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

[GWRC Ref: WAR 070077]

In the matter of	a resource consent application to Greater Wellington Regional Council pursuant to section 88 of the Resource Management Act and its Amendments.
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In the matter of	a Notice of Requirement to Masterton District Council pursuant to section 168 of the Resource Management Act and its Amendments.
By	Masterton District Council
For	The Proposed upgrade of the Masterton Wastewater Plant

STATEMENT OF EVIDENCE OF JOHN HARDING
ON BEHALF OF MASTERTON DISTRICT COUNCIL

Subject Area: Peer Review and comments on public health issues

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1. INTRODUCTION

1.1 My name is John Richard Harding. I practice as a consulting engineer specialising in the field of wastewater engineering. I hold the qualifications of BE (Hons) (Civil) from Canterbury University and M.Eng.Sc (Public Health Engineering) from the University of New South Wales. I am a member of the Institution of Professional Engineers of New Zealand, and also a member of the New Zealand Water and Wastes Association. I have worked as a wastewater engineer for more than 35 years and have been a Director of PHE Consulting Ltd since 2003. In this role I provide advice to Government Departments, Councils and other clients in the field of wastewater engineering.

1.2 I am currently the Technical Adviser to the Sanitary Works Technical Advisory Committee (SaWTAC), which is the committee set up by the Minister of Health to make recommendations on the allocation of Sanitary Works Subsidy Scheme (SWSS) subsidies. This $173 M subsidy scheme was established in 2002 to assist local authorities provide sewerage schemes for small communities. As technical adviser to SaWTAC I am responsible for the review and evaluation of treatment and disposal proposals prepared by consulting engineers for district councils. There have been more than 140 applications for subsidy so far from communities spanning the length of New Zealand and involving a wide range of treatment options.

1.3 I previously worked for MWH NZ Ltd where I was technical adviser to Hutt City Council during the implementation of the new Hutt Valley Wastewater Treatment Plant at Seaview. I was a member of the tender evaluation team and took part in an international study tour to inspect treatment technologies offered by tenderers. I performed a similar role, including a study tour, during the planning and implementation of the Wellington Wastewater Treatment Plant at Moa Point. These two projects gave me good insight into international best practice wastewater treatment.

1.4 I was project manager for MWH during the preparation of the Issues and Options Report for the upgrade of the Palmerston North Wastewater Treatment Plant in 2002-03. This project is similar to the Masterton project in that Palmerston North is an inland city that discharges treated wastewater into a river, with the wastewater causing undesirable environmental effects at low flows. A comprehensive range of treatment and disposal options was prepared for consultation with the public. The consented upgrade involves ongoing full time discharge to the river after UV disinfection and part time phosphorus removal.

1.5 Last year I provided peer review evidence in relation to the Clutha District Council Milton Wastewater Upgrade addressing health risk issues and the practicalities of land treatment.

1.6 My professional involvement with the Masterton Wastewater Upgrade Scheme commenced in early 2004 when I was appointed independent peer reviewer for the project. At the time the integrity and professionalism of Council's staff and engineering advisers were being questioned by some members of the public and an experienced and independent view was sought. Since then I have attended Project Control Group meetings, have reviewed technical reports prepared by Becas and the various specialist consultants, have been involved in a number of the public consultation meetings and have attended Council meetings to provide overview reports. I have also prepared peer review reports for Council.

1.7 I have read the Code of Conduct for Expert Witnesses issued as part of the Environment Court Practice Notes. I agree to comply with the code and am satisfied the matters I address in my evidence are within by expertise. I am not aware of any material facts that I have omitted or might alter or detract from the opinions I express in my evidence.

1.8 My evidence is structured as follows:

(a) Scope of evidence;
(b) historical perspective and need for an upgrade;
(c) assessment of alternatives;
(d) pros and cons of 'state of the art' treatment options;
(e) key features of the selected option;
(f) the Inflow/Infiltration problem;
(g) health risk overview;
(h) conclusions.

2. SCOPE OF EVIDENCE

2.1 My evidence will address the key factors that have led to the selection of the proposed upgrade option. I will outline the key matters that Beca needed to take into account when developing the scheme for presentation to Council. I will compare the wastewater treatment and disposal circumstances for Masterton with those for several

comparable communities to illustrate the decision making logic that was followed in arriving at an effluent standard and a treatment process.

2.2 My evidence will address the current health risk and the improvement that will be achieved with the upgrade. It also provides an overview of the viability of ceasing the discharge of treated wastewater to the Ruamahanga River.

3. HISTORICAL PERSPECTIVE AND NEED FOR AN UPGRADE

3.1 Masterton's wastewater has flowed by gravity to the Homebush site since 1914. Primary treatment was provided in large septic tanks until 1970 when the existing two stage oxidation ponds were built, with the discharge piped into the Makoura Stream. These ponds have served Masterton well for nearly 40 years, providing reliable, low maintenance, low cost 'natural' treatment with low energy input. Pathogen removal is better than for a conventional mechanical secondary treatment plant without disinfection, however nutrient removal (ie phosphorus and nitrogen) is no better than a mechanical treatment plant and Dissolved Reactive Phosphorus (DRP) can be a problem at low flows, causing periphyon growth (ie slime on the stoney river bed) when the river is clear and warm.

3.2 The Ruamahanga River is typical of Tararua sourced rivers, being flashy in summer and winter. The peak flow at Wardells Bridge exceeds 800 cumecs, while the median flow is less than 13 cumecs. The frequent freshes flush the river and prevent any potential cumulative periphyton growth effects which might otherwise be attributed to the Masterton WWTP.

3.3 There is considerable non-point source pollution (ie rural run-off) in the catchment during wet weather and the river can be very dirty at times, with large mass loads of nutrients (nitrogen and phosphorus). These nutrients are discharged into Palliser Bay where their effects are not harmful and can be seen as beneficial in that they improve the productivity of the ocean. On an annual basis the contribution of nutrients from the Masterton WWTP is small relative to the total nutrient load discharged by the Ruamahanga River, as described by Jim Cooke.

3.4 During low flows the water quality upstream of the Masterton WWTP can be described as pristine, with low *E.coli* and DRP concentrations. This is when the effects of the existing discharge become most significant, with an algae rich green unmixed plume hugging the right bank of the Ruamahanga River downstream of the junction with the

Makoura Stream and extending downstream further than Wardells Bridge. This plume of partly mixed oxidation pond effluent compromises receiving water quality at Wardells Bridge, particularly on the right bank, and a warning sign advises people to avoid bathing.

3.5 There is a popular swimming location known as The Cliffs some 10km further downstream, past the junction with the Waingawa River. It is likely that this site was popular for swimming prior to the construction of the existing ponds in 1969, in the days when there was only minimal treatment provided by the old septic tanks. Since the ponds have been built, there have been no reports of swimming related illness, according to Andrew Ball. This supports the findings of his risk assessment, which concludes that the current discharge, whilst causing an elevated risk, complies with the MfE/MoH guidelines at The Cliffs and at Wardells Bridge. Nevertheless, swimming in a mixture of reasonably pristine river water and oxidation pond effluent is undesirable and distasteful, regardless of the risk. This is particularly the case at Wardells Bridge where the discharge is not fully mixed.

3.6 The ponds were constructed in the wet in an old gravel based river meander. In these conditions, it was not possible to provide a compacted clay liner, consequently the ponds have always leaked. The adverse effects (ie nutrients and pathogens) of the leakage have been monitored by NIWA and have been shown to be minor, even at low river flows when dilution is least. During the engineering investigation of options, the ponds were seen as an asset, albeit they were not constructed to modern civil engineering construction standards. The 2007 applications for the upgrade scheme proposed retaining them. However submissions in response to the interim consent hearing and the 2007 application demonstrated considerable public concern about the integrity of the ponds and perceived health risks caused by the leakage.

3.7 Submitters were also concerned that the existing ponds have been constructed in the Ruamahanga River flood plain and are vulnerable to erosion. The 2007 scheme required the expenditure of several million dollars on river defence works to protect the existing ponds, using heavy rip-rap.

3.8 As noted in David Hopman's evidence, the purchase of additional land allowed Council to consider the option of building new ponds, with the existing pond site to be restored and used for land treatment. I peer reviewed the Council's process of considering options made possible with the additional land. I am satisfied that the Council and its consultants adopted an appropriate process for considering those options.

3.9 Pond construction materials will be derived from the newly purchased land, and the cost of river defence work is much lower than for the 2007 scheme. The additional land area has provided space to build new ponds without compromising the area needed for land treatment of effluent. In my opinion the decision to build new ponds, though not essential from an environmental perspective, is desirable.

4. ASSESSMENT OF ALTERNATIVES

4.1 The selection of a wastewater treatment and disposal option always involves weighing up a number of complex and not always inter-related factors. Virtually every treatment/disposal situation is unique and requires a unique solution – there is no 'one size fits all'. Wastewater can be treated to a very high standard, limited only by how much money a community wishes to spend. However, water carriage wastewater systems produce very large volumes of contaminated water and the hardest part of the equation to solve is generally the selection of a method of treated effluent disposal which meets with public approval, especially Iwi.

4.2 The Masterton sewerage upgrade poses special challenges in that sewage flows are very high due to the amount of Inflow and Infiltration (I/I) experienced, as described in Malcolm Franklin's evidence. The average daily flow is around 15,750m³, which amounts to nearly 6 million tonnes of wastewater per annum. This influent quantity of dilute wastewater is more than double a normal design flow and the high flow does limit options, particularly in respect of land disposal.

4.3 Humphrey Archer's evidence provides a summary of the alternatives that were investigated for the Masterton WWTP upgrade. A complete history is provided in the AEE and in the Issues and Options Report (Beca, 2004). I peer reviewed both of these documents and I am satisfied that the most practicable options were properly considered.

4.4 The Masterton WWTP consultant team identified 3 options for the disposal of treated effluent, firstly 365 day disposal to river (as for Palmerston North and Hamilton), secondly 365 day disposal to land (as for Levin, Taupo and Rotorua) and thirdly a mix-and-match combination of land treatment and disposal to the river.

4.5 For 365 day disposal to river, wastewater treatment standards need to be developed to protect recreational users of the river and to prevent eutrophication at low flows

(ie excessive periphyton growth). Chris Hickey of NIWA was commissioned to carry out a study of the Ruamahanga River aimed at determining the limiting nutrient (nitrate or DRP) and at establishing the target in-river maximum concentration of this nutrient.

4.6 His study determined that DRP is the limiting nutrient for the Ruamahanga River and that a maximum in-river DRP concentration of < 0.03mg/L should be maintained for summer river flows below half median, or 6.2m³/sec.

4.7 The 0.03mg/L in-river DRP target figure was used by Beca when evaluating treatment options for a 365 day per annum discharge to river. This option has in fact been chosen for Palmerston North, where there is continuous 365 day 24 hr discharge to river of secondary treated effluent. In the summer there is UV disinfection, and when the river flow drops below half median chemical stripping of DRP commences, using alum. For Masterton, Beca determined that this option was not as cost effective as the selected option.

4.8 Beca also carried out a high level review and costing of a 365 day per annum effluent discharge to land option. It was concluded that the large volume of effluent requiring disposal and unsuitable soils result in a very large land area requirement. This means high costs, which effectively ruled out the option. I concur with this finding which is consistent with investigations for other wastewater treatment and disposal schemes around the country. While there is generally a public preference for full time land disposal of treated wastewater, 365 day per annum disposal to land only works for permeable soils with considerable depth to groundwater. The three major land treatment schemes in New Zealand are all based on permeable soils. Levin effluent is sprayed onto sand hills planted with pines, Rotorua effluent is sprayed onto volcanic ash planted with pines and Taupo effluent is sprayed onto volcanic ash used to grow pasture.

4.9 For the Palmerston North project some 1500 to 2000ha of land would have been needed for a 100% land disposal option. Locating suitable land near Palmerston North proved to be very difficult, therefore long and expensive pipelines to convey effluent to land to the west of SH1 would have been necessary. The cost of this option was estimated to be an unaffordable $80M, and the operating costs would also have been very high in terms of labour and energy. Further, when consultation meetings were held in the Himatangi vicinity, there was a very strong NIMBY reaction - the locals simply did not want Palmerston North effluent anywhere near them. A similar reaction

could be expected if Masterton was to contemplate long pipelines to outlying effluent disposal sites.

4.10 The third option that was investigated for Masterton was the ultimately selected mix-and–match option involving land treatment whenever possible, with discharge of treated effluent to the river when the river flow is > median and with any excess effluent stored until discharge to river can commence. This option has a major advantage in that Council already owns sufficient land to build a viable and sustainable mix-and-match scheme.

4.11 Oxidation ponds are an excellent fit with the adopted mix and match scheme because they can be built with freeboard for storage, they can handle Masterton's high peak flows without significant effect on effluent quality, they provide low operating costs (labour and energy), they are robust and by inclusion of maturation cells they produce a very good effluent standard, comparable with that achieved by UV disinfection. The proposed oxidation ponds are a generation ahead of the 1960's single stage oxidation ponds that have been widely adopted and have gained a poor reputation in some quarters. In this respect I note once more that the 2-stage Masterton oxidation ponds have provided excellent service at very low operating cost and energy input for almost 40 years.

5. PROS AND CONS OF 'STATE OF THE ART' TREATMENT OPTIONS

5.1 In my 35 plus years working as a wastewater engineer I have frequently encountered a misconception among some members of the lay public regarding wastewater treatment. There is a perception that there is a new treatment technology out there, or nearly out there, that has not been considered, or that New Zealand engineers are not up with the play and they know better overseas, or that there are technologies that convert sewage into biogas to provide a revenue stream, etc etc. As an example I recall the 'German system' which was proposed for Wellington by an entrepreneur whose main expertise was in armaments. This system was claimed to produce a 10:10:10 effluent which was far superior to anything else being considered at the time. While it certainly impressed people when it was presented to a public meeting in Rongotai, it in fact came to nothing.

5.2 As a general rule there is an inverse relationship between the size of a wastewater treatment plant and the cost of the plant. When treatment plants have to become smaller to fit compact sites, they become more expensive to build, more complex to

operate, less resilient to upset, less capable of handling peak flows and more energy intensive. New technologies such as Membrane Bio Reactors are now available and they appear attractive because, when working properly, they provide a very high effluent standard. However, like ponds they do not strip phosphorus, they can handle only very low peaking factors, are relatively unproven for long term service and come at a high cost, both capital and operating. The energy consumption of MBR's is particularly high, approaching double the energy used by an activated sludge plant and many times the energy consumption of the pond based treatment system proposed for Masterton. This is clearly an important factor as the cost of energy rises.

5.3 During the last 6 years while I have been the technical adviser to SaWTAC I have been responsible for evaluating the technical merits of a wide range of wastewater treatment options put forward by NZ's leading wastewater consulting engineers. In my view none of them would be more suited to Masterton's situation than the solution that has been adopted.

5.4 In my view the MDC proposal is sensible and sustainable. It goes somewhat further than is required from a physical environmental perspective but not as far as some would like in terms of cultural perspectives. I believe that it meets the definition of Best Practicable Option under the RMA. There are further enhancements that could be made, but in my opinion none of those are necessary from an environmental perspective and some have significant cost and or management issues associated with them.

6. KEY FEATURES OF THE SELECTED OPTION

6.1 Masterton is fortunate in that Council now owns a large site, relatively close to the urban area and at a suitable level which permits gravity flow of influent sewage. This generous site has permitted the development of an innovative and sustainable 'green' solution which I predict will be the envy of many other communities. Treated effluent will no longer be discharged to the river in the summer when the river flow falls below median, which means that for 66% of the 1 November to 30 April summer period, when the river quality is at its best and most desirable for recreation, there will be no discharge. When treated effluent is discharged to the river, the effects will be minimal.

6.2 The new oxidation ponds will replace will replace ponds built 40 years earlier. Pond design has advanced considerably since the 1970's, especially in terms of hydraulic design using maturation cells to prevent shortcircuiting and optimise pathogen

reduction. By using maturation cells the pathogen reduction will be comparable to a mechanical secondary treatment plant followed by UV disinfection.

6.3 The design and construction of the earthworks for the new ponds will be supervised by experienced geotechnical engineers to ensure that materials are carefully selected and properly compacted at optimum moisture content, using modern earthmoving equipment. This will minimise leakage.

6.4 Oxygen is needed to treat wastewater, and with conventional mechanical treatment plants, for example activated sludge, the oxygen is typically provided by blowers powered by electricity. Oxidation ponds are sometimes described as wind driven machines, with the oxygen needed for treatment being provided by a combination of wind and photosynthesis by algae. As a backup to cover the possibility of oxygen sag during long periods of calm, the new ponds will be equipped with aerators so that the operators have a "lever to pull" in the event of low surface dissolved oxygen levels.

6.5 During periods of low river flow the treated oxidation pond effluent will receive tertiary treatment through what is in essence a very large filter, namely the land treatment stage. This filter will strip much of the DRP and will reduce *E.coli* to low levels. It will perform the functions provided by chemical stripping and UV disinfection at the Palmerston North WWTP.

6.6 There will be a cut-and-carry pasture system which will provide a revenue stream. However I must emphasise that the prime purpose of the land purchased by the Masterton DC for border strip irrigation of effluent is to provide sustainable land treatment for as much effluent as possible, not for farming.

6.7 Effluent irrigation on pasture will be implemented by means of a border strip system. Preparation of the strips will involve careful grading using machines guided by lasers. The objective of the grading is to create uniform falls and to avoid low spots where effluent could collect. If this was allowed to occur, algae in the effluent could be expected to blind the surface, turn anaerobic and prevent infiltration.

6.8 I have seen this problem occur at the former Waikanae land treatment system where oxidation pond effluent was sprayed by a solid set sprinkler system onto undulating sandhills. Algae in the pond effluent blinded the surface in the depressions, creating a number of small ponds and preventing infiltration. For sustainable land treatment of

oxidation pond effluent, it is most important that such ponding is prevented and that the soil is rested and given the opportunity to aerate between applications.

6.9 The relative merits of border strip versus centre pivot irrigation have been addressed in the evidence of Neal Borrie. As Mr Borrie observes, the principal objective of the proposed wastewater irrigation system is to maximise the sustainable treatment and disposal of wastewater by land, not to maximise revenue from cropping the land or to maximise use of the effluent for irrigation. The Masterton District Council purchased the land for the express purpose of upgrading the wastewater treatment and disposal system, not to farm the land themselves, or lease the land to a neighbouring farmer.

6.10 Mr Borrie is an experienced consulting agricultural engineer with specialist expertise in the sustainable land treatment of wastewater. I have reviewed his evidence and I agree with the logic of his arguments. I am firmly of the view that either system would require re-grading of the land to prevent ponding of algae-rich oxidation pond effluent.

6.11 Opponents of the proposed border strip irrigation system argue that land treatment and disposal systems are losing favour because they are inefficient. Seen from a farming perspective, border strip probably is inefficient because it wastes water, however wasting water is clearly not an issue when the objective of this scheme is to maximise land treatment and minimise disposal to the river. Conversely, if we were in Australia where water is far more highly valued, centre pivot may well be sensible.

6.12 Centre pivot irrigation would be more energy intensive than border strip because it would involve higher pumping heads. It would increase the amount of effluent disposed of to the river and furthermore it would create aerosols which could be expected to travel off-site on windy days, which would be a concern for the neighbours.

6.13 The Council's proposals will not preclude the use of treated effluent on private land. A market for the effluent may well develop in the future, and provided users are responsible for obtaining consents and for any additional treatment needed, it should be encouraged because it would re-cycle nutrients in the effluent and would reduce the volume discharged to river.

6.14 Any such demand for effluent is likely to be for deficit irrigation. I cannot imagine that neighbouring farmers would be interested in taking effluent in the winter, or during wet periods in the summer. Because Council has to deal with wastewater 365 days per year, it has to have full control of a viable, reliable and sustainable means of treated

wastewater disposal. If a market develops in the future, it should be seen as a bonus, not as an essential component of the scheme.

6.15 The present focus should be on utilising the Council land and getting on and constructing the upgrade. I do not see any merit in further delays.

7. THE INFLOW/INFILTRATION PROBLEM

7.1 Masterton District Council is running two projects in parallel, one being the upgrade of the wastewater treatment plant and the other being the upgrade of the leaking reticulation system. This would be a major financial challenge at the best of times, but it is especially so in today's economic climate.

7.2 With a mix and match treated effluent disposal scheme the amount of effluent that receives land treatment is of course finite for a given land area, while the amount that is disposed of to river is a function of the total flow. In other words, it is the surplus treated effluent flow above the capacity of the land which is discharged to the river, and in Masterton's case the surplus is largely the result of I/I, in other words it is the result of rainwater rather than sewage.

7.3 The estimated replacement value of the sewerage reticulation is around $80 million, with another $35 million for private laterals. (Malcolm Franklin evidence) If the economic working life of this asset is 100 years, around 1% of the asset value or $1.15 million needs to be spent annually just to "hold the line", ie maintain the current, admittedly poor, asset condition and prevent I/I getting worse.

7.4 As noted in David Hopman's evidence, Council plans to increase expenditure on I/I reduction to approximately $2 million per year over the next 5 years, which in theory should do somewhat better than just holding the line and should provide some reduction in the average annual influent flow. While I certainly support this level of expenditure, the actual benefits of this increased rate of spending remain to be seen.

7.5 Given that discharge to the river will only occur at flows > median in summer when effects on river water quality will be minimal, a higher rate of expenditure on I/I reduction would be difficult to justify solely in terms of receiving water environmental benefit.

8. HEALTH RISK OVERVIEW

8.1 For this project specialist advice on health risk caused by the existing and proposed discharge has been provided by Andrew Ball of ESR in Christchurch. For the AEE investigations Andrew was the author of the Health Impact Assessment (HIA) (Ball, 2007) which I reviewed. As described in Andrew's evidence, the HIA determined that the current risk of infection at Wardells Bridge at median flow is 7.3 per 1000, which is less than the acceptable limit described in the HIA of 10 per 1000 and inferred from the MfE/MoH Microbiological Water Quality Guidelines, 2003.

8.2 The 7.3 per 1000 figure for Wardells assumes full mixing, when in reality with the oxidation pond plume running down the right bank the model does understate the risk for the right bank, and overstate it for the left. Given that there is warning signage and very few people swim at Wardells Bridge at present, the difference is perhaps academic. However I do note that currently at low river flows, ie well below median, there is less dilution, and the risk at Wardells Bridge may rise above 10/1000, which is unacceptable.

8.3 Following the upgrade there will be no summer discharge of treated effluent at river flows < median. According to Andrew Ball's model, this reduces the risk to less than 0.3 per 1000 at Wardells Bridge, which is much better than the acceptable risk of infection limit of 10/1000.

8.4 It has been suggested that swimming can take place in the Ruamahanga River at flows higher than the 12.3 m^3/sec median flow, when there will be a discharge of treated effluent. The water quality *E.coli* implications of discharging treated effluent diluted 30 times in this flow range have been examined by Chris Hickey and have been described in his evidence.

8.5 Table 11 in Chris Hickey's evidence illustrates what he predicts will happen after the upgrade when treated effluent is discharged to the river in the 12.3 to 20 m^3/sec threshold flow range. The median upstream *E.coli* concentration in this flow range based on recorded data is 83cfu/100mL, and after treated effluent is discharged the downstream concentration is predicted to increase by around 4.3% to 87cfu/100mL. These figures are both well under the MfE/MoH "alert" level of 260cfu/100mL.

8.6 The significance of Table 11 is that it clearly shows that upstream water quality determines water quality downstream when discharge is taking place. If the upstream

water quality complies with the guidelines, the downstream water quality will as well. This can be explained by the proposed 30 times dilution of the treated effluent. In simple terms the upstream to downstream *E.coli* increment is 300 divided by 30, or 10cfu/100mL. In fact it is even less than this, as shown by Chris Hickey's Monte Carlo simulation which combines the distributions of two data sets, ie upstream river quality and predicted effluent quality.

8.7 The other point which must be remembered, is that risk is a product of concentration and exposure. As flows and current velocity increase and the water temperature drops, the river becomes less attractive for swimming. Contact recreation above median flows in summer will not be in significant numbers and will mainly be secondary contact. Furthermore, the river is only in this threshold range infrequently and for a very short time.

8.8 There is currently a warning sign at Wardells Bridge advising the public not to swim on account of the Masterton WWTP discharge. The analyses by Chris Hickey and Andrew Ball have demonstrated that the post upgrade water quality at Wardells Bridge will be virtually the same as the upstream water quality. The water quality will only deteriorate at higher flows as a result of non-point source run-off. The need for a warning sign can therefore be questioned, however given that public confidence may be an issue, the most pragmatic approach to signage may be to monitor the water quality upstream of the plant and at Wardells Bridge for a year or two after commissioning the upgrade. This monitoring should demonstrate that the plant does not adversely affect water quality, and that warning signage can be removed.

9. CONCLUSION

9.1 The existing ponds have provided good service for nearly 40 years. Cumulative adverse environmental effects in the Ruamahanga River have been minimised by frequent freshes.

9.2 At low river flows phosphorus in the effluent is a problem. At high flows the MWTP is a relatively small contributor of the total phosphorus load, with the majority coming from rural run-off.

9.3 The current health risk at Wardells Bridge at low flow is, in terms of the MfE/MoH Guidelines, marginal, however there are no reported incidences of illness attributed to the river.

9.4 The upstream water quality varies from pristine at low flows to poor at high flows. After the upgrade there will be no discharge of treated effluent at low flows.

9.5 A wide range of treatment options has been investigated. Masterton's abnormally high Inflow and Infiltration (I/I) limits viable treatment and disposal options.

9.6 The high average and peak flows mean that removal of all discharge from the Ruamahanga River is not a viable option.

9.7 Oxidation ponds are well suited to treating the high average and peak influent flows.

9.8 The reticulation system is defective, however repair would be very expensive and may not result in a significant reduction in I/I.

9.9 After the upgrade, the Masterton WWTP will not adversely affect the river water quality at low or high flows.

9.10 After the upgrade, the Masterton WWTP will not adversely affect the health risk for river users.

9.11 The proposed upgrade will protect public health and provide Masterton with an innovative, economic, robust, reliable, sustainable and "green" wastewater upgrade solution that should serve the community well for at least another 40 years.

9.12 As peer reviewer for the project, I am satisfied that the proposal is sensible and sustainable and in my opinion represents the best practicable option for the community.

9.13 I am also satisfied that the Council has properly considered alternatives and has reached a sound decision based on good advice.

John Richard Harding
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PHE Consulting Ltd
13 February 2009