ENVIRONMENT WAIKATO

Memorandum

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To D Pearks, M Wood and A Meredith

From N Selvarajah

Subject **Review of the Proposed Waste Water Treatment and Disposal System for Morrinsville**

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The existing treatment system
The current treatment system receives four major waste water streams *viz*. Anchor Products, domestic sewage, Waikato Beef Packers and Du Pond Peroxide. It is clear that the existing treatment system employed by Matamata Piako District Council (MPDC) is not efficient to handle the existing loading of effluent let alone the proposed future loadings. The existing system comprises of two mechanically aerated ponds and one 'oxidation pond'. Considering the strength of the waste water stream, the extent of aeration provided is not sufficient to icrease dissolved oxygen levels to breakdown dissolved organic carbon in effluent.

The 'oxidation pond' functions as effleunt retention pond prior to final discharge into the Piako River. The 'oxidation pond' is unusually deep, about 8 m depth, and hence cannot be expected to function as a typical oxidation pond. Generally oxidation ponds are constructed shallow due to the following reasons: (a) to be aerated by turbulence caused by wind (b) to increase dissolved oxygen levels through algal growth (c) to kill harmful bacteria using natural UV rays provided by sunlight Except for the Du Pond Peroxide waste water others are discharged into the first aerated pond whilst Du Pond Peroxide waste water is discharged directly into the 'oxidation pond'.

The effluent quality data presented for the existing aerated pond and 'oxidation pond' from July 1993 to March 1994 clearly indicate the following characteristics which suggest that the extent of aeration was not sufficient:

1. High presence ammoniacal-N (NH_4/NH_3-N) and nitrite-N (NO_2-N) compared to nitrate-N (NO_3-N).
2. High presence of BOD and COD.

It is also very clear that among the three major effluent streams received for treatment, the effluent from Anchor Products is the strongest and difficult one to deal with due to its high BOD, nitrogen and phosphorus contents and greater temporal effects on the treatment system. For example the oxygen demand contribution by Anchor Products to the waste water stream is approximately 54%. Consequently, as acknowledged by the consultants for MPDC, the BOD of the influent is 4-5 times greater than the conventional municipal influent. Moreover, the peak milk production and processing correspond when the Piako River flow is at its lowest annual level. It must also be emphasised that the Anchor Products waste water stream also introduces a substantial quantity of dissolved reactive phosphorus which is difficult to treat using conventional biochemical treatment processes. This characteristic of the Anchor Product waste water also reflects on the effluent data obtained from July 1993 to March 1994 where >85% of the total phosphorous was dissolved reactive phosphorus. In my opinion, if the Anchor Products waste water stream is eliminated the existing treatment system will not require the substantial changes that have been proposed by the consultants.

From the information provided by the consultants it is ambiguous whether the nitrogen input provided for domestic sewage was an estimate or measured value. Considering the Morrinsville population of 6000 the total kjeldhal nitrogen (TKN) estimated by the consultants (i.e. 90 kg TKN/day) appears to be very high. Assuming there is little or no nitrogen input from other industrial effluent sources into domestic sewage, the TKN figure given translates into 15 g N/person/day. Since this is the average theoretical daily N output for an adult, it can be argued that the TKN value provided was correct. However, considering about 80-90% of this nitrogen is urea-N which rapidly hydrolyses into ammoniacal-N, there is a greater potential for a high proportion the excreted N to be lost into the atmosphere as ammonia gas through ammonia volatilisation process. Consequently, the actual N input from the domestic sewage could be substantially lower than quoted in the report.

It has been claimed in the Consultancy report that in November 1994 the aerated ponds were modified by installing motorised control valve between aerated pond 1 and 2 and by changing the aeration sequence. The consultants indicated that although the above changes resulted in substantial reductions in SS and BOD, the existing 'oxidation pond' did not provide the conducive environment for an anticipated ammoniacal-N reduction. In my opinion it is difficult to comment on the 'modified' existing system unless a full data set is provided on the effluent quality after the modifications.

The treatment options review

The proposed system

Following a review of the existing system and other available future options the consultants for MPDC have recommended the use of retrofitted aerated lagoons combined with tertiary treatment and overland flow discharge. The discharge quality predicted from such a treatment system is several folds better than that of the current discharge quality. Using the technology that has been proposed the predicted quality can be achieved. However, I am concerned that MPDC appeared to have decided to use the proposed system without proper consultation with the New Zealand Dairy Group (NZDG) regarding their long-term plans. According to the NZDG strategic plans there will be only four major sites that will be used for milk processing in future. It appears that sites such as Morrinsville will be closed down within few years. Moreover, the current status of the beef market does not provide certainty to meat factories such as Waikato Beef Packers to sustain meat processing. If the poor beef market trend continues either less animals will be slaughtered or the plant will be shut down until the beef market recovers. If both dairy and meat factory waste waters are stopped from entering the

waste water stream for the above reasons, MPDC will inherit an effluent treatment plant whose capacity will be several fold greater than required for merely treating municipal waste water. Considering the relatively stable human population of Morrinsville, the proposed effluent treatment plant will have to wait for many years until used to its full capacity.

Land treatment system

Nitrogen loading rate

There have been references made about the use of land treatment system as an option to treat effluent. In my opinion land treatment system undeservedly received very little attention from the consultants, probably due to their lack of knowledge about land treatment systems. It is unclear how the estimates for land treatment system were made by the consultants. For example the land area required for high quality effluent was estimated as 84 ha without stating the annual N loading rate (i.e. kg N/ha). A simple review of the recent resource consents granted by Environment Waikato would have indicated that N loading has been one of the most important factors determining the outcome of the applications for land treatment system. For example, an average N loading rate of 300 kg N/ha/year has been granted by Environment Waikato to Anchor Products (i.e. Buxton (Hautapu) Farm and Lichfield Farm) and Wallace Corporation, Waitoa.

Time frame for implementation

The time frame to implement a land treatment system was estimated by the consultants as 2 years due to land acquisition and irrigation trials. In my opinion from environmental risk assessment view point, up to 300 kg N/ha/year can be used as N loading rate for clover based pasture (grazed by dairy cows) without any prior irrigation trials. On the other hand, if a 'cut & carry' (without grazing) system is used, the loading rate could be up to 600 kg N/ha/year. Such a 'high' loading rate has been granted to Taupo District Council by Environment Waikato to treat Taupo domestic sewage effluent.

It must be emphasised that if the above N loading rates are to be exceeded due to lack of irrigable land availability, a 2 year trial will not be able to justify a greater N loading rate. This is because soil-N mineralisation-immobilisation turnover is a very complex biochemical process and hence warrants at least 5-6 year trials.

Concerns about animal and human health

The consultancy report also indicated that land treatment system is one of the most expensive options available for MPDC. There were references made in the report that several Morrinsville farmers were interested to irrigate the effluent onto land. It was ambiguous whether this option was persuaded by MPDC or its consultants. Such an option does not involve a high capital burden and it is one of the best practicable options. The only concern could be animal or human health. However, according to Canterbury Health gastroenteric helminths (tapeworms) do not occur under New Zealand conditions due to the prevailing sanitary customs and climate which are not conducive to maintain life cycles. A recent laboratory test performed on a waste water stream (sewage and dairy factory) from Anchor Products, Waitoa confirmed the above assumption. On the other hand, the threat to animal health could be from Waikato Beef Packers waste water where animal faeces and blood could carry certain pathogens. Providing sufficient retention time in treatment ponds and maintaining at least 2 weeks stock withholding period from grazing are conditions unlikely to cause any potential animal diseases. If in doubt the waste water could be screened for pathogens.

Controlled discharge to river
Another option that was not considered by the consultants was a combination of land treatment and discharge into waterways. According to this option the effluent discharged into Piako river during winter months and during balance of the year irrigated onto pasture. Currently, such an option has been used by Wallace Corporation, Waitoa. This option disallows effluent discharged into waterways during low flow periods and hence utilises the additional moisture required for spring and summer pasture growth.

Land treatment of Anchor Products effluent
A further option which received little or no attention was using land treatment system to treat Anchor Products waste water throughout the year. There are several sites in the Waikato regions where dairy factory effluent is treated using land treatment systems (e.g. Lichfield, Hautapu, Reporoa) despite high sodium levels in dairy factory effluent. High levels of sodium in effluent could result in soil structure depletion and poor infiltration. Anchor Products argues that there is a substantial amount of other cations present in dairy factory effluent which would help minimise sodium saturation in soils. Moreover, Anchor Products is also committed to reduce sodium levels in effluent by improving recycling of cleaning agent such as caustic soda.

It must be noted that there is sufficient information available on the potential of Waikato soils to treat dairy factory effluent. Considering the high BOD, COD and dissolved reactive phosphorus levels of the dairy factory effluent, land treatment system is the best available option to treat dairy factory waste water. Allowing such a high carbonaceous waste water into municipal sewage waste water stream not only demands a very expensive and sophisticated treatment plant but results in significantly high running cost. From an energy efficiency view point oxidising this rather slowly biodegradable waste water using electrically powered treatment plant appears to be not sustainable. Like other Anchor Products waste waters, the Morrinsville Anchor Products waste water could be applied onto land without any pre-treatment. In my opinion such an approach is energy efficient, less expensive and promotes the concept of 'waste' recycling.

'Waste disposal' vs food production
It appears that there is a considerable confusion over the concept of 'waste disposal' and 'waste recycling'. The first concept does not consider waste as a resource and hence looks at ways to 'dump' it. The latter considers 'waste' as manure to improve soil fertility to maintain or enhance food production. It must be emphasised that when a land treatment site is managed efficiently the soil quality is likely to improve rather than deteriorate. Consequently, the issue of best use of high quality soils, i.e. food production vs waste 'disposal' does not arise.

Forestry irrigation as land treatment system
In New Zealand several exotic forest areas are used as land treatment systems to treat domestic sewage (e.g. Rotorua, Whangamata, Whiritoa). The existing information suggests that compared to pasture irrigation of effluent, forest irrigation requires greater land area. This is because the N uptake of forest trees is substantially less than pasture (100 kg N for *Pinus radiata* compared to 600 kg for 'cut and carry' pasture system) and forest system is unable to treat waste water with high hydraulic and BOD loadings. It could be argued that *Eucalyptus spp* grown for firewood production could tolerate greater effluent loadings than *Pinus spp*. However, in my opinion converting existing high quality pasture soils in the Morrinsville area to produce forest is not an option to sustain soil quality and versatility in the region. On the one hand, forest plantations do not require high quality soils, on the other, soils used for forest production require a substantial amount rehabilitation to return to pasture production. For these

reasons use of forestry as a land treatment system to treat Morrinsville waste water (i.e. combined waste water stream) is not recommended.

Other systems

The treatment systems proposed (in the consultancy report) with direct or indirect discharge of treated effluent into the Piako River will result in effluent quality substantially better than the existing system. Nevertheless, these systems do not either meet Iwi requirements or result in high quality effluent which is required to improve the existing Piako River quality substantially. Moreover, the high capital investment made on these systems may not be worthwhile, considering the future reduced effluent loadings due to Anchor Products' and/or Waikato Beef Packers' strategic decisions to cease or reduce their operations.

Impact of the proposed effluent discharge on Piako River water quality

This topic will be dealt by Dr A Meredith, Resource Information Group, Environment Waikato. However, the following points are noteworthy:

1. Currently many dairy farms in the Piako catchment discharge oxidation pond effluent into waterways. Although comparatively these discharges are much smaller than municipal effluent discharges, considering the high number of dairy farms in the catchment such discharges can cause high cumulative impact. The introduction of transitional regional plan to manage dairy farm effluent in the Waikato region by Environment Waikato in 1994 means that dairy farmers in this catchment must apply for resource consents to discharge treated farm effluent. Consequently, the farmers must pay an annual administration fee to Environment Waikato. However, according to the *1994 Dairy Shed Effluent Operative Plan*, farmers who use land treatment system to treat dairy farm effluent are exempted from applying for resource consent or paying administration fees. These incentives combined with farmers awareness regarding the high fertiliser value of farm effluent are currently resulting in many farmers selecting land treatment system as the most preferred system. The predicted trend for the Waikato region is that by next year 60% of the dairy farms will not be discharging pond effluent into waterways. If such a trend continues there will be high improvement in the Piako River water quality. Consequently, it is reasonable to expect other dischargers in the catchment to either improve their effluent quality substantially or cease discharge to waterways by using land treatment systems.

2. The effluent target pH of the discharge should be 6-8, not 6-9 as stated in the draft conditions. This because high pH (>8) has the potential to increase free ammonia (NH_3) in receiving waters.

3. There is no proposed strategy to manage nutrient discharges in the draft conditions until a 2 year review is performed. For example there has been references made to dissolved reactive phosphorus treatment by polyelectrolyte dosing. However, there was no target level set for phosphorus reduction. Moreover, it has been stated that there will be a substantial reduction in nutrient input to the river. The information provided suggests that from mass loading view point the mineral-N (ammoniacal-N + nitrate-N) loading reduction achieved following the treatment plant upgrade will only be 25% of the existing loading (using pre November 1994 data). This is because whilst attempt has been made to reduce ammoniacal-N, nitrate-N loading has increased substantially. Furthermore, there is no consideration to manage organic-N in effluent discharge.

4. In my opinion considering the commitment of MPDC to minimise stormwater intrusion and Anchor Products and Waikato Beef Packers to minimise waste water generation, consent requiring to discharge 10000 m^3/day when the Piako River flow exceeds Q_5 low flows is overly conservative. A daily discharge of 4500 m^3/day is sufficient and achievable.

5. Similarly, considering the proposed 5 g/m^3 compliance level for ammoniacal-N the proposed loading for TOD (total oxygen demand) is very high during >Q_5 low flows. A maximum TOD loading of 100 kg/day is achievable under all conditions. Moreover, considering the upstream TOD of 2.5 TOD g/m^3 (estimated from J C Rutherford's report), a compliance level of 20 g/m^3 TOD downstream is overly conservative. Assuming the flow rate of 490 l/s this translates into a TOD loading of 740 kg/day! The maximum proposed TOD loading when the flow rate is >2000 l/s is only 294 kg TOD/day. However, using a loading rate of 100 kg TOD/day at 490 l/s flow rate the downstream river TOD level will be approximately 5 g/m^3 (assuming an upstream TOD level of 2.5 g/m^3). Since there is uncertainty attached to the upstream TOD levels I believe an increase in TOD level of 2.5 g/m^3 downstream could be used as more practicable and achievable compliance limit.