow. This assessment was made on the basis of the measured pond 95%ile ammoniacal-nitrogen concentration (NIWA 2006) and based on a river pH of 7.5 (Table 25 of my evidence) and is based on the ANZECC (2000) guideline for chronic (ie long-term) exposure. Compliance with the water quality guideline would still be achieved for **half-median flow** with concentrations reaching about **68% of the guideline value**. I note that the median pond pH is 7.04 (NIWA 2006), and this would tend to be lower in winter when low pond and river photosynthesis occurs (which increases pH), and so the

river pH after mixing may be further lowered which would act to increase the guideline value (ie reduce potential ammonia toxicity and widen the safety margin).

8.3 I do not consider that there is a significant ammoniacal toxicity issue for the effluent discharge to the winter period half-median flows.

9. NUTRIENTS AND PERIPHYTON – CONTAMINANT LOAD

(Officers' Report Section 12.4.1(d) (p37))

It is important to note that the applicant has sought a considerably higher maximum instantaneous rate of 1,200 L/s compared with the current rate of 700 L/s. This means that when there is a discharge to the river a potentially greater volume and contaminant load would be able to be discharged. ***For this reason there needs to be some control of nutrient contaminant loads****.*

Response:

9.1 I disagree with this statement that control of loads is required (bold emphasis). The reasons for my opinion are set out below.

9.2 I have noted above my basis for assessing the increase in discharge rate to the Ruamahanga River and that there will be no concerns with the proposed 30:1 dilution ratio (Section 1 of this response). In this section of the Officers Report, nutrient load restrictions are proposed for both phosphorus and nitrogen. In my opinion, the scientific basis for load restrictions are not appropriate for this proposed scheme and the contents of the section are not supported by the environmental monitoring data.

9.3 A primary consideration for assessment of effects of the MWWTP discharge is the nature of the aquatic environment which is being protected from the nutrient load, and secondarily the nature of the exposure. While shallow rivers respond primarily to dissolved nutrient concentrations, poorly flushed lakes are responsive to loads of total nutrients, and the limiting nutrient (ie phosphorus or nitrogen) may differ between environments. I note from the Officers Report that Lake Onoke is considered: "*The lake is the ultimate receiving environment for the MWWTP which, despite being highly modified, has considerable human uses and values, particularly fishing, boating and natural character.*" (OR section 12.1.1., p22). I have stated in my evidence that I would expect that the rapid flushing of Lake Onoke at both low flows and during freshes will prevent algal blooms occurring (section 6.72). This opinion is supported by Robertson and Stevens (2007) who categorise Lake Onoke as having a "high potential to flush

nutrients and phytoplankton from the estuary" (p16), but note that the flushing potential is low at times when the lagoon mouth is closed. Their assessment is: "… a "moderate to low" overall susceptibility of the estuary (when open) to eutrophication problems." (p16). Furthermore, they consider that the estuary/lake is most likely to be P-limited when the mouth is closed (p16). Together, these assessments indicate that Lake Onoke is not susceptible to the MWTP nutrient loads, and therefore not a key water body of concern in relation to limiting nutrient assessment, nor does it necessitate mass load reduction for water quality improvement. Additional calculations of nutrient mass loads are provided in the evidence of Dr Jim Cooke.

9.4 In contrast, the Ruamahanga River is phosphorus limited (NIWA 2003) and susceptible to dissolved nutrient concentrations. This is the focus for the proposed scheme and the emphasis on DRP management for limitation of periphyton growths. The absence of a downstream receiving water which is sensitive to eutrophication effects means that total phosphorus load compliance conditions are not appropriate for effects-based management. Monitoring should be in place to quantify loads and aim to minimize discharges, however, I consider that the proposed compliance is not appropriate given the flow-triggered discharge.

10. NUTRIENTS AND PERIPHYTON – DRP STANDARD

(Officers' Report Section 12.4.1(d) (p38))

The technical review suggests that adoption of the applicant's site specific DRP limit (0.030 g/m^3) is not as appropriate as deriving a standard in strict accordance with the periphyton biomass model in the national periphyton guidelines (Biggs 2000). ***Using this model, a standard of 0.012 g/m^3 is recommended****.*

Response:

10.1 I disagree with this statement (bold emphasis). The reasons for my opinion are set out below.

10.2 I consider that the site-specific guideline of 0.030 g/m^3 is appropriate for application to the Ruamahanga River for low flow conditions. I have addressed the basis of this derivation in the AEE and my evidence (sections 8.16-8.21). This site-specific guideline is to limit nuisance growth proliferations. I consider that the derivation followed the guideline procedure ("Biggs 2000", MfE 2000), and was calibrated by field measurements in the Ruamahanga River. These are addressed further below.

11. NUTRIENTS AND PERIPHYTON – FLUSHING FLOWS

(Officers' Report Section 12.4.1(d) (p38))

The technical report also demonstrates that freshes do not always produce 'flushing flow' conditions, and so disagrees with the applicant's view that discharging wastewater to the river above 12.3 m^3/s in summer will always prevent the stimulation of periphyton growths. In addition, there is evidence of significant periphyton coverage in the Ruamahanga River outside of the summer period, including the occasional guideline exceedance for cyanobacteria mat coverage. This highlights the need to manage nutrient inputs to the river year-round.

Response:

11.1 I disagree with this statement. The reasons for my opinion are set out below.

11.2 I describe the site-specific DRP guideline derivation and application in my evidence (sections 8.15-8.21). This evidence cites the results of field studies which showed floods of 3x summer median flow (6.5 m^3/s) would scour and reset the algal periphyton growths (section 8.16, from NIWA 2003). The site-specific guideline is not designed to "…*always prevent the stimulation of periphyton growths*." as appears to be the guideline basis for the Officers Report, but rather to limit nuisance growths of periphyton. I acknowledge that there will be occasions when periphyton blooms of short duration may occur both upstream and downstream of the discharge (section 8.18). The frequency of these would not be at a level which I would consider constitutes a significant adverse effect.

11.3 I am not aware of any published or accepted guideline for 'cyanobacterial mat' coverage. Our review of river periphyton data has documented dominance of various species of cyanobacteria both upstream and downstream of the discharge (NIWA 2003). I have acknowledged in my evidence that settling of pond-derived algae (including cyanobacteria) is an issue at low flows at Wardells Bridge, however, this will be remedied by moving the discharge location and a flood-triggered discharge. Further details need to be provided on the criteria for "guideline exceedance" for cyanobacterial mats.

11.4 I do not agree with the Officers statement "*This highlights the need to manage nutrient inputs to the river year-round.*" The proliferation of periphyton is largely associated with summer periods of high light and temperature and low river flows. We have followed the recommended procedure in the national guideline for a summer management period when recreational use is high (MfE 2000).

12. AMMONIACAL NITROGEN

(Officers' Report Section 12.4.4(e) (p39))

The one possible exception is ammoniacal nitrogen if effluent is discharged at just above half median river flows under the proposed minimum dilution ratio and the river pH is elevated. The establishment of a maximum ammoniacal nitrogen effluent discharge and receiving water standards is therefore recommended.

Response:

12.1 I do not agree with this statement and have provided a response earlier (Section 8 of this response).

13. MACROINVERTEBRATE HEALTH12.4.4(e), p39

(Officers' Report Section 12.4.4(e) (p39))

Given the removal of the direct discharge at low flows the downstream macroinvertebrate community may become healthier. However this will depend on periphyton biomass which in turn is dependent on what effects seepage from the oxidation ponds and land disposal area will have. Monitoring of dissolved nutrients, periphyton and invertebrates is therefore recommended.

Response:

13.1 I do not agree with the Officers comment that the macroinvertebrate health "…*will depend on periphyton biomass which in turn is dependent on what effects seepage*…". I have addressed the health of the existing invertebrate communities in my evidence (sections 7.18-7.25), and conclude that there is "…*no marked changes or ecologically significant degradation in macro-invertebrate community structure between sites upstream and downstream of the existing MWTP discharge*." (section 7.24). Currently there is no strong adverse effects on invertebrate communities associated with periphyton downstream, but rather an increase in communities associated with algal growths (ie snails, midge larvae). An appropriate level of monitoring should be undertaken, but it should focus on periphyton and macroinvertebrate communities which integrate the water quality, rather than the highly time-varying nutrient concentrations.

14. NUTRIENT SEEPAGE PREDICTIONS

(Officers' Report Section 12.4.4(f)(b) (p39))

It is considered that the nutrient seepage to Makoura Stream could be higher than predicted given the concerns raised about the land disposal. For this reason it is considered appropriate to monitor water quality, stream flow and aquatic life.

Response:

14.1 I do not agree with this statement.

14.2 I do not consider that the uncertainty with regard to land treatment nutrient load predictions to the Makoura Stream would be a major driver affecting the heath of macroinvertebrate or fish communities. The stream is already highly nutrient enriched upstream and the removal of the continuous point source discharge will be most beneficial to community health. An appropriate level of monitoring should be undertaken to address specific evaluation and effects assessment objectives. Such a programme should be reviewed and revised after 2-3 years of operational data has been collected.

15. LOAD COMPLIANCE

(Officers' Report Section 12.4.4(h)(b) (p40))

Restrictions on the daily wastewater volume/nutrient load discharged. …

As such restrictions may have implications for the viability of the proposed WWTP operation (additional discharge to land and/or storage is likely to be needed), they will need to be discussed at the hearing, with clarification provided from the applicant on the rationale for and intended application of the minimum dilution ratio and maximum instantaneous discharge rate.

Response:

15.1 I do not agree with the proposal to require load compliance.

15.2 I have responded earlier to the issue with the minimum dilution ratio (Section 1) and the relevance of load compliance monitoring (Section 9). I provide further comment in my section on Compliance Monitoring.

16. ROUTINE MONITORING

(Officers' Report Section 12.4.4(d) (p41))

Regular monitoring of multiple sites within both the Ruamahanga River and the Makoura Stream. Monitoring of the Makoura Stream is required given its location within the land irrigation area and strong hydraulic connection with groundwater. Provision can be made in the consent conditions to review the frequency of monitoring after two years of the MWWTP upgrade being fully operative if monitoring does not detect any significant difference between upstream and downstream water quality.

Response:

16.1 I agree with the need for a routine monitoring. This should, however, be designed to detect effects on aquatic communities and to provide the supporting chemical monitoring to measure the effectiveness of the treatment system. Because the nature of the direct discharge and indirect diffuse discharges differ, there is a need to tailor the location and type of monitoring to suit the potential nature of the effects. I consider that a comprehensive monitoring programme should be in place for the initial two to three years following scheme initiation, with a subsequent review and rationalisation. The proposed monitoring programme in the Officers Report is extensive and includes components which would not add value. I provide further comment in my section on Compliance Monitoring.

17. ADEQUACY AND BASIS FOR 30:1 DILUTION RATIO

(Surface Water Quality Technical Report (SR) section 62 (p19))

17.1 As discussed in Section 6.7.2 of the AEE, a dilution factor of 30 is considered to be an appropriate value for oxidation pond wastewater discharges to freshwater. Previous work of relevance to the proposed scheme for Masterton, indicates that a dilution factor of 30 to 50 should usually prevent any stress on benthic invertebrate communities from occurring (Quinn & Hickey 1993). Other work reports that a dilution factor of 30 or more will also reduce the degradation of clarity in a clear stream from an oxidation pond effluent of average clarity. The median pond effluent suspended solids from the study of eight domestic oxidation ponds was 56 g/m3. Suspended solids was found in the study to be strongly correlated with clarity. The Masterton pond effluent by way of comparison has effluent suspended solids of 22 g/m^3 (median) and therefore the required dilution to achieve clarity impacts on the receiving water will be less.

17.2 The results of these studies and their receiving waters have shown that a wide range of impacts may be anticipated being influenced greatly by the variation in upstream clarity as well as the pond effluent quality. In view of this inherent variability, the approach used (and outlined in Section 8.2.3 of the AEE) was to determine clarity impacts of the discharge using a Monte-Carlo simulation. The clarity reduction at threshold flows averaged a reduction of 17% at 300 m (20 X dilution) and a reduction of 13% at 800 m (30 X dilution) (the range was 0-50% reduction and 0-42% reduction respectively). The upper 95%ile of clarity reduction for the partially mixed effluent in the threshold range is at the target range guideline value. Flows in this threshold range only occur for 4% of the time in summer and thus any aesthetic impacts will be minimal. It is considered that a clarity change of at least 50% will be required to result in a conspicuous change in this shallow river, where the bed generally dominates the perceived clarity and colour. Clarity impacts will decline at higher river flows because of higher background levels and greater available receiving water dilution. This approach confirms that the use of a 30 times dilution for full mixing of the effluent is appropriate for this situation. The same analysis was also carried out for *E. coli* as outlined in Section 8.2.3 of the AEE.

17.3 It should be noted that the river flow during freshes normally exceeds 36 m^3/s which is the value at which the WWTP discharge rate is restricted to 1.2 m^3/s (1.2 m^3/s X 30 times dilution = 36 m^3/s). River flows greater than 36 m^3/s will provide more than 30 times dilution.

18. ANZECC TRIGGER VALUES

(Surface Water Quality Technical Report (SR) section 47(b) (p14))

Dissolved reactive phosphorus concentrations, a key determinant of periphyton growth, consistently exceed the ANZECC (2000) trigger value for lowland aquatic ecosystems at both Wardell's Bridge (100% of sampling occasions over 2003-2008) and above the Waingawa River confluence (58% of sampling occasions). Exceedences are less frequent upstream of the discharge (29% of upstream sampling occasions).

Response:

18.1 I do not agree that the Officers should use these ANZECC "trigger values" as justification that the "…existing effects are both significant and adverse." (section 47 Introduction). The reasons for my opinion are set out below.

18.2 These numeric values are benchmark values from the New Zealand National Monitoring Network and provide a numeric value for the 80th percentile of 'upland' and 'lowland' rivers. The background report is provided on the MfE website

(http://www.mfe.govt.nz/publications/water/trigger-values-rivers-may00/index.html). Exceedance of this "trigger value" does not represent a measure of adverse effect, but rather that some investigation may be triggered into the higher than average concentration. It is very unfortunate that the ANZECC 2000 guidelines used the 'trigger' term for both physico-chemical (including nutrients) and toxicant guidelines.

19. BIOMASS AS MEASURE OF EFFECTS

*(Surface Water Quality Technical Report (**SR**) section 47(c) (p14))*

The applicant's assessment of the effects of the discharge on periphyton growth focused primarily on periphyton coverage across the river bed. Periphyton surveys have consistently reported greater algal biomass downstream of the discharge. An investigation undertaken by NIWA (2003) in summer 2003 showed an average twofold increase in periphyton biomass downstream of the discharge, with algal growth estimated to be up to 27.5 times higher than upstream5. Similarly, routine annual periphyton assessments undertaken for the applicant in both February 2007 and March 2008 found downstream algal biomass exceeded national guidelines (Biggs 2000) for the protection of benthic biodiversity (50 mg/m^2) and aesthetics/trout angling (120 mg/m^2). In the 2008 survey, chlorophyll a concentrations (an indicator of algal biomass) upstream of the discharge and downstream at Wardell's Bridge and the Waingawa confluence were 105, 267 and 99 mg/m^2 respectively.

Response:

19.1 I do not agree that "biomass", as measured by chlorophyll *a*, provides a more appropriate effects measure. The reasons for my opinion are set out below.

19.2 The sites downstream of the ponds are sensitive to both the settling and entrapment of algae from the pond discharge and to algae growing in the river environment. Thus higher chlorophyll a concentrations downstream of a pond discharge do not necessarily represent growth in response to nutrients, but could represent an artefact of the receiving environment. The sites reported in the MfE (2000) guideline document are all responding to diffuse nutrient inputs and not to pond-derived discharges.

19.3 The benthic biodiversity downstream of the discharge consistently increase downstream of the discharge as described in my evidence (section 7.24). The proportion of sensitive EPT species also remains high at the downstream Wardells Bridge site. These site data indicate minimal effects and do not support application the cited guideline values.

19.4 Again, the issues raised in this paragraph by the reviewing Officers do not justify classifying this site as "…existing effects are both significant and adverse." (section 47 Introduction).

20. EXTENT OF EFFECTS

*(Surface Water Quality Technical Report (**SR**) section 47(d) (p14))*

Macroinvertebrate surveys undertaken for the applicant have reported a lower quality invertebrate community downstream of the discharge. This was shown in the 2007 survey by a greater abundance of pollution-tolerant orthoclad and tanytarsus midges at both downstream sites compared with upstream, and in the 2008 survey by a lower abundance of pollution sensitive Deleatidium *and* Nesameletus *mayflies downstream of the discharge.*

Response:

20.1 I do not consider that the points raised in this paragraph justify classifying this site as "…existing effects are both significant and adverse." (section 47 Introduction).

20.2 An increase in pollution-tolerant species is expected downstream of an oxidation pond discharge because of the increase in organic food supply (Quinn & Hickey 1993). I have addressed the response of sensitive EPT species (including mayflies) in my evidence (sections 7.20-7.22), and would expect these to be among the species to respond when the discharge is moved.

21. DRP STANDARD DEVIATION

*(Surface Water Quality Technical Report (**SR**) section 81 (p5))*

The proposed in-river DRP standard of 0.012 g/m^3 (Table 4) was derived in strict accordance with the periphyton biomass model in the national periphyton guidelines (Biggs 2000), focusing on the protection of aesthetics/trout angling and taking into account the average number of days for periphyton accrual over the course of a year (19 days based on the full data record dating back to 1977, with a "filter" period of 5 days). We consider our standard to be more appropriate than the guideline proposed by NIWA (0.030 g/m3) which was based on a 13-day accrual period calculated from summer data only and a "filter" period of just one day. A standard of 0.012 g/m^3 also relatively closely aligns with standards in other regional plans (e.g., Horizons and Hawke's Bay both have a standard of 0.015 g/m^3 for some catchments) and the applicant's own predictions of the downstream concentration after full mixing (refer paragraph 70).

Response:

21.1 I do not agree with the proposed DRP standard of 0.012 g/m^3 or the derivation procedure used by the reviewing Officers. The reasons for my opinion are set out below.

21.2 The basis for our site-specific DRP guideline was field studies undertaken in 2003 which provided the confidence that summer freshes above 3x the summer median flow (6.5 m^3/s) would effectively scour and 'reset' the algal periphyton communities at Wardells Bridge. These results are shown in the NIWA report (NIWA 2003, Fig 5.2, p13) and provide the basis for the site-specific guideline development (NIWA 2004). We have provided detailed justification for our decisions of accrual period and flood "filter" period in our report (NIWA 2004). These clarifications were required for many measures because the MfE (2000) guideline document is not descriptive or methodological, with key variables such as 'accrual period' or 'median flow' not being defined in the document. Our field studies, combined with the routine monitoring data, provide the basis for our confidence in the approach we have taken.

21.3 There should not be an expectation that all DRP guidelines should be "align" as indicated by the Officers. Because not all rivers hydraulically similar, some being slow moving but others with frequent floods, this key variable will affect the site-specific guideline, with the guidance provided in the MfE (2000) document. Comparative data for the Manawatu and Ruamahanga rivers (Figure 1) shows the markedly longer inter-flood spacing in the Manawatu, with a strong (but similar) effect for the interflood-filter period in both rivers. These data show that flood effects will not be the same in these two river systems. Other field data has shown that the presence of high number of macroinvertebrate grazers can prevent periphyton bloom formation even at very high nutrient concentrations (Welch et al 1992). Together, these studies indicate that site-species DRP guidelines will vary markedly between river systems and that a fixed "standard" value approach is not appropriate for all situations.

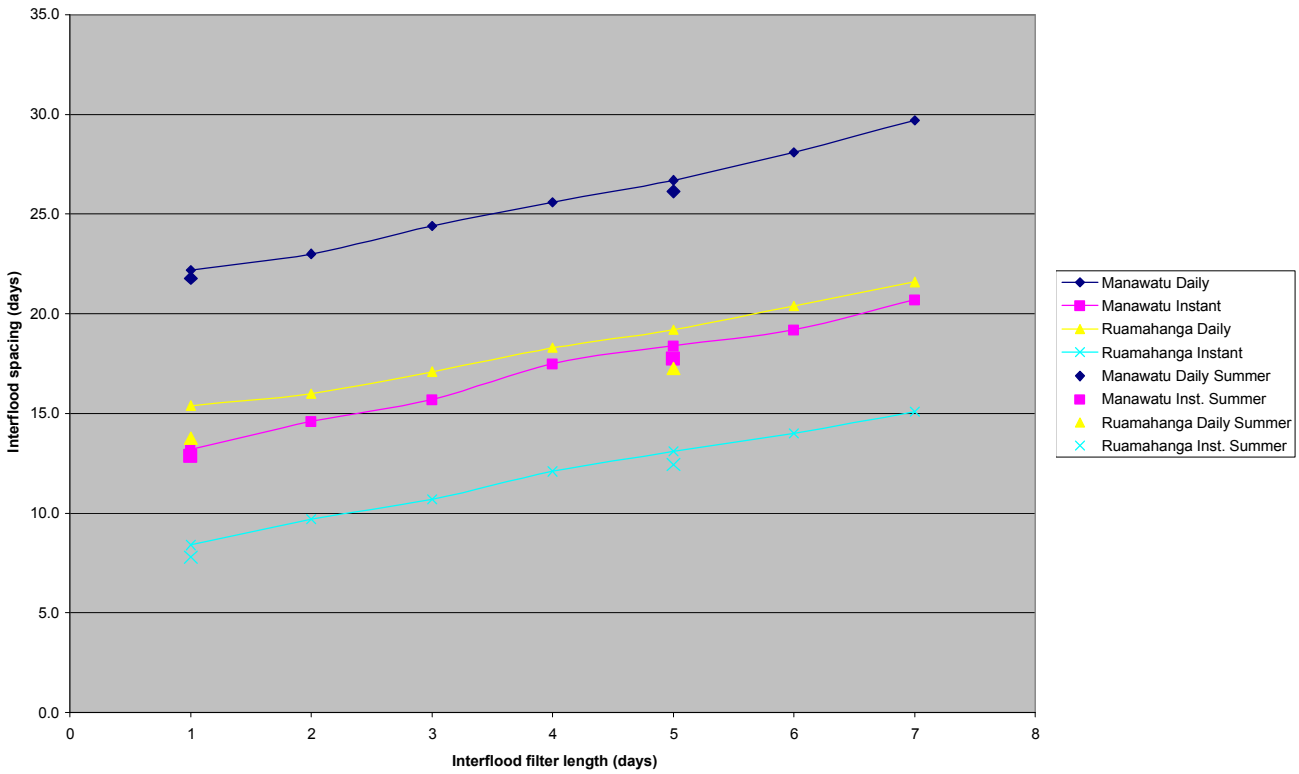

Figure 1 Comparison of interflood period relationships between Manawatu and Ruamahanga rivers (NIWA data, M. Duncan).

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