Threats to land treatment systems in New Zealand

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1. INTRODUCTION

New Zealand has an extensive land area that is currently utilised mainly for agricultural, horticultural and silvicultural uses. Most agricultural and horticultural areas are on rolling to flat landscapes. With the exception of the West Coast, New Zealand has moderate to low rainfall.

Most regional councils in New Zealand prefer land treatment systems over discharge to surface water. Maori also have a preference for land treatment systems. It is culturally offensive to discharge human effluent to fresh water which affects the Mauri of water.

It has been nearly 14 years since the enactment of the Resource Management Act (RMA) and 16 years since the establishment of the New Zealand Land Treatment Collective. Effluent assimilation in soil has been studied for nearly 50 years in New Zealand, more intensively for the past 10 years. Currently there is substantial information available on contaminant reactions in soil and leaching and bypass flow of contaminants to groundwater.

Those who know land treatment systems will accept that the sophisticated artificial biological and mechanical systems for treating waste water cannot match the effectiveness of a well managed land treatment system. Table 1 illustrates the key differences between the two systems.

Table 1

	The best available artificial biological and mechanical waste treatment systems	**Well managed land treatment systems**
1.	Discharge will contain most contaminants, eg ➢ phosphorus ➢ nitrogen ➢ suspended solids ➢ BOD ➢ pathogens ➢ hormones	Leachate may contain only nitrate
2.	Culturally offensive when discharged to fresh water.	Culturally acceptable.
3.	Mixing zone may be required for surface water discharge.	No surface water mixing zone is necessary.
4.	No income derived from waste water treatment.	Plants or animals could be produced on most land treatment systems.

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I have noticed that the North Island has many more land treatment systems than the South Island. Some examples are: sewage effluent discharge to forest sites at Whangamata, Whirito and Rotorua; sewage effluent discharge to pasture in Taupo; dairy factory effluent discharge to pasture at Hautapu and Lichfield; and meat processing effluent discharge at Waitoa and Richmond.

In contrast, in the South Island, with the exception of a few meat processing waste water discharges to land in Canterbury and a sewage discharge to forest in the north of the South Island, there are no major land treatment systems. One would have expected the South Island to have more land treatment systems because of dry weather conditions in the east.

I am concerned that despite the great potential for the use of land treatment systems in New Zealand, many waste water discharges continue to rely on artificial biological and mechanical treatment systems that promote often poorly treated discharge to surface water. It is timely that the New Zealand Land Treatment Collective and soil, water or waste water scientists discuss any limitation to land treatment systems in New Zealand and explore and advocate ways to remove any roadblocks that exist.

This paper discusses critically the poor uptake or use of land treatment systems in New Zealand. Many of the issues that are discussed in the paper are considered as threats to land treatment systems in New Zealand, hence the title of the paper. The paper particularly targets the members of the New Zealand Land Treatment Collective, land-based scientists and experts, and to an extent the wider community New Zealand.

2. DISCUSSION

The threats to land treatment systems in New Zealand as I see them could be divided into the following categories:

Knowledge	a)	Lack of knowledge
	b)	Lack of expertise
	c)	Lack of technology transfer
	d)	Lack of appropriate research
Attitude	e)	Lack of urgency in resolving surface water quality issues
	f)	Widely accepted practice of "dilution as a solution"
	g)	Lack of cultural and community pressure against discharges to surface water
Environmental and economic	h)	Market forces
	i)	Soil, climate and groundwater conditions

a) Lack of knowledge

Whilst many people associated with land treatment systems through research or operation are aware of the capabilities of land treatment systems, a majority of the community including the waste treatment experts do not appear to have fully grasped the concept and functions of land treatment systems.

When approached by any potential land treatment system users such as district councils, waste water treatment "experts" tend to downplay the significance and advantages of using land treatment systems. In most cases the "in house" waste treatment engineers of district councils do not have sufficient knowledge in land treatment systems and hence they, with the support of waste water consultants, advise district councils to adopt or continue with surface water discharges.

I am also concerned that a basic knowledge of land treatment systems does not exist at policy maker or consent officer levels. Many such people are trained in planning matters and have had little or no opportunity to learn the basics of land treatment system processes.

b) Lack of expertise

New Zealand is regarded as one of the top countries in specialist knowledge and skills in land treatment. In the past decade New Zealand has performed much key research in land treatment of waste water. Despite this there is a shortage of land treatment expertise.

A good understanding of the land treatment system process requires at least a basic knowledge of soil science. Many waste treatment experts are engineers who did not have the opportunity to gain soil science knowledge during university studies.

I am not aware of any waste treatment training or courses in New Zealand that offer training in soil science or waste water interaction in soils.

I am afraid that the existing expertise pool in land treatment processes is small and is ageing rapidly. I am unable to see a full replacement of even the existing small pool of expertise. The current university and school education systems are not conducive to alleviating the expertise shortage. Current education systems appear to promote commerce, information technology and social studies. In the past the agricultural or horticulture graduates who studied at either Massey or Lincoln universities pursued soil science post-graduate degrees. Most such graduates have become either soil scientists or land treatment system experts. I understand that the numbers of students registering for agriculture and horticultural degrees have been declining rapidly, hence it could be argued that the opportunity to maintain or increase the existing pool of expertise in land treatment process is very slim.

c) Lack of technology transfer

As I stated before, New Zealand is one of the leading nations in land treatment research. Despite this, the lack of knowledge continues to exist among the end users such as the industries and district councils, policy makers from the district and regional councils and central government, consultancies and the wider communities.

The New Zealand Land Treatment Collective has been functioning since 1989. The Collective has played a pivotal role in technology transfer in New Zealand consultancies, industries and researchers to its annual or biennial meeting. In 2000 the Collective, with funding assistance from MfE, produced the New Zealand guidelines for utilisation of sewage effluent on land. The Collective networking also encouraged access to information from researchers who hold a subsidised membership with the Collective. The Collective has also been publishing annual reviews on key land treatment issues and collation of conference

papers. Field trips are also an integral part during the meeting of the Collective members. Such field trips enabled access to practical and "hands on" information on land treatment systems.

Despite the good work by the Collective, I would argue that there is considerable lack of knowledge on land treatment systems and hence we need to consider ways of improving the technology transfer process.

The expertise that exists within consultancies may not be accessible for technological transfer since the cost may be prohibitive. On the other hand the knowledge that exists within the research organisations and universities is not transferred regularly because the existing government funding system is not conducive to promote an effective technology transfer. Generally, technology transfer from research organisations and universities occurs through research publications and such publications rarely reach the end users. Even if publications are accessible by the end users, they are not in an easily understandable form.

d) Lack of appropriate research

As stated, intensive and extensive research on land treatment processes occurred within the past decade in New Zealand. Although soil research on nutrient cycling in soils has been in existence in New Zealand for more than 50 years, such research has been complementary and pivotal to the understanding of the land treatment processes.

Substantial information had also been collected from many existing and consented land treatment systems through consent monitoring. Unlike traditional soil research on land treatment processes, the consent monitoring of the land treatment systems has provided valuable groundwater quality and land treatment process information.

Most soil research is conducted on lysimeters or under controlled conditions, hence information on groundwater contamination is not often available. Often, it is difficult to simulate grazed pasture conditions in controlled land treatment trials.

Many research projects had been developed on the basis of existing issues and hence been reactive to issues. Often reactive research projects are either poorly planned or are short-term projects. If researchers have access to good information they do not appear to provide advanced information to policy makers or operators.

Many consented land treatment sites hold long term soil, effluent and groundwater information that will enable better understanding of land treatment processes. I see there is an opportunity to engage intensive studies on consented land treatment sites, however, with the exception of one or two sites, researchers continue to ignore any such complementary studies.

e) Lack of urgency in resolving surface water quality issues in New Zealand

Since the enactment of the RMA in 1991 there have been wider awareness and focus on improving surface water quality. In some cases, stringent standards have been imposed by regional councils to improve existing discharges to surface water. Despite this move many poor quality discharges to surface water continue.

Our understanding of the relative contribution of point and non-point sources has improved substantially in the past several years. Since it has been identified that the point discharges contribution to surface water pollution is about 30%, in contrast to the 70% from the non-point sources, our attention appears to have shifted towards resolving non-point source discharges.

In the past the government has attempted to provide awareness through water quality guidelines development. However, more recently its focus has also shifted towards non-point source pollution issues. The recent Water Action Programme (December 2004), published by the government for consultation, signals government's concerns about non-point sources of pollution and its desire to be involved in reducing the adverse effects of non-point sources. Whilst the non-point source pollution fully deserves this attention, we must not ignore the relative significance of many point source discharges for improving surface water quality.

It may be argued that recent Ministry of Health (MoH) funding may assist in improving some point source discharges from district councils. I understand that many such discharges have the potential to improve with government funding but will continue to be discharged into surface water. In rare cases there has been MoH funding on "mix and match" systems resulting in partial land treatment systems.

As stated above, a majority of the discharges to surface water is from district councils. Such discharges are either stormwater, landfill leachates, or human sewage. With the exceptions of many stormwater discharges, landfill leachate and human sewage discharges require resource consents from regional councils.

I understand that many district councils' sewage effluent discharges fail to comply with regional council consent conditions. Since there is a desire from most regional councils to co-operate with district councils, regional councils are reluctant to take legal actions against district councils.

When sewage discharge consents are due for renewal, there is an opportunity to improve them. However, often the lack of community affordability to upgrade sewage treatment systems mean regional councils are reluctant to demand any upgrades by district councils. Often discharge consents granted to district councils are medium and long term and since little or no review of consent conditions occurs the upgrades tend to be postponed indefinitely, resulting in ongoing pollution of surface water.

f) Widely accepted practice of "Dilution as a solution"

New Zealand has a substantial number of river and stream catchments with good flowing water. Many point source discharges such as industries and district councils utilise surface water systems to discharge contaminants. Generally, the greater the flow of surface water, the greater the discharge volume with a high level of contaminants.

The RMA requires consideration of a "mixing zone" when granting any discharges to water. Often the dischargers demand large mixing zones in order to discharge high levels of contaminants. Generally historical low river flows are used to determine mixing zones. Such processes often ignore the mass loading of nutrients to catchment or ocean and fail to consider the longer term effects of hormonal discharges to habitat.

Whilst it is convenient to discharge to surface water, this process fails to provide any certainty to the dischargers. This is because water quality standards/guidelines continue to change and be stringent, hence requiring further upgrading of effluent treatment systems that discharge to surface water.

g) Lack of cultural and community pressure against discharges to surface water

As stated before, it is offensive to Maori for human sewage to be discharged to surface water and generally Maori and most regional councils prefer effluent discharges to land. Despite the cultural impacts, many sewage discharges continue to be to surface water and there are no signs of such discharges being shifted to land.

I am not at all surprised that Maori believe that human effluent discharges to surface water either reduce the Mauri of the water or are offensive. This is because, as stated before, the artificial biological or mechanical treatment systems are unable to treat most contaminants fully, hence most contaminants will continue to exist in the surface water where surface water is used as a source of drinking water or food gathering by Maori. It appears that once human faecal materials are discharged to surface water, however treated they are, the surface water loses its wide range of uses, not only for Maori but for the wider community.

Some Maori accept surface water discharges to water provided the treated water is passed through either a constructed wetland or infiltration trenches. I am concerned about this approach since neither the constructed wetlands nor the infiltration trenches are capable of protecting the Mauri and treating the effluent to a quality that is achieved by a proper land treatment system.

Many sewage discharges are of large volume requiring large areas of expensive land for irrigation and hence district councils resort to artificial biological or mechanical treatment systems rather than using land treatment systems. Under the circumstances, as stakeholders, iwi and regional councils tend to sympathise with district councils. On the other hand, numerous low volume sewage discharges requiring small parcels of land continue to exist as surface water discharges in New Zealand.

When sewage discharge consent applications are publicly notified there is little or no participation from the wider community with the exception of some interest groups. Often the district councils gain the support of interest groups. This means that the pressure on regional councils to improve stringent discharge quality standards is low.

In some cases the "nimby" syndrome (‘not in my backyard’) means there is opposition to land treatment systems because of potential odour and aerosol emissions. Some communities are also worried that land treatment systems may increase groundwater contaminants, hence rendering their groundwater sources unsuitable for drinking purposes. In other cases there is community concern about heavy metals and other chemicals accumulating in soils.

h) Market forces

The RMA requires consideration of alternative discharges or best practicable options during the consent application process. The affordability of a system is one of the critical components in the decision-making process.

I consider increasing land prices in New Zealand as one of the major threats to land treatment systems. Since land treatment systems can be successfully used in highly sought rolling or flat areas, often the system demands costly land purchases. When such land purchases are made they are on a "sellers'" market and the purchase prices are further inflated.

If land treatment systems are not designed properly or waste water discharge loadings are not estimated properly, there may be a need to purchase additional land several years after the commencement of a land treatment system. This may be difficult if further land is not available in the same area.

Increasing attention by exporters to overseas market perception gives rise to fears that food produced from land treatment systems that treat human effluent may be rejected by the overseas buyers. The land treatment system users are concerned about the uncertainties associated with the land treatment systems. There is also a perception that any product produced from land treatment of waste water is of little or no value to the community and hence most products (eg silage, hay) are given away free of charge.

The one exception to the above is the use of forestry as a land treatment system. Forestry establishment does not require expensive land purchase and the forestry products from land treatment systems are not considered different to those produced normally.

Forestry systems also have the benefit of reducing additional hydraulic input by rainfall interception and high evapotranspiration losses. Despite extensive opportunities to access and use forestry systems, the extent of forestry used as land treatment systems in New Zealand is very low.

i) Soil, climatic and groundwater conditions

As stated before, generally New Zealand soil and climatic conditions favour the use of land treatment systems. However there are areas that require further research to use land treatment systems successfully. Such areas have poorly drained soils, cooler temperatures and relatively good distribution of rainfall.

If access to well drained soils is possible, groundwater quality may cause limitations in terms of effluent loading rates. In areas where intensive agricultural or horticultural land uses exist, the groundwater quality is already degraded. In such areas the land treatment systems have to be designed well and maintained carefully.

In some areas freezing conditions that exist during winter also prohibit surface irrigation of effluent.

3. SOME SOLUTIONS TO PROMOTE LAND TREATMENT SYSTEMS IN NEW ZEALAND

a) Technology transfer

As identified before, poor knowledge of land treatment system processes and the lack of urgency in improving or reducing surface water discharges are the key issues that appear to affect the uptake of land treatment technology. I believe that the NZLTC is in a strong position to effect major changes to land treatment technology absorption. The NZLTC should provide leadership in developing a framework of technology transfer. The key target audiences are district councils, industries, iwi, consultancies, regional councils and MfE. The existing annual NZLTC meeting is only a small part of such a framework and I suggest the NZLTC Technical Committee consider a sound framework that facilitates effective and timely technological transfer.

b) Expertise

- Along with CRIs, the NZLTC should lobby the government in influencing the New Zealand education system to increase expertise in soil or land treatment systems.
- A certifying system could be introduced by the NZLTC that trains and certifies land treatment system operators or consultants.
- NZLTC should facilitate collaborative research and technology transfer with overseas experts to improve our understanding of the land treatment system process.
- NZLTC should lobby the government for sufficient funding for land treatment systems process.
- NZLTC should identify the gaps in land treatment systems information and research and provide this information to MoRST or FoRST and the CRIs.

c) Long term sustainability of land treatment systems

- NZLTC should identify and provide systems that provide good treatment of waste water that are affordable.

4. CONCLUSIONS

There are many threats to land treatment systems that exist in New Zealand. I believe such threats are growing and hence I request NZLTC to advocate and promote for the long term sustainability of land treatment systems in New Zealand.

The objective of my paper is to create an awareness among NZLTC members of the growing threats to land treatment systems and to request members to assist NZLTC to lead and provide in the areas of technology transfer, improving and increasing expertise on land treatment systems, design and process, and the long term sustainability of the land treatment systems.