Horizons Regional Council

Recent History and Rationale for Wastewater Treatment Plant Upgrades

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CPG New Zealand Ltd
A subsidiary of Downer EDI Limited

Horizons Regional Council

Recent History and Rationale for Wastewater Treatment Plant Upgrades

Quality Assurance Statement		
Task	Responsibility	Signature
Project Manager:	Hamish Lowe	
Prepared by:	Jared Mayer, Peter Hill, Hamish Lowe	
Reviewed by:	Hamish Lowe, Victor Mthamo	
Approved for Issue by:	Hamish Lowe	

Revision Schedule					
Rev. No	Date	Description	Prepared by	Reviewed by	Approved by
1	6 Nov 2009		Peter Hill		Hamish Lowe

Prepared by:

CPG New Zealand Ltd
Level 3, Rangitikei House
89-93 Rangitikei Street
PO Box 562
Palmerston North, 4410

New Zealand
Telephone: +64 6 354 4501
Fax: +64 6 354 4516
E-mail: palmerstonnorth@nz.cpg-global.com

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Horizons Regional Council

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1. EXECUTIVE SUMMARY

As part of the Horizons Regional Council (Horizons) One Plan process, Horizons is taking an opportunity to provide for ongoing sustainable management of waterways by revising policy, objectives and strategies of managing discharges into and from waterways. TLAs (Territorial Local Authorities) have expressed concern that the cost of meeting such Proposed One Plan targets is prohibitive for small communities. Horizons has sought to gain an understanding of what is happening nationwide regarding wastewater treatment upgrades, as a basis for further communications with TLAs in its Region.

Horizons is also interested in understanding issues surrounding the uptake of wastewater land application systems and generic rationale that may limit their uptake. This includes the merits of combining land and water discharges consents.

Horizons engaged CPG New Zealand Limited (CPG) to conduct a nationwide review of present practices in WWTP upgrades and to provide commentary on the general uptake of land application systems for wastewater discharge.

A review of Long Term Council Community Plans of TLAs was undertaken to assess their commitment to expenditure on wastewater. It was found that those TLAs located within the Manawatu-Wanganui Region (Horowhenua, Manawatu, Palmerston North, Rangitikei, Ruapehu, Tararua, and Wanganui) on average had committed less than $100/person in the most recent financial year, compared with $100-200/person committed by TLAs in other areas.

A review of the present practices and associated costs for 21 wastewater treatment plant (WWTP) upgrades across New Zealand was undertaken. The review was limited to predominately inland communities of 1,000 to 80,000 people.

The majority of upgrades were designed to meet more stringent consent targets for five-day biochemical oxygen demand (BOD_5), suspended solids, ammonia, phosphorus, faecal coliforms, and *Escherichia coli (E. coli*).

The primary treatment components that the upgrades have addressed are organics, nitrogen and, to a lesser extent, phosphorus removal. The upgrade costs per person are highest for nitrogen and organic removal followed by phosphorus.

The primary treatment technology used to upgrade effluent quality is mainly activated sludge systems. This includes conventional systems such as Sequencing Batch Reactors (SBR), and Membrane BioReactors (MBR). There is also an increasing tendency to include UV disinfection.

The costs of these upgrades are significant and the smaller the reticulated community the greater the cost of the upgrade per person. From the WWTPs surveyed the cost per person to upgrade the WWTP for a community of fewer than 10,000 people is on average $2,500, whereas for a community of more than 10,000 people the cost is less than $1,000 per person.

With the upgrading of the WWTP most communities consider alternative discharge environments. However, most WWTPs surveyed indicated that where alternatives were considered, the majority resisted changing discharge environments. Generally, only the method of discharge had changed, with a clear trend away from discharging treated effluent directly to water and rapid infiltration to discharges via rock outfalls.

Land application was considered in many upgrades but there was a reluctance to make the shift. Based on CPG's experience, the factors preventing the shift to land application are:

(i) Cost;
(ii) Perception of lack of need as current system is adequate;

(iii) The need to maximise use of existing infrastructure;
(iv) The preparedness to accept perceived higher risks of alternatives;
(v) Lack of political will; and
(vi) Cultural issues associated with discharge of human effluent to land.

In order to encourage the uptake of land application the following actions are typically required:

(i) Environmental regulator taking the lead role in initiating change; and
(ii) Increasing public awareness of problems with wastewater discharge to water.

Another option that is gaining in popularity in New Zealand and overseas is combined land and water discharge (CLAWD). A CLAWD system combines the advantages of both land and water discharges while ameliorating the disadvantages of each system. The principle is that wastewater is discharged to land during dry weather, with land providing the nutrient and pathogen attenuation. During wet weather, when soils are saturated, the wastewater is discharged to water, and the effects of the discharge are mitigated by the dilution that occurs during the associated high stream flow. The main disadvantage of CLAWD is the increased complexity of discharging to two environments under different conditions. Careful management, decision-making, monitoring and accountability can counteract this disadvantage.

2. INTRODUCTION

2.1 Background

Horizons' Region represents South-Central North Island. It covers 10 Territorial Local Authorities (TLAs), seven of which are completely within its boundaries. The Region represents the catchments of the Manawatu, Rangitikei and Whanganui Rivers as well as several minor catchments. The Region is predominantly land-locked with only 160 km of coastline. The majority of local communities utilise discharge to water as the means of wastewater treatment plant (WWTP) discharge. With numerous local community resource consents coming up for renewal, Horizons Regional Council (Horizons) is taking this opportunity to provide for ongoing sustainable management of waterways by revising policy, objects and strategies for managing discharges to waterways. These are included in the Proposed One Plan (POP) process. TLAs have expressed concern that the cost of meeting such proposed POP targets is prohibitive for small communities. Therefore, Horizons is seeking to gain an understanding of what is happening nationwide regarding wastewater treatment upgrades, as a basis for further communications with TLAs.

Horizons is also interested in understanding issues surrounding the uptake of wastewater land application systems, and generic rationale that may limit their uptake. This includes the merits of combing land and water discharges.

Horizons engaged CPG New Zealand Limited (CPG) to conduct a nationwide review of present practice for WWTP upgrades and provide a commentary on the general uptake of land application systems for wastewater discharge.

2.2 Scope

This report provides a review of proposed TLA expenditure as indicated solely in Long Term Council Community Plans. In order to ensure relevance of recent upgrades, only WWTP upgrades from the past three years (2006-2009) have been considered, including plants presently under construction. This review covers proposed budgetary expenditure, the WWTP technology and discharge methods prior to an upgrade, the actual upgrade technology and works utilised, the reason for the upgrade, the targets of the upgrade, the cost of the upgrade, and any change to discharge mechanism. This information is then correlated to form a picture of the primary drivers and costs for WWTP upgrades within New Zealand. Finally, commentary is provided on the acceptance of land treatment systems for wastewater discharge and the potential for utilising dual water and land discharge systems.

3. COMMITMENT TO WASTEWATER EXPENDITURE

3.1 LTCCPs

Every three years TLAs are required to produce Long Term Council Community Plans (LTCCPs) which set out priorities for the upcoming 10-year period. These plans identify goals that have been agreed between the Council and the community. From this document directions and tendencies regarding Council priorities can be gleaned. CPG has researched the priorities set out in each Council's LTCCP regarding the three waters (potable, storm, and wastewater). Information regarding planned expenditure on wastewater is presented in the following section.

Data is presented on a per capita basis in order to ensure that the data is comparable. It should be noted that this approach can be slightly misleading as it fails to separate the unreticulated proportion of a District's population. However, the approach is considered the best available given the scope and budget for this project, and will provide an indicative trend.

It should also be noted that wastewater expenditure includes expenditure on sewer maintenance and does not entirely represent expenditure on WWTPs.

3.2 Historic Overview

Information related to expenditure on wastewater-related projects of selected Councils in the past financial year (2008-2009) is presented in Figures 1 and 2 below. The operational expenditure (Opex) and capital expenditure (Capex) data is separated as not all Councils provided information on both expenditures. It should be noted that a lot of Councils did not provide any information. TLAs within the Manawatu-Wanganui Region are highlighted in blue to gain an understanding of where the Region stands in comparison with other regions. The expenditure reported below is dependent on specific projects undertaken in the 2008-2009 year only, and does not average projects in previous or future years.

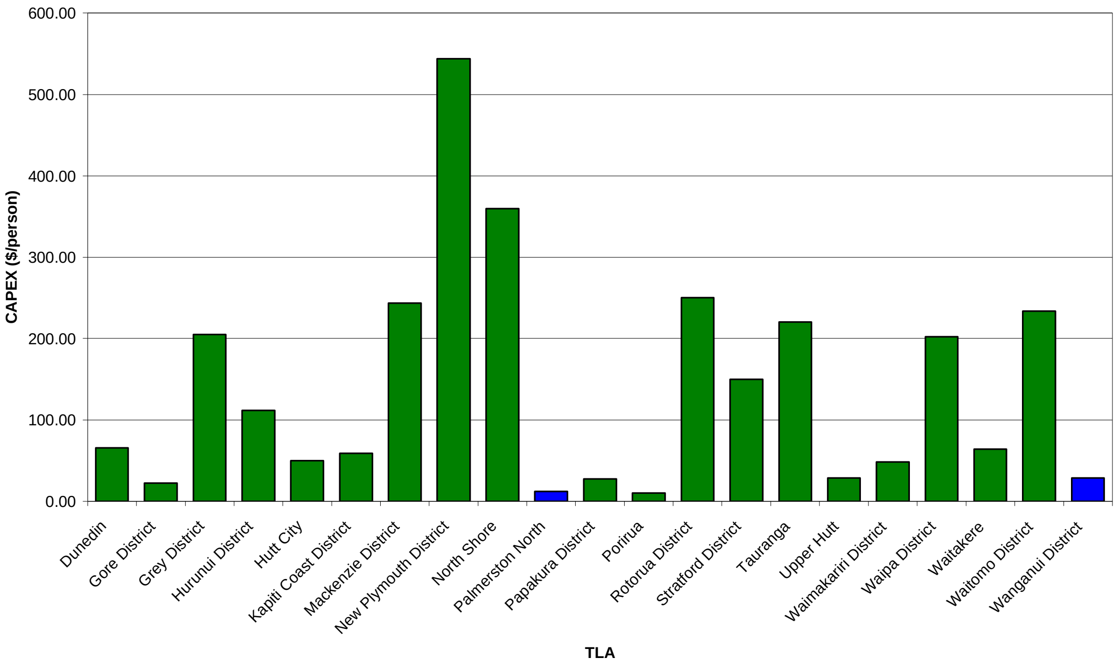

Figure 1: Capex for the 2008-09 financial year

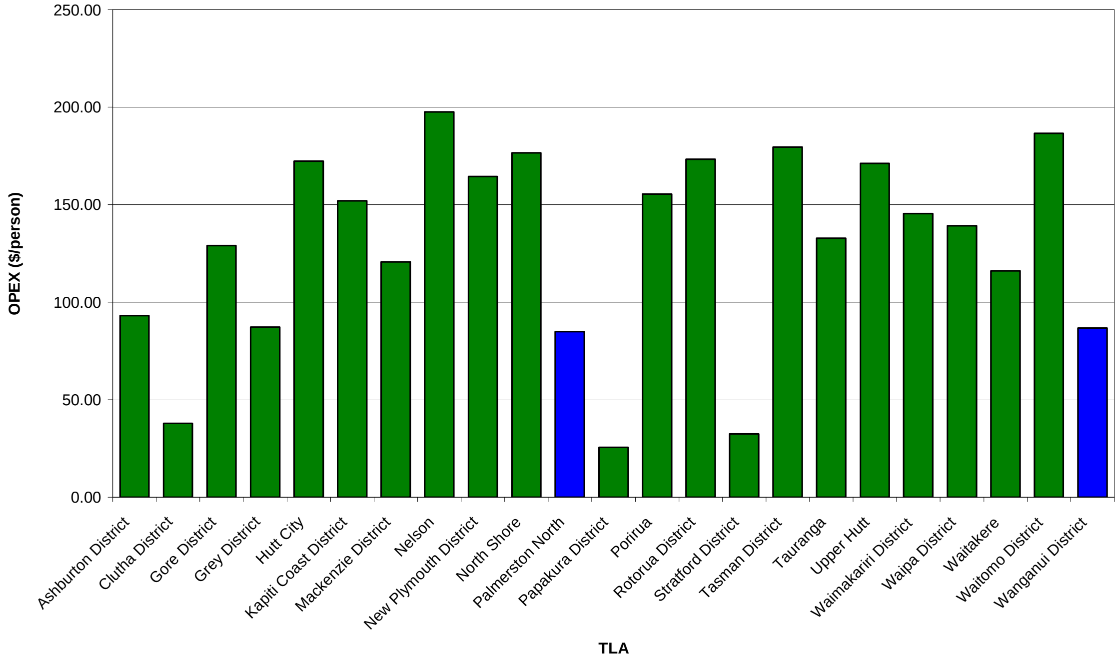

Figure 2: Opex for the 2008-09 financial year

There are no clear trends for Capex in 2008-09. Suffice to say that the Capex figures for the TLAs within the Horizons' Region (i.e. Palmerston North and Wanganui) are at the low end of the expenditure range when compared with other councils represented.

In general, the Opex for all TLAs represented for 2008-09 is between $100 and $200 per person. The Opex figures for those TLAs in Horizons' Region (i.e. Palmerston North and Wanganui) are below this range, but within the report range of all data.

3.3 Proposed Long Term Expenditure on Wastewater

3.3.1 National

It is useful to observe how the TLAs are planning on investing in wastewater into the future. This information is presented in Figures 3 and 4 below. As before, the information is separated into Capex and Opex. The per capita rates are based on 2006 Census data and the predicted rates of population change. In order to display this information concisely, the TLAs have been grouped into three regions; Northern, Central, and Southern. The Northern Region extends from the Far North District to Opotiki and Whakatane Districts in the east, Taupo District in the south, and Otorohanga in the west (all inclusive). The Central Region extends from the aforementioned districts (exclusive) to the base of the North Island. The Southern Region encompasses the South Island.

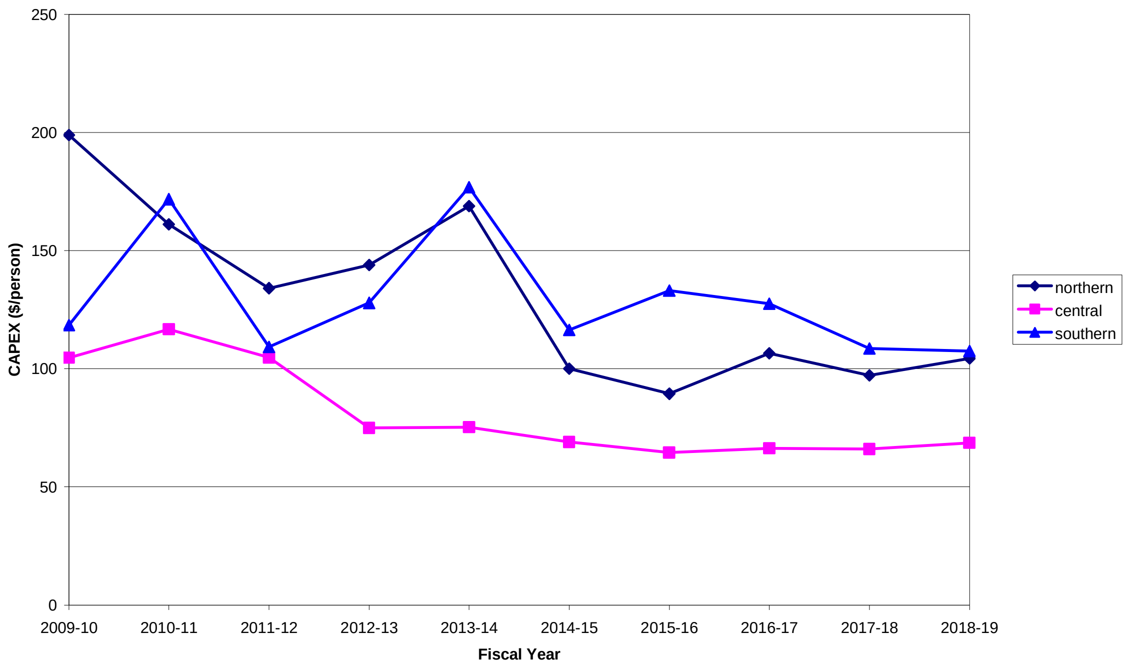

Figure 3: Long-Term Planned Capex for the three regions

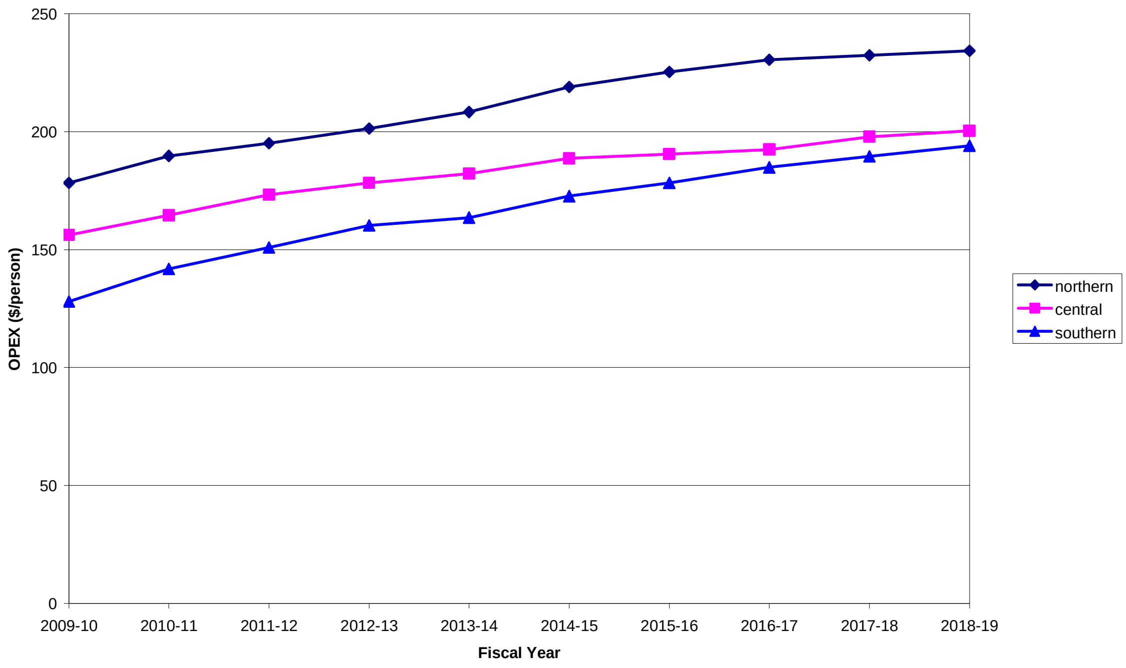

Figure 4: Long-Term Planned Opex for the three regions

It is of interest to note that the Northern and Southern regions planned Opex increases at the same rate. This is likely due to comparable depreciation taken into account. The two regions maintain a roughly $100 per capita gap. The Central region expenditure increases at a lesser rate than the other regions.

The planned Capex for the Northern and Southern regions is roughly equivalent while theplanned Capex for the Central Region is relatively constant from 2013 (i.e. without the spikes that can be seen in the other regions, which likely indicate planned major WWTP upgrades).

3.3.2 Horizons' Region

Figures 5 and 6 show the planned expenditure on wastewater for those TLAs within Horizons' Region (i.e. Horowhenua, Manawatu, Palmerston North, Rangitikei, Ruapehu, Tararua, and Wanganui). This data are calculated as described previously. Note that there is no specific information regarding wastewater Opex for Rangitikei District.

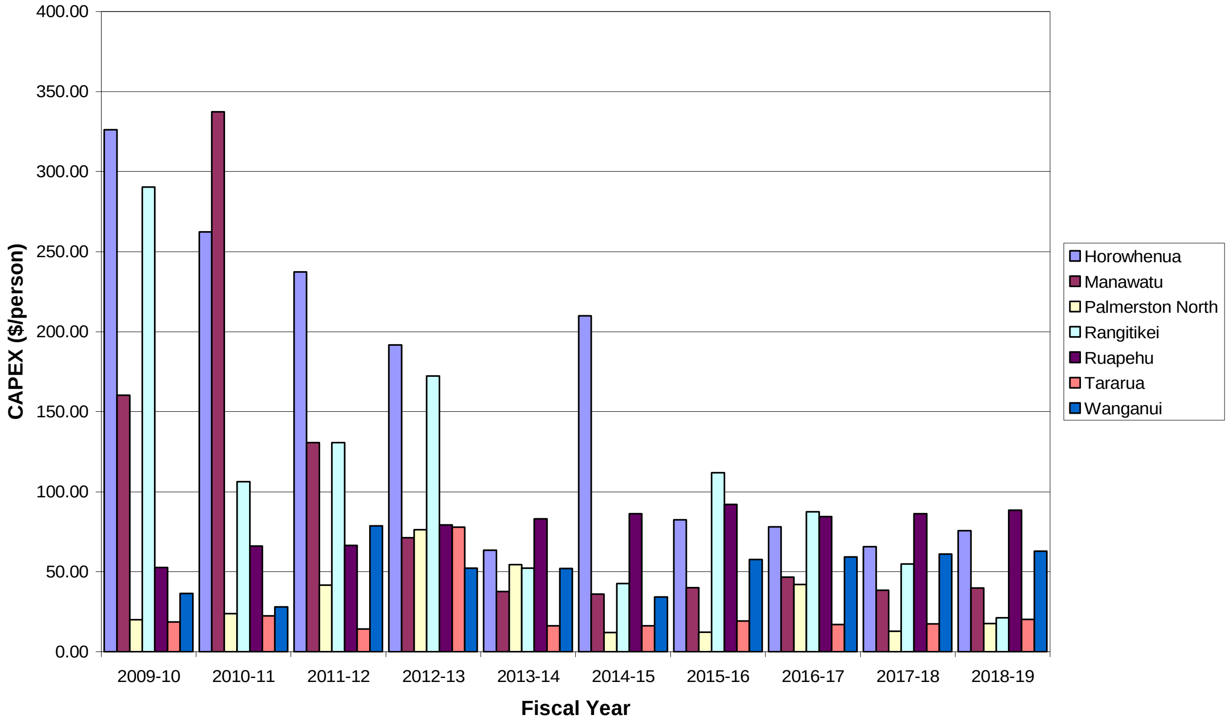

Figure 5: Planned Capex for Wastewater in Horizons' Region

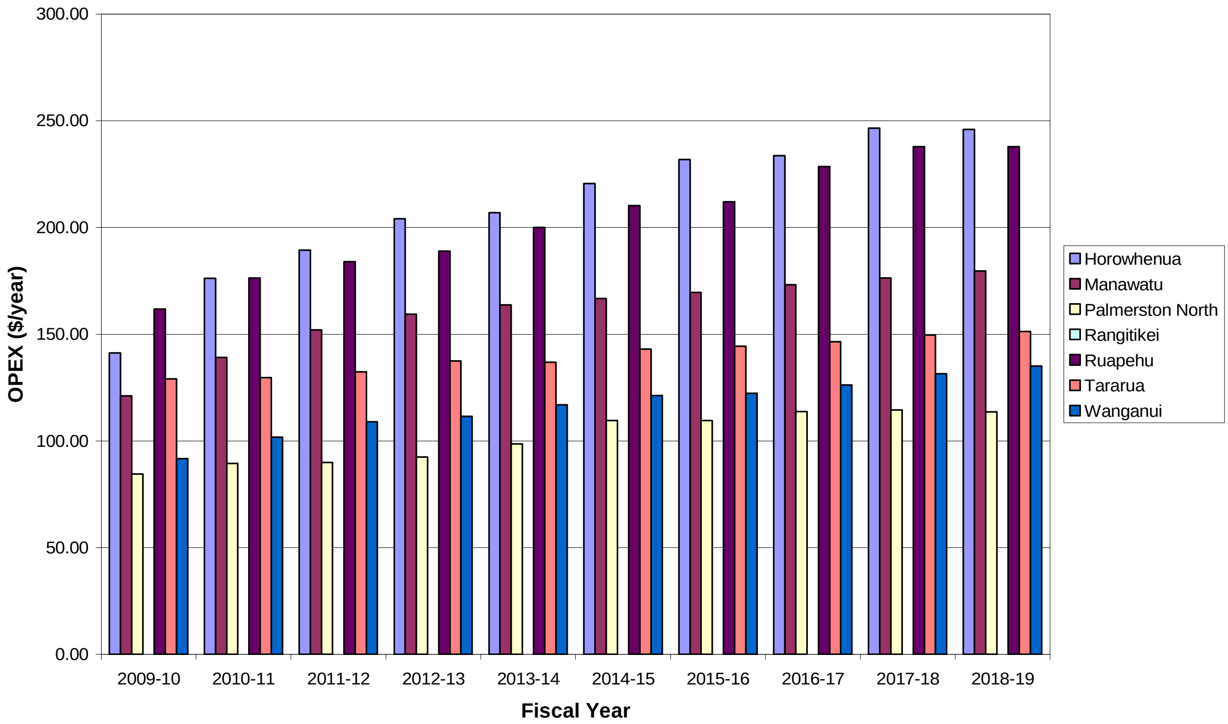

Figure 6: Planned Opex for Wastewater in Horizons' Region

Figure 5 above shows that there is likely to be a large investment in wastewater in the Horowhenua, Manawatu and Rangitikei Districts in the next three years. However, after that there is no large investment in wastewater planned. After 2013 the per capita Capex for the Region's TLAs is almost exclusively below $100. This is below the typical bracket for Capex for the 2008-09 financial year.

Figure 6 above shows a consistently increasing trend for Opex by all the Region's TLAs. The difference in the rate of increase is likely due to the different rates of depreciation used by the TLAs.

3.4 Conclusion

Based on the above information obtained from the various TLA LTCCPs across New Zealand, there appears to be less capital expenditure on wastewater planned by the TLAs within Horizons' Region. The typical national per capita Capex for wastewater is between $100-$200 per year. Howewver, the per capita Capex planned for wastewater by TLAs in Horizons' Region, with the exception of Horowhenua District, is less than $100 per year. Furthermore, the rates of depreciation used by the TLAs within Horizons' Region, with the exception of the Horowhenua and Ruapehu Districts, appear to be greater than those used by TLAs in other regions.

4. SURVEY METHODOLOGY AND FINDINGS

4.1 General

A survey was undertaken to assess recent WWTP upgrades that have occurred around New Zealand and to identify their associated costs. Due to time constraints, the majority of upgrades surveyed are those in which CPG has had direct experience or knowledge. Relevant papers presented at the Water NZ (formerly NZWWA) conference have also been included. This survey and its results are presented below.

4.2 Survey Methodology

The questionnaire generated for this survey was designed to answer the following questions:

1. Prior to the upgrade what was the treatment process, consent conditions, and discharge environment?
2. What were the drivers and final consent targets after the upgrade?
3. What technology and what were the costs of the upgrade? and
4. What discharge environments were considered and what were the reasons for discarding the alternative?

A copy of the questionnaire is appended to this document (Appendix 1).

It was intended to identify plants throughout New Zealand that had been recently upgraded, to ensure that a sound geographical spread was obtained. However, there was a focus on inland communities of 1,000 to 80,000 people. This excluded a number of recent upgrades because of their size and coastal discharges.

The questionnaire was completed by consultants working within CPG and systems targeted were based on personal experience and local knowledge of recent upgrades. Therefore, this is not a comprehensive national overview of upgrades. Only upgrades within the past three years and those approved for construction are included, as costs and relevant standards have changed, thus making comparison of previous upgrades of lesser or limited value.

The survey results have been collated and are presented in the following sections.

4.3 Survey Results

4.3.1 General

Despite the intention to limit the survey to non-coastal and communities of more than 1,000 people, a coastal discharge and a small community (250 connections) were included.

A total of 21 WWTP upgrades were surveyed. Care is therefore required when making inferences and extrapolating the survey data, due to the limited sample size.

4.3.2 Location of Recent Upgrades

The upgrades were located in various parts of New Zealand, but it was notable that more upgrades were surveyed in the Waikato region. Figure 7 below shows the national spread of treatment plants that featured in this survey. Note that the locations are based on Regional Council boundaries.

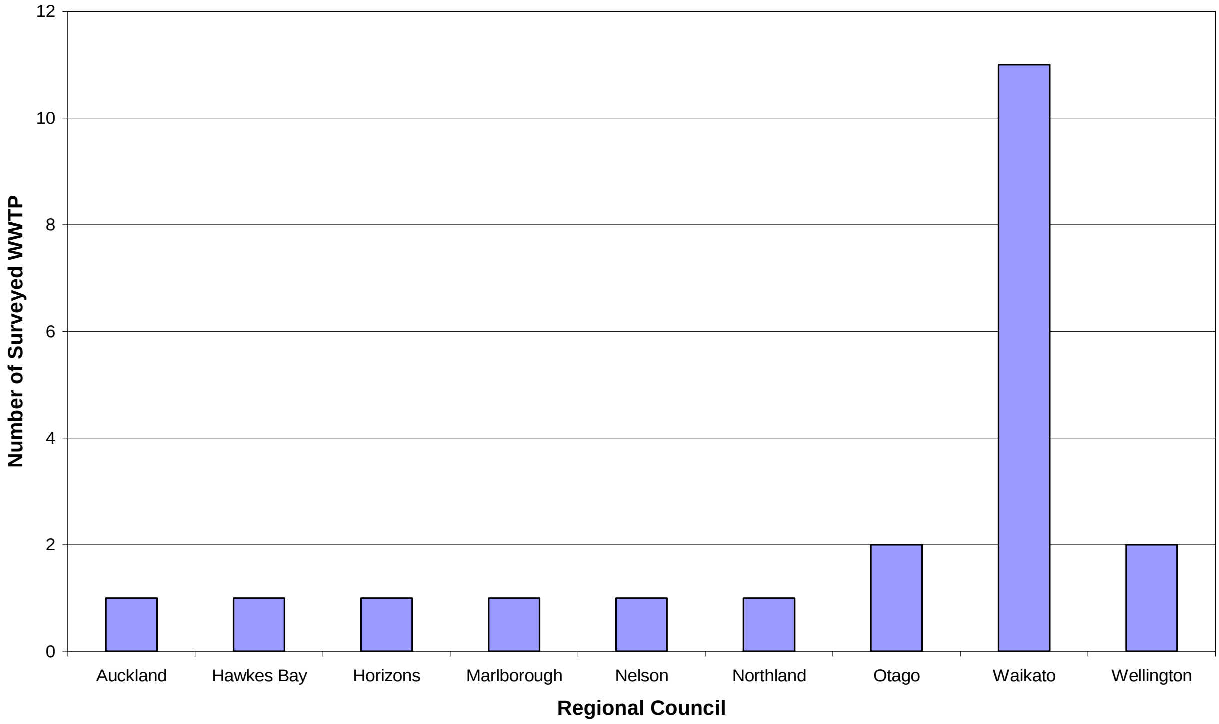

Figure 7: Region for WWTP Upgrade

4.3.3 Upgrade Drivers

The majority of treatment upgrades were undertaken to improve water quality, but some were undertaken to provide for changes in circumstances, such as increased flows. Modifications were also undertaken to address cultural values. In a number of cases the upgrade addressed a combination of water quality, flow management and cultural values. There were a number of other reasons for upgrades, with public heath being a major reason, for which Ministry of Health Sanitary Works Subsidy Scheme (SWSS) funding was provided in a number of cases. A breakdown of the various drivers for upgrades is shown in Figure 8.

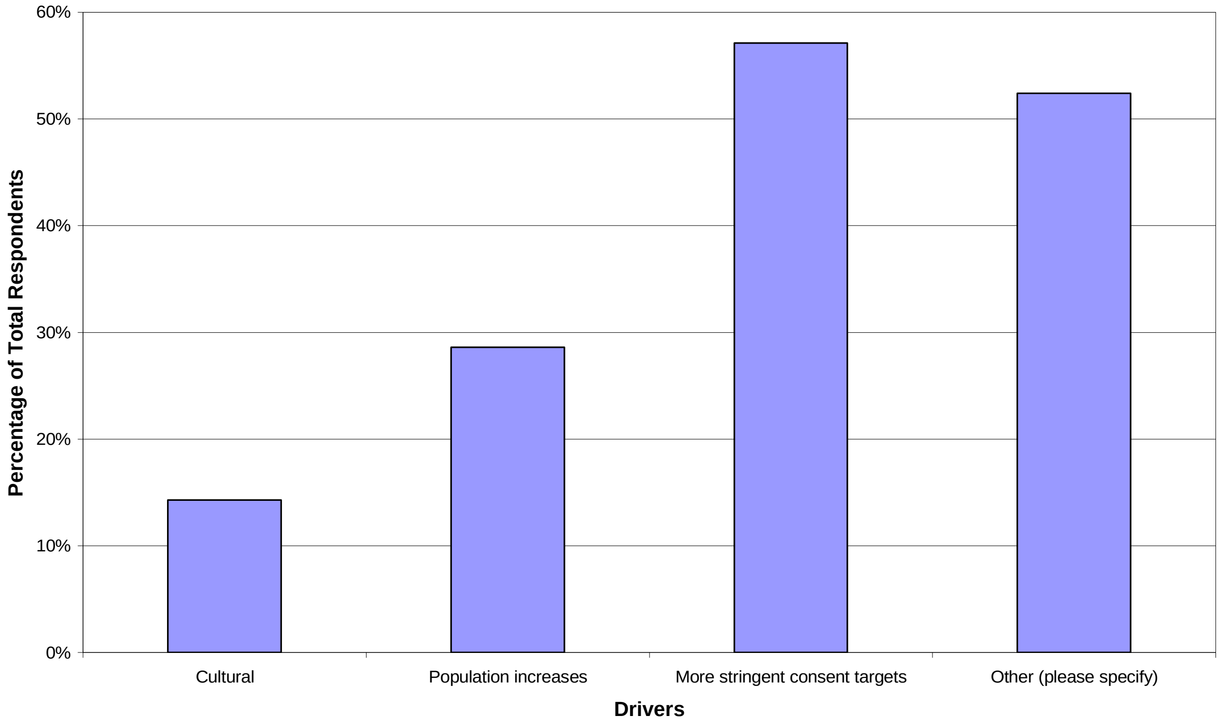

Figure 8: Driver(s) for the Upgrade

4.3.4 Upgrade Components

In order to meet and satisfy the drivers for improvement, specific water quality targets and treatment components are needed. Figure 9 below identifies the range of specific components that need to be met. As can be seen in Figure 9, the primary focus for changes is providing for nitrogen and phosphorus removal.

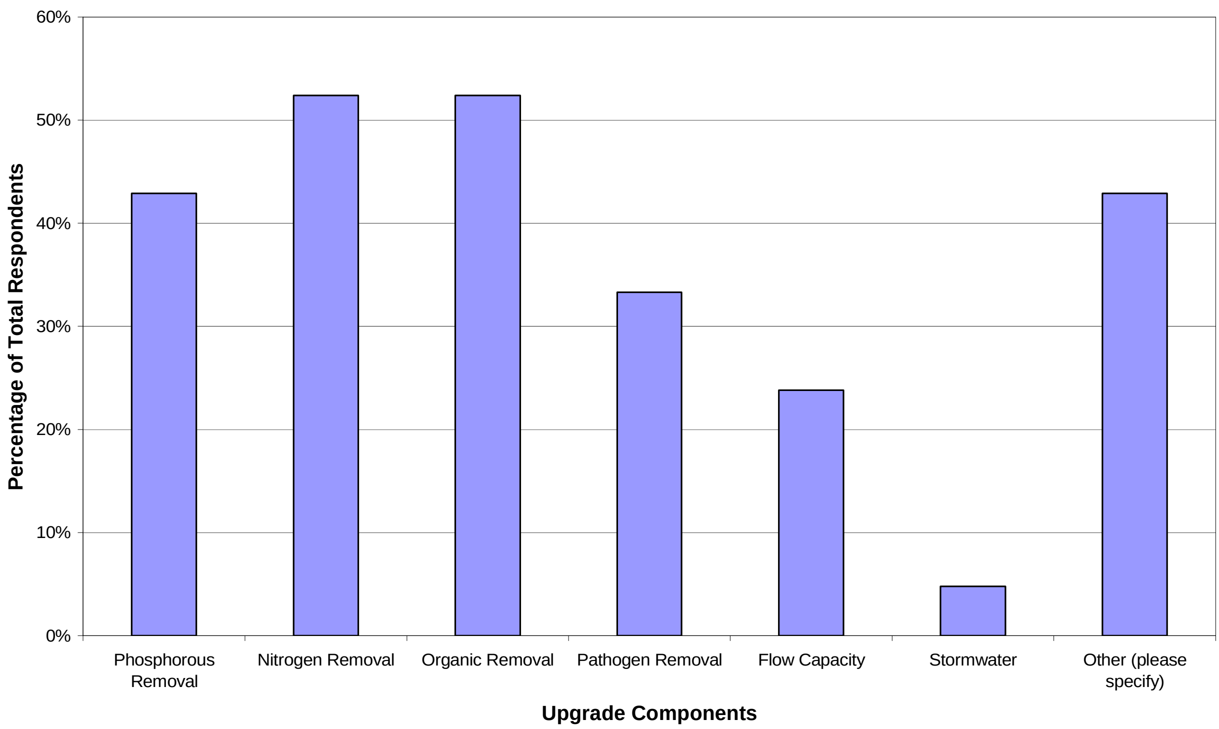

Figure 9: The Specific Components of the Upgrade

4.3.5 Technology Used

The survey sought to identify existing technology and the resulting changes. Figure 10 below summarises the spread of existing technology, while Figure 11 summarises the post-upgrade technology. Please note that at some plants more than one technology component may be used, e.g. ponds followed by UV disinfection.

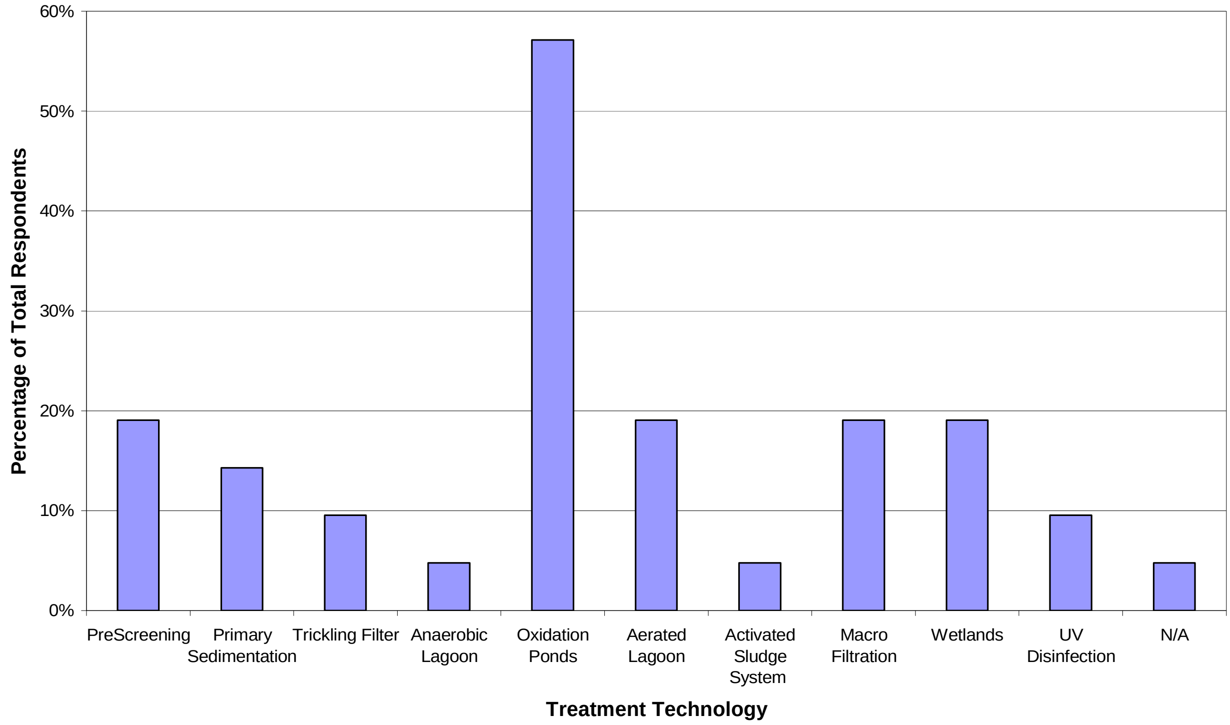

Figure 10: Pre-Upgrade Technology

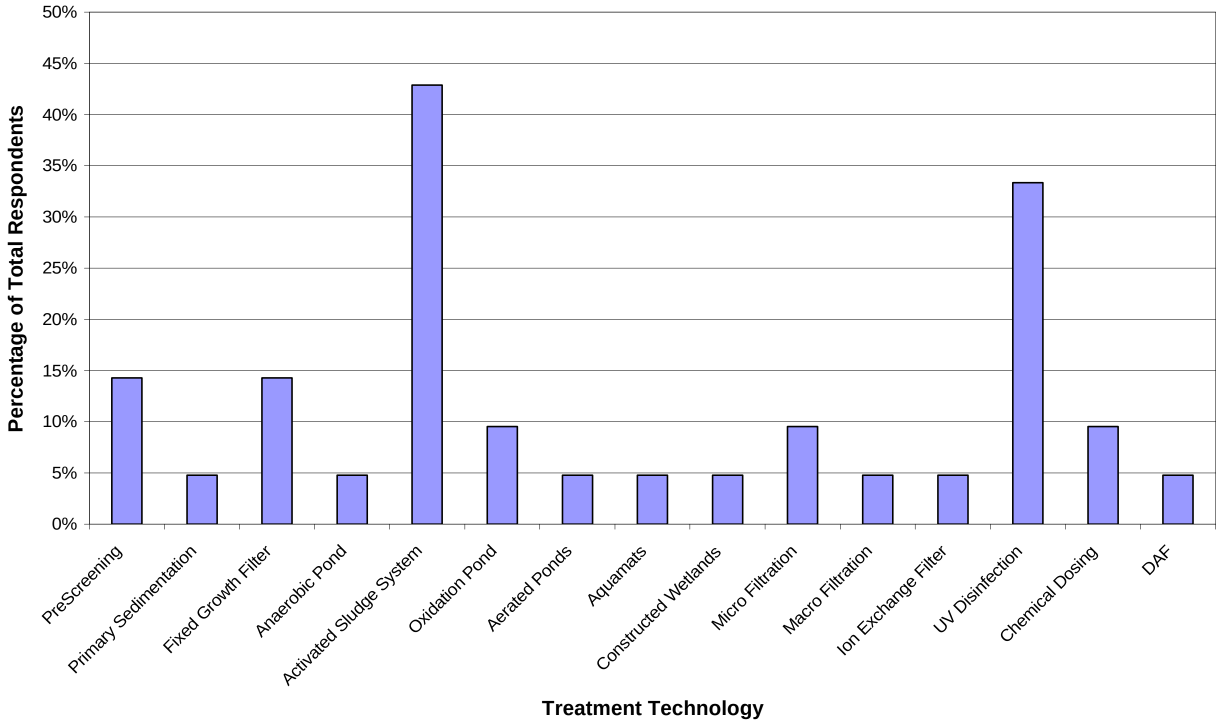

Figure 11: Post-Upgrade Technology

The summary data presented above shows that a greater range of more sophisticated technology is being used in the upgrades. Please note that some technology options have been grouped to limit the presentation of proprietary systems and site specific technology.

4.3.6 Discharge Environment

Of the 21 systems reviewed, there was a range of discharge environments, both pre- and post-upgrade. The relative proportions of each are shown in Figures 12 and 13 below.

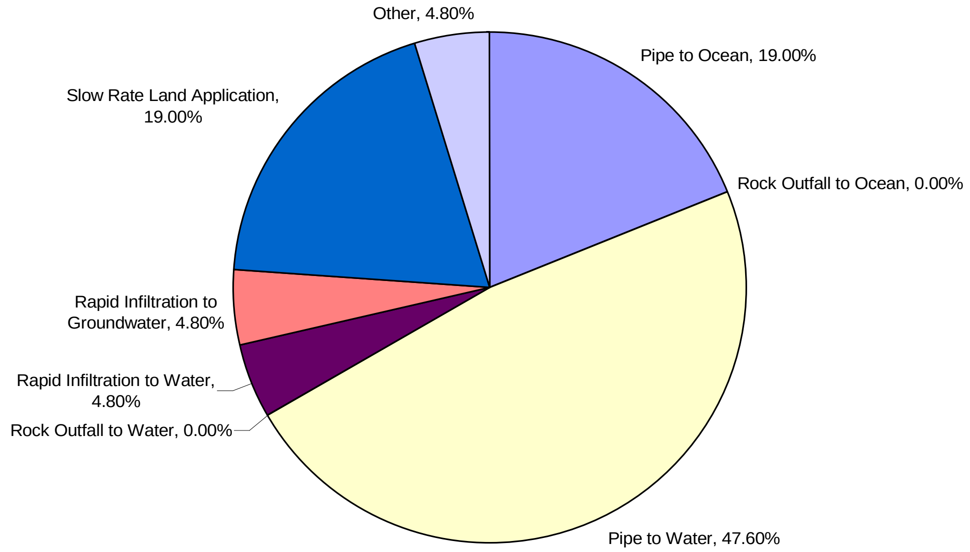

Figure 12: Discharge Environment Prior to the Upgrade

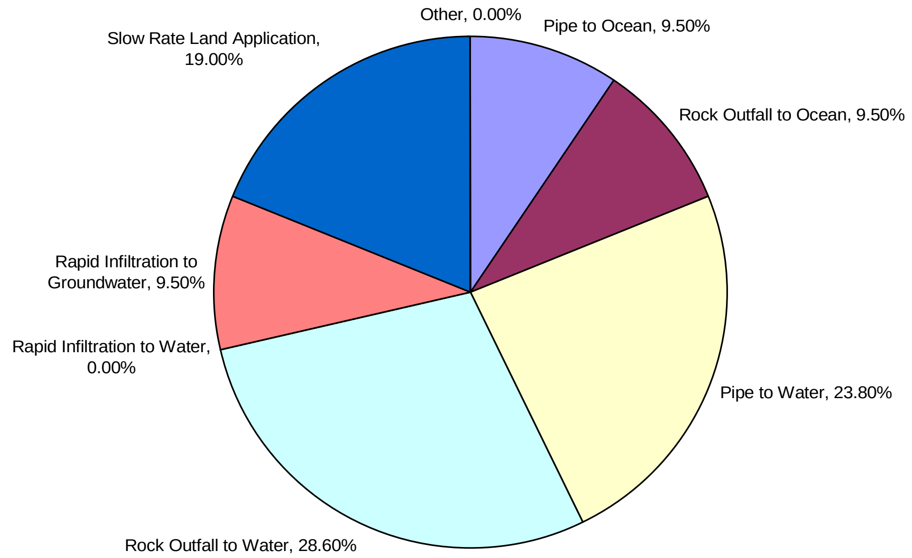

Figure 13: Discharge Environment after the Upgrade

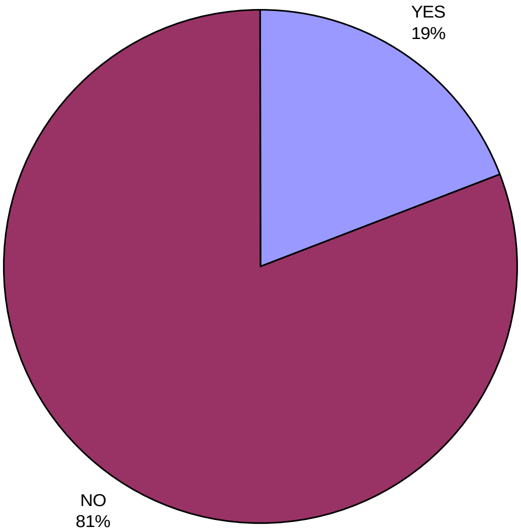

Figure 14: Has there been a Change in the Discharge Environment?

A noticeable change with recent upgrades has been a move away from direct pipe discharges to water; with these being replaced by indirect discharges via rock outfalls and rapid infiltration systems.

When considering the changes in the receiving environment it was important to consider if the receiving environment had changed, necessitating the changes. Figure 14 above illustrates that in the vast majority of cases the receiving environment had not changed.

4.3.7 Alternative Discharge Locations

As part of the discharge upgrade, alternative options were often identified. Figure 15 below indicates the frequency with which alternatives were considered.

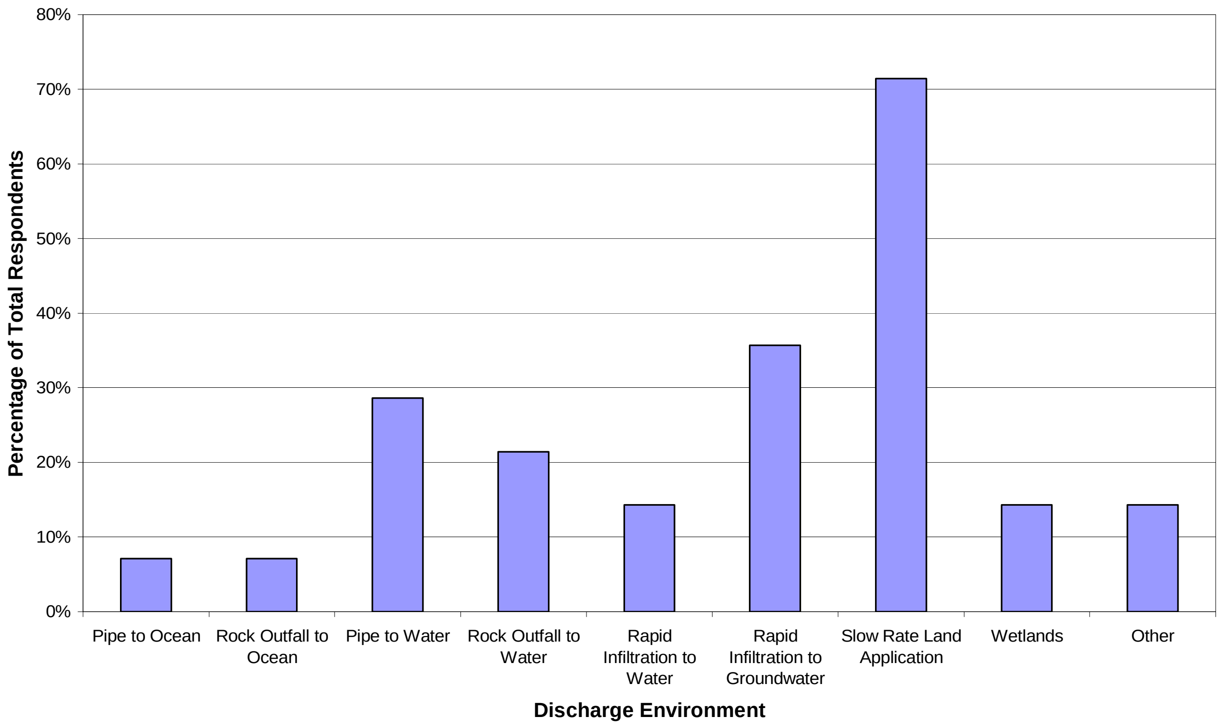

Figure 15: Alternative Discharge Environments Considered

The reasons for alternatives not being adopted were varied, but cost appeared to be the primary reason appeared. There were also uncertainties with the operation, management and access to suitable land for slow rate land application systems.

4.3.8 Changes in Water Quality

Information was sought on changes in water quality. To provide a degree of commonality, this was assessed by changes in resource consent discharge standards. While standards are improving, it is difficult to compare trends as the reasons for changes and the extent of changes are very site specific. However, it is possible to assess the extent of changes of resource consent conditions where they exist, i.e. discharge standards pre- and post-upgrade. Figures 16 and 17 below highlight the relative changed in the mean and maximum of the discharge standards.

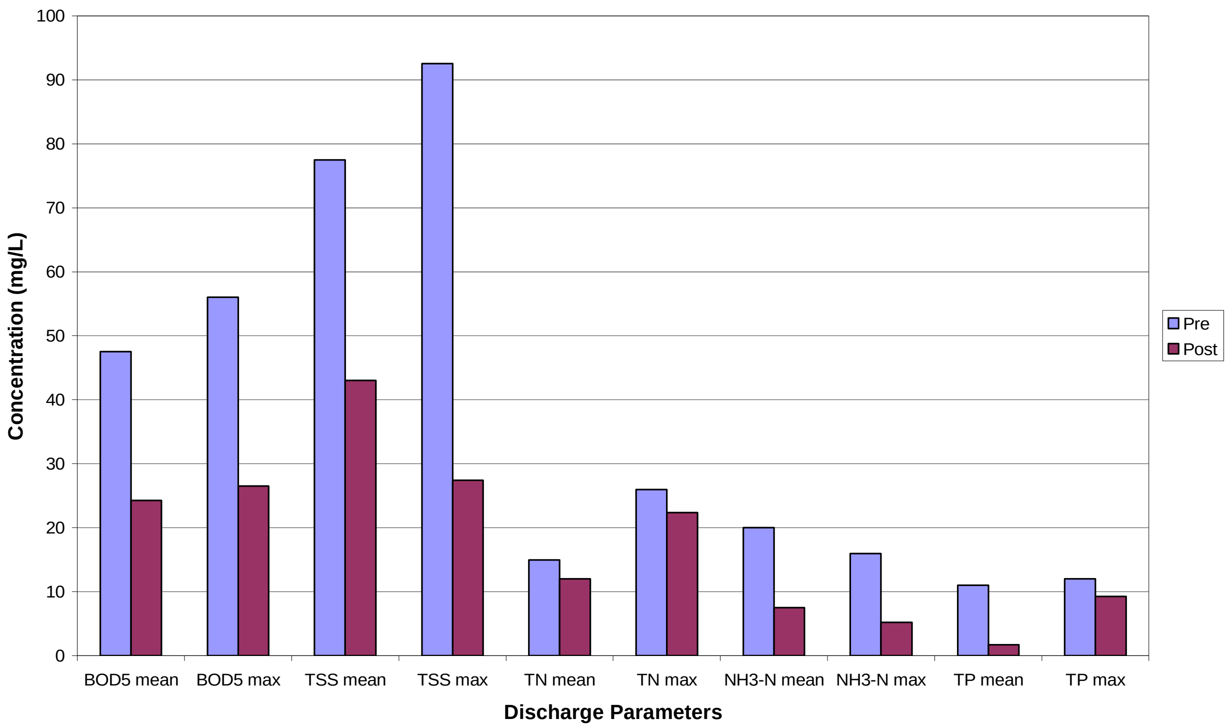

Figure 16: Change in Discharge Limits (Chemical)

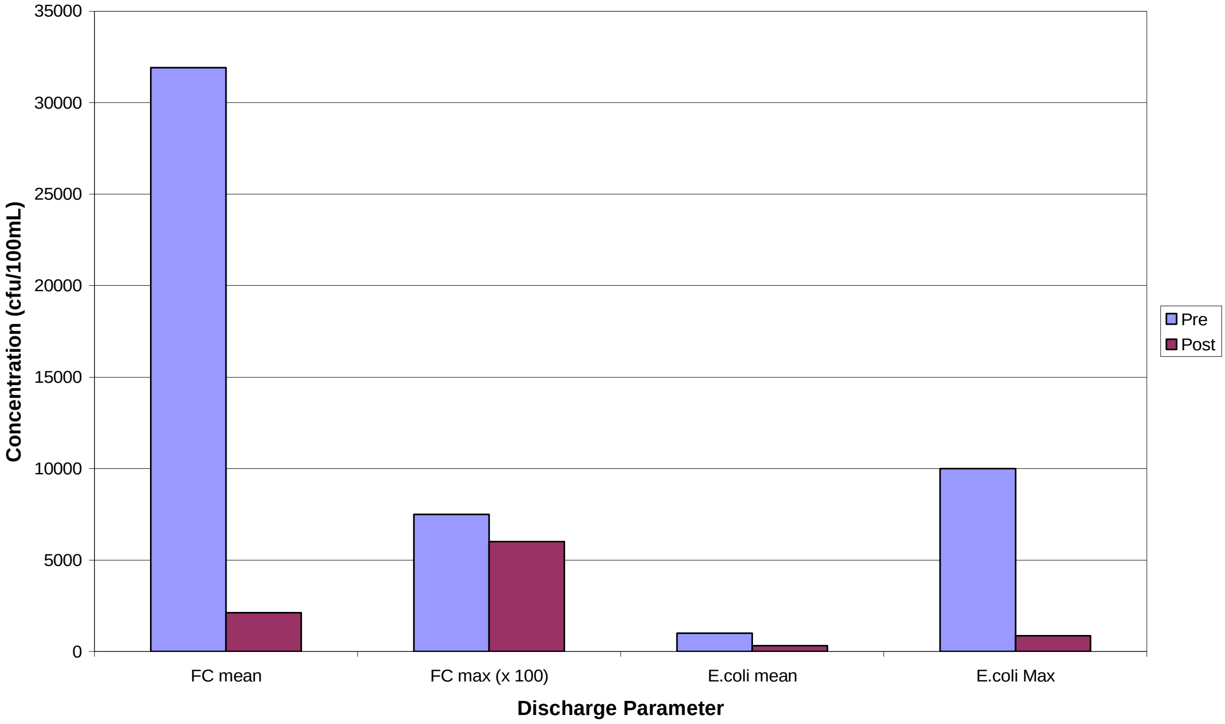

Figure 17: Change in Discharge Limits (Pathogens)

An interesting feature of consent standards for recent wastewater upgrades has been a move away from absolute maximums in favour of the adoption compliance with means, with allowances for samples not to exceed specified percentile values. Typically, 90 percentile or 95 percentile values are used. Due to the greater range of compliance values, less comparable data is available for the post-upgrade assessments. Further, recent upgrades feature multiple compliance points, e.g. mean, 90 percentile and absolute maximum.

4.3.9 Capital Costs

Upgrade costs for communities can be substantial. Figure 18 below shows the cost for the community on a per person basis (note that this is the cost based on community's population and not the district or dwelling/connections). Should the cost per dwelling be required, then the per person cost should be multiplied by the typical number of people residing there. The estimated costs also include the associated upgrade requirements for trade and industrial connections. The information below highlights the higher per person cost associated with small community upgrades, suggesting an impact of economies of scale.

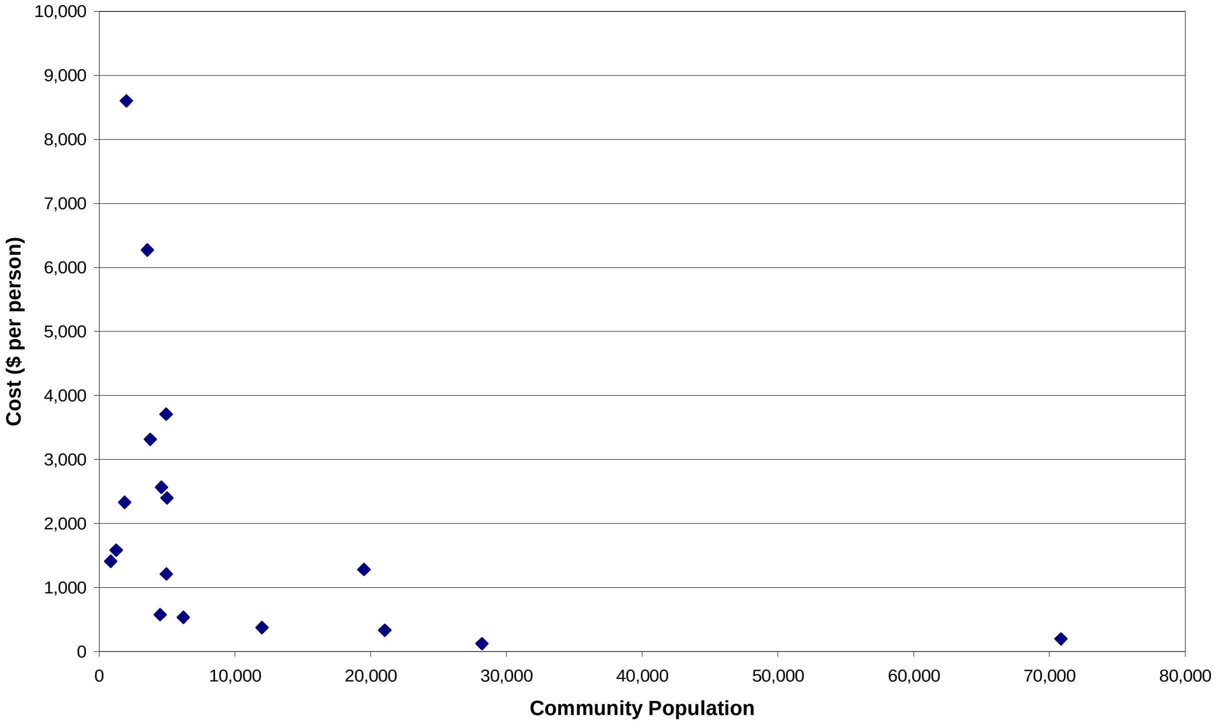

Figure 18: Upgrade Costs per Person

It should also be noted that the costs vary significantly based on the type and requirement for the upgrade. This is considered in Figure 19. Figure 19 also demonstrates the per person costs for upgrades for a specific person.

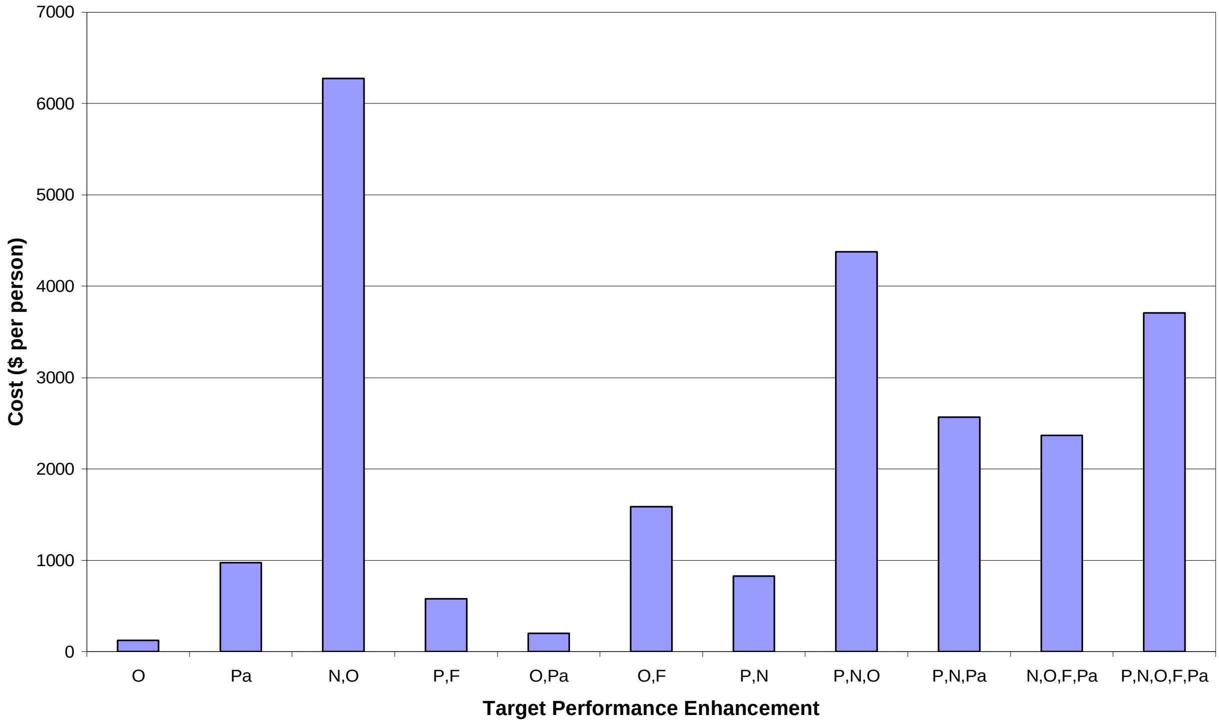

Figure 19: Cost per Person for Particular Gain

In Figure 19 above the following abreviations apply to specific reductions:

O – organic
Pa – pathogen
N – nitrogen and organic
P – phosphorus and flow
F – flow

4.4 Summary of Findings

(iii) 21 municipal wastewater plant upgrades were surveyed around New Zealand, with more in Waikato region than in other regions.
(iv) The need for improvements to water quality and public health were the main drivers for the upgrades surveyed. N, P and organic removal rated high, and pathogen reduction was the primary focus for change in one third of cases.
(v) Most plants had oxidation ponds before upgrade, and most went to Activated Sludge systems, with UV disinfection and a number of other sophisticated treatment technologies.
(vi) Of the discharge systems, about half of those that previously been piped to the ocean, and about half of those that had previously been piped to rivers, had installed a rock filter in the discharge line. Only 19% of those surveyed had changed their discharge environment.
(vii) Slow rate land application was assessed as an option in more 70% of cases, but dismissed mostly on grounds of cost.
(viii) There has been a significant tightening across the board in consented effluent parameter limits.
(ix) Costs were markedly higher per person in smaller communities than larger ones, reflecting economies of scale.

5. ISSUES RELATING TO UPTAKE OF LAND APPLICATION OF WASTEWATER BY TLAS

5.1 General

Land application of treated wastewater is one of a range of improvements that can be made to an existing WWTP discharge. The information presented in the survey above clearly demonstrates that slow rate land application systems were considered in many cases, however the uptake of land application is limited. The reasons that TLAs may have for and against land application, and other improvements, are addressed in this section.

The assessment below explores the rationale for current decisions on land treatment acceptance.

5.2 Short History

Most New Zealand cities and major towns were established on sites at or near the coast, with the few that were not being invariably located alongside rivers or lakes (e.g. Palmerston North, Hamilton, Rotorua, Masterton, and Gore). When reticulated sewage systems were first introduced, the priority was the safe conduit of wastewater away from residences, and where it was discharged was a matter of less concern.

From those early beginnings, public wastewater systems have been upgraded as required to meet perceived need. Where discharges to water have not led to other problems, they remain appropriate today, but where problems have been attributed to the discharge, then upgrades have followed. In this respect, the New Zealand experience follows earlier practices in other parts of the world. There were piped public sewers in the Middle East and Mediterranean (e.g. Ephesus, Rome) more than 2,000 years ago. Cities in Britain (e.g. Manchester, Edinburgh) piped sewage to water bodies more than 200 years ago, but enhanced the discharges when it was found that they were the cause of major public health problems.

5.2.1 WWTP Upgrade Drivers

In New Zealand, as reticulated systems gradually replaced individual pit privies, septic tanks and more primitive arrangements, piped discharges into the sea and rivers were the norm. Moves by TLAs to address the problems caused by wastewater discharges to water have occurred in response to one of three drivers;

(i) A public health issue;
(ii) Public/political preference; or
(iii) An environmental regulatory requirement.

There has been a natural progression in the priority of the drivers, roughly in the order presented above. Currently it is possible that the environmental regulatory requirements are being considered in combination with public/political preference.

As an example, Auckland discharged modestly treated wastewater directly into the Waitemata Harbour at Bastion Point until the 1960s. At that time a new treatment plant and discharge facility was proposed to be built at Browns Island, also in the Waitemata Harbour. Mr Dove-Myer Robinson was elected Mayor on the notion of protecting the well-used Waitemata and proposed to discharge into the less-popular Manukau Harbour instead; work on the Browns Island tunnel was terminated, and the Mangere WWTP was constructed. This change was driven by public opinion and electoral process, with a perception of public health concern. It was not driven by any environmental regulatory process.

Aside from the Auckland example, very few major upgrades are found to have been initiated by TLAs on their own volition. More recent local upgrades in towns such as Palmerston North, Masterton and

Dannevirke have been driven by environmental regulatory requirements, fostered by the adoption of the Resource Management Act in 1991.

5.2.2 WWTP Upgrade Confounders

Just as there are three main drivers for WWTP upgrade, there are also five main confounders;

(i) Cost;
(ii) Perception of lack of need as current system is adequate;
(iii) The need to maximise use of existing infrastructure;
(iv) The preparedness to accept perceived higher risks of alternatives;
(x) Lack of political will; and
(xi) Cultural issues associated with discharge of human effluent to land.

5.2.3 Competing Expenditure and Why Stick with Water Discharges?

Cost will normally be the bottom line consideration for any TLA wanting to make this transition because of the balance required between the need for more efficient but expensive utility infrastructure and controlling rates increases. While there is a general acceptance by TLAs that existing on-site septic tank systems in urban and village environments may need to be replaced by improved systems, there is often the view that an existing municipal WWTP seems to be adequate, and its upgrade is lower down the priority order against other demands for expenditure within the community.

There is a good deal of municipal wastewater infrastructure within communities that is less than 50 years old. Financially prudent TLAs have good reason to be reluctant to decommission infrastructure that may still be good for a few decades yet, given the ever existing budgetary constraints.

A discharge to water is attractive to a TLA because once the discharge has occurred, there is no further need for the TLA to be involved. The river, or the sea, takes it away and it is often perceived that there is no further liability on the TLA.

5.2.4 Perceived Problems with a Land Treatment Option

Land treatment as a specific upgrade option has been addressed in a number of WWTP upgrades; CPG's work with some of these provides a basis for an informed view on the TLAs' decision-making processes. Issues that have encouraged TLAs to dismiss land treatment in favour of a continued discharge to water, albeit with improvements in the quality of the discharge, are known to include the following:

(i) Land treatment has been assessed as being more expensive than the discharge to water;
(ii) Land treatment has been considered to require the purchase of land for application, which in turn has been seen as more expensive than discharging to water;
(iii) Land treatment is associated with land purchase costs or contractual arrangements with landholders. These have been considered a risk compared with the perceived "as-of-right" entitlement to discharge to water;
(iv) In some instances, water quality planning that would drive a land treatment option has been challenged as unreasonable;
(v) There are perceived to be risks and uncertainties in committing to land treatment systems, which are considered to be greater than the risks and uncertainties of discharging to water.

5.2.5 Responses to Perceived Problems with a Land Treatment Option

Land treatment may not necessarily be the best or only sustainable option for a TLA. Cost considerations will always be a major consideration, but there are aspects of the "problems" highlighted in Section 5.2.4 above that could lead to a re-consideration of whether land treatment really is any more expensive or risky than a discharge to water. Reconsideration is often assisted with a thorough understanding of the principles of land treatment, which in many cases is absent from most evaluations. A possible response to some of the perceived problems is set out below:

(i) A large portion, if not all, of the cost of a WWTP upgrade to meet increasingly stringent receiving water standards can potentially be avoided if the discharge is to soil rather than to water, i.e. there is less need for a high quality water standard and therefore upgrade treatment facilities.

(ii) Contractual arrangements with landholders for the irrigation of wastewater onto land need not involve cost to the TLA. The irrigation provides valuable benefits to the landholder as well as to the TLA and has the potential be cost neutral or even return a profit.

(iii) While there are risks and uncertainties with landholder arrangements, they are capable of being managed constructively; and there is the potential that there are now also risks and uncertainties associated with discharges to water which have not yet been fully appreciated, e.g. the impact of contaminants is of emerging concern.

(iv) There is scope for the establishment of private/public or public/public partnership arrangements which allow responsibilities to be shared. This is typical in other aspects of public utility management, e.g. solid waste management. Further, and by way of an innovative example, there are now examples where a Regional Council has purchased land as what amounts to a plantation forestry investment, and has offered the TLAs the opportunity to irrigate wastewater onto that land. This removes from the TLA's concerns the cost of land purchase, the uncertainties of future renewal of any private contract commitment, and the need to be involved in subsequent land management.

5.3 Summary of Issues with Land Application for TLAs

Cost is always the first concern for elected TLAs that already have a high level of financial commitment to essential community infrastructure. Councils throughout New Zealand have every incentive to avoid additional wastewater costs if they can, and to minimise them if they can't. However, environmental regulatory drivers now impose requirements that in many instances are not met by the cheapest option.

The evidence suggests that it is easier to contemplate innovative approaches to wastewater management when new systems are being considered to replace ailing onsite systems in small towns. With larger towns already having invested heavily in reticulation and treatment systems, the urge to extend the benefit of using existing infrastructure is strong.

The uncertainties that are perceived to make land application a less attractive option need to be re-evaluated in the light of water discharges no longer being able to be considered to be free and as-of-right. Partnerships warrant further consideration to assist TLAs to overcome both the actual costs, and perceived uncertainties, in moving their wastewater discharges from water to land.

6. COMMENTARY ON THE PROSPECT OF COMBINED LAND AND WATER WWTP DISCHARGES

6.1 General

The suitability of land application must be considered along with other technology and discharge methods. In reality there are only two receiving environments – water and land. What changes is the method for introducing the wastewater to that environment and the quality of the treated water that is discharged.

Land application is not the ultimate answer for all discharges, and in some cases discharge to waterways may be more appropriate. However, there is scope to consider both. This section explores the merits of a combined land and water discharge (CLAWD) system.

6.2 Principles of a CLAWD System

In principle, a CLAWD system can provide advantages over and above individual land or water discharges, while reducing the disadvantages of each. The principle is that wastewater is discharged into a river or stream at times of higher flow, but is applied to land at times when stream flow is low. Advantages and disadvantages are set out below:

6.2.1 Advantages of a CLAWD System

A CLAWD system can offer the following benefits:

(i) In dry weather, an irrigation application to land can avoid the stream discharge, when the receiving stream flow is low and its sensitivity to contaminants is greatest.

(ii) WWTP upgrades to provide for pathogen and nutrient reductions may not be needed as critical in-stream parameters are less sensitive during high flow.

(iii) Irrigation of land has the initial benefit of assisting growth of the crops being produced. Irrigation will be most beneficial following limited rain, when stream or river is at low flow.

(iv) Irrigation of land with wastewater has the addition benefit of utilising the nutrients it contains, instead of losing those nutrients into a waterway when systems discharge to water. This can reduce the need for expensive imported fertilisers.

(v) Land application is an effective protection mechanism against pathogens, with populations being reduced by 2 logs within the first 10 mm of soil, subject to suitable application rates being used.

(vi) In wet weather the soil may be saturated and irrigation of wastewater could lead to preferential through-flow, ponding or run-off. This would impact on the usability of the land and its productive capacity. In such cases, river or stream discharge will be available as the alternative.

(vii) When the land is too wet to irrigate, in normal circumstances stream flow will be sufficiently high to offer a high degree of dilution to the wastewater; at these higher flow rates the alternative uses of the waterway for recreational and other purposes demanding higher water quality will be less likely to be taking place.

(viii) CLAWD reduces the requirement for reserve wastewater storage that would be necessary to achieve sustainable environmental outcomes from either a high flow stream discharge or a land application alone. The cost of operating a dual discharge system can be offset by the cost savings of not providing for winter storage when irrigation may be suspended.

6.2.2 Disadvantages of a CLAWD System

There are some disadvantages. These include:

(i) Two sets of wastewater discharge infrastructure are required, rather than just to land or just to water. This may be more expensive, depending on storage requirements.

(ii) The system is more complex than a single discharge option, requiring management, decision-making, monitoring and accountability to be better than is typically required for a single discharge.

(iii) The complexity of the dual discharge, with the possibility of limited storage being a third routing option for wastewater on any given occasion, increases the scope for operator error to confound the environmental improvement intended to be delivered.

6.3 Examples of a CLAWD System

Historic examples of CLAWD systems are limited. They are being considered more relevant especially for small to medium sized communities (i.e. fewer than 50,000 people) as transitional storage volumes can be easily provided for.

There are local examples including the AFFCO Manawatu Feilding wastewater discharge of meat processing wastewater. While it is not municipal wastewater, it nevertheless serves as a useful local example of a CLAWD system. The volume of wastewater, at up to 6,000 m^3/day, and its parameter loadings of nitrogen, phosphorus and pathogens, make it comparable with a small town's discharge. Wastewater is irrigated to land on an adjacent farm when conditions are appropriate, and is discharged into the adjacent Oroua River when river flows permit. River discharge is staged against river flow, with no discharge when the river flow is below 3 m^3/s. There is also significant reserve wastewater storage capacity at the plant to manage the transition period between land application not being possible and a discharge to the river being permitted.

The Fonterra Longburn milk processing plant provides another example of a CLAWD type system in Horizons' Region and examples in other regions include recent upgrades to the Masterton and Blenheim WWTPs and their associated discharges.

In conclusion, CLAWD systems provide a potentially attractive option to complement present river wastewater discharges at New Zealand's inland towns and cities, under circumstances where limited treatment upgrades are needed. Environmental and management advantages, and disadvantages, of CLAWD systems do not appear not to have been, nor are they currently being, evaluated. There are increasing opportunities where adjoining landholders are prepared to participate with their TLA, especially as pressure comes on available freshwater resources. The advantages of irrigation and a reduction in the reliance on surface waterways to receive wastewater offer an opportunity that is worth further evaluation, especially for inland communities adjacent to appropriate water bodies.

6.4 Summary of Issues with CLAWD Systems

CLAWD systems offer an alternative approach to solely land, or solely water, discharge of municipal wastewater. Their attraction is that they can avoid the limiting conditions of land or water discharges, and avoid the expense of meeting the environmental requirements imposed by those limiting conditions.

With a discharge of wastewater to land, the wet weather circumstances that will not allow irrigation drive a requirement for expensive storage. A CLAWD system may be expected to reduce that storage requirement by discharging to water at the times when storage would otherwise be required.

With a discharge of wastewater to water, the dry weather circumstances that lead to low stream flow drive a requirement for a high standard of treatment. Low flow in streams means lower dilution available for the assimilation of wastewater, and this requires the substantial expense of a higher standard of treatment. A CLAWD system may be expected to remove the requirement to treat all wastewater down to low flow quality requirements.

CLAWD systems involve complex management, and the cost of duplication of discharge infrastructure, but in many inland situations the advantages suggest that detailed cost assessment is worth further consideration.

7. CONCLUSIONS

Territorial Local Authorities (TLAs) within Horizons' Region (i.e. Horowhenua, Manawatu, Palmerston North, Rangitikei, Ruapehu, Tararua, and Wanganui) have committed less money per capita to capital expenditure (Capex) on wastewater than the rest of New Zealand, at less than $100/person compared with $100-200/person for TLAs in other regions.

A survey of recent upgrades strongly suggests that there is a strong focus on reducing nutrients in water bodies. This is reflected in the majority of upgrades occurring to meet more stringent consent targets. There is a clear trend towards reduced concentrations of BOD_5, suspended solids, ammonia, phosphorous, faecal coliforms, and *Escherichia Coli* (*E. Coli*).

The primary treatment technology used to upgrade effluent quality is Activated Sludge. This includes conventional activated sludge systems, Sequencing Batch Reactors (SBR), and Membrane BioReactors (MBR). There is also an increasing tendency to include UV disinfection.

The costs of these upgrades are significant and the smaller the community the greater the cost of the upgrade per person. From the WWTPs surveyed the cost per person to upgrade the WWTP for a community of fewer than 10,000 people is on average $2,500, whereas for a community of more than 10,000 people the cost per person is less than $1,000.

Most communities considered alternative discharge environments when upgrading their WWTPs. While most WWTPs surveyed indicated that alternatives were considered, the majority resisted changing discharge environments. Generally, only the method of discharge was changed, with a clear trend away from discharging treated effluent directly to water in favour of indirect discharges via rock outfalls.

Land application was considered in many upgrades but there has been a reluctance to make the shift. Based on CPG's experience, the considerations that working against the shift to land application are:

(i) Cost;
(ii) Perception of lack of need as current system is adequate;
(iii) The need to maximise use of existing infrastructure;
(iv) The preparedness to accept perceived higher risks of alternatives;
(xii) Lack of political will; and
(xiii) Cultural issues associated with discharge of human effluent to land.

In order to encourage the uptake of land application the following actions are typically required:

(i) Environmental regulator taking the lead role in initiating change; and
(ii) Increasing public awareness of problems with wastewater discharge to water.

Another option that is gaining in popularity in New Zealand and overseas is combined land and water discharge (CLAWD). CLAWD combines the advantages of both systems while ameliorating the disadvantages of both. The principle is that wastewater is discharged to land during dry weather, with land providing the nutrient and pathogen attenuation. During wet weather, when soils are saturated, the wastewater is discharged to water, and the effects of the discharge are mitigated by the dilution that occurs during the associated high stream flow. The main disadvantage of CLAWD systems is the increased complexity of discharging to two environments under different conditions. Careful management, decision-making, monitoring and accountability can counteract this disadvantage.

APPENDIX A
Survey Form

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