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Quality Assurance Statement	
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The following **five changes** have been made from the March 2003 Final, to this May 2003 Final:

Page 15 – new sentence added at the end of text on On-site Effluent Treatment Systems

Page 23 – second sentence at the top of the page, changed

Page 46 – 5.1 first bullet; word ‘domestic’ added in first line

Page 49 – Table 5.3; Katikati added

Page 63 – added new last bullet point

## Executive Summary

The **objectives** of this report are to **impartially compare the issues and costs of “land application” and “ocean discharge”** of treated wastewater.

The report is an **overview that provides a comparison of issues and estimated costs**. In undertaking this, there are a **wide and diverse range of matters** that need to be considered and encompassed in the decision process in terms of a communities wastewater management. These in particular include:

- legislative, planning instruments and national guidelines;
- social, cultural, economic and environmental factors.

The position of Tangata Whenua in terms of the provisions of the Resource Management Act, is particularly relevant.

In consideration of these matters they should be assessed in the wider context of the following **recent developments and trends**; a number of which are encompassed within the New Zealand Waste Strategy 2002:

- sustainable development and associated holistic approaches;
- more efficient resource use and “closing the loop” strategies;
- the principle of kaitiakitanga / stewardship;
- overall wastewater management and minimisation strategies;
- setting of project objectives;
- understanding a “Best Practicable Option” approach.

For this project it is important to **define what is encompassed in the term “land treatment”**. There has always been confusion as to what various terms and technologies mean. The report **defines each of the following technologies** and gives New Zealand examples as well as traversing which technologies have been considered and are presently being used in the SmartGrowth study area.

- |                                |  |
|--------------------------------|--|
| – On-site (effluent) treatment | – Deep Bore Injection                      |
| – Land Disposal                | – Land Passage / Riparian Strip            |
| – Land Treatment               | – Re-use and Renovation / Reclaimed        |
| – Overland Flow                | – Wetlands                                 |
| – Mix and Match                | – Sludge / Biosolids application onto land |

It is important to appreciate that while this **wide range of technologies have been grouped under the term “land application”** they fall into two categories as to what actually happens to the treated wastewater applied to them. These categories are:

- Those technologies where the treated wastewater is actually applied onto or into the land in order to dispose of it. These include land disposal, land treatment (albeit a portion is collected in drains after it has percolated through the land), deep bore injection and infiltrating wetlands and the land application part of mix and match techniques.
- Those technologies where the treated wastewater is in contact / moves through some land in order to achieve some treatment be it physical or cultural. These technologies include: overland flow, land passage / riparian strip and wetlands.

**Risk assessment of alternative disposal and discharge options also forms an important part of the decision process.** In this respect the findings are that some land application techniques, particularly land disposal, land treatment and deep bore injection often have much higher implementation and / or long term operational risks associated with them than discharge to surface or ocean waters. These risks include NIMBY (Not In My Back Yard), land acquisition, unacceptable adverse environmental effects such as ground and surface water contamination and aerosol effects, market sensitivity to crops and issues of long term sustainability of the practice.

**Decision processes** for ocean discharge have been well developed and tested in New Zealand whereas (large) land application schemes that have many interrelated and often complex factors, have not been developed or tested to anywhere near the same extent.

#### **The overview of land application in New Zealand highlights:**

- Over the last 30 years or so there has been a drive towards land application schemes in New Zealand. This has particularly been the case for a good number of smaller and medium size communities.
- Very approximate calculations indicate that about 3% of New Zealand’ wastewater is disposed of in land disposal and land treatment schemes. Increasing larger amounts (possibly as much as 35%) are passing through wetland and land passage / riparian strip technologies, prior to discharge to surface and marine waters.
- The drivers for land application schemes have been fostered since the event of the Resource Management Act (RMA) (1991) and the New Zealand Coastal Policy Statement (NZCPS) and also by and related to the position of Tangata Whenua with their cultural and lifestyle values associated with the abhorrence of direct discharge of human sewage to water and the need for it to be returned to the land.
- Most of the communities using land application techniques’, in particular land disposal and land treatment, are smaller communities. This is where land disposal and land treatment can have a particular place, local factors permitting.
- Many of these small community land application schemes are understood to be cost effective, work well and to date, are considered to be relatively sustainable as to their ongoing operation.
- Rotorua, Taupo and Levin are the three largest land schemes for municipal sewage in New Zealand. There are some difficulties with each of these schemes that are being addressed.

- The value of irrigation and nutrient (nitrogen, phosphorous and potassium) for crop and forest (tree) growth is often a benefit.
- In appropriate locations, particularly with some small communities, there is an increased use of “mix and match” schemes.
- Use of wetlands has been enthusiastically promoted and applied in many areas prior to river and ocean discharge.
- Tangata Whenua abhorrence of the discharge of human sewage into natural water, both the marine environment and inland (fresh) waters, has resulted in some recent collaborative compromises from all stakeholders. These have included “enhancements” to some schemes, such as land passage or riparian strip land application systems. Wetlands are also used in this way.
- Reclaimed / renovated treated wastewater is used for irrigation in at least three areas of New Zealand (including Tauranga) for irrigation use and this use may increase.
- Land application of appropriately treated sludges and bio-solids is also receiving significant positive attention.
- No new large land disposal or land treatment schemes have been implemented in recent (i.e. the last 5 or so) years.
- Consent requirements and associated monitoring costs for some land application schemes, are rather complex and annual (regulation) costs high, even for small schemes.
- Risk issues associated with land application, particularly the larger land disposal and land treatment schemes, are often greater than with direct discharge to water schemes.

#### **The overview of Ocean Discharge in New Zealand highlights:**

- Over the past three or so years, a number of New Zealand’s larger coastal towns have, after extensive option studies, made the decision to keep their discharge to the marine environment.
- For those cities and towns discharging into the marine environment, and particularly those directly into the ocean, an interrelationship exists between the outfall location and the associated degree of treatment..
- Within the last 2 to 3 years there would appear to be additional interest in and adoption of offshore ocean outfalls as the long term sustainable solution for treated wastewater discharge. The case studies of the inland towns of the Timaru District, the coastal towns of Waimakariri District and towns in Taranaki, highlight this.
- The majority of (larger) inland communities continue to discharge treated effluent directly into rivers.
- There is increasing use of wetlands and land passage / riparian strip technologies prior to ocean and river discharge. This applies to the city schemes as well as medium and smaller sized communities.

There are **many local factors in the SmartGrowth study area that dictate the appropriateness, or otherwise, of the various land application technologies and ocean discharge.** These include:

- the need to minimise contamination of the Tauranga Harbour and estuaries by nutrient rich run off and seepage and disease carrying micro-organisms; and
- The soil types, pumice and sands suitable for land disposal, etc. low lying peat soils; and
- The high ground water tables and floodable nature of the coastal low lying areas particularly between Tauranga and Maketu and the limitations this poses on land disposal and land treatment technologies; and
- The elevation and slopes of the hinterland and the limits / costs this poses to land application; and
- The Proposed Regional Coastal Plan's water quality requirements for contact recreation and other uses and restrictions this places on ocean discharge locations; and
- The social and cultural issues and peoples' perceptions.

The report summarises these and other factors on a community by community basis. Maps have been prepared to show indicatively those areas that could be suitable for land disposal and land treatment.

**An extensive range of wastewater treatment and disposal / discharge studies have been undertaken for all significantly sized communities in the SmartGrowth study area.** In total these studies have included **the full range of land application technologies** introduced and defined in this project. Their key findings from the 10 major studies summarised in this report are:

- Local factors such as soil types, ground and surface water characteristics including potential contaminant runoff and seepage to the Tauranga Harbour and estuaries in the area, water supply protection, land use and development have resulted in many areas either not being suitable, or only marginal, for those land application techniques where the treated wastewater is applied onto or into the ground principally as a disposal technique (e.g. land disposal, land treatment, deep bore and infiltrating wetlands as defined in this report).
- Notwithstanding the extensive studies there are two land disposal systems in use although these each only take a (very) small proportion of the treated water flow. They are:
  - (i) The Tauranga reclaimed water (wastewater) irrigation during the summer of the Omanu golf course and two reserve areas. (Another seven areas are allowed for under the present reclaimed water resource consents.)
  - (ii) The Waihi Beach Schemes sub-surface irrigation trial into an eucalyptus plantation.
- Recent studies have confirmed some of the community areas in Omokoroa and Maketu are unsuitable for on-site septic tank disposal systems particularly as the dwelling density increases.
- The detailed studies, including those in 1990 for Tauranga City, have highlighted the siting and other difficulties, and higher costs to implement long term sustainable land disposal, land treatment and deep bore injection schemes.

- By contrast, all Community Sewerage Schemes in the study area include some form of wetland and/or a land passage / riparian strip land treatment system. In a number of cases these have been installed to assist, albeit as a compromise, Iwi and Hapu with their cultural position against direct discharge of (treated) human sewage to a river or the sea. This is understood to have been the position with Tauranga in having wetlands before ocean discharge. Such land treatment / land contact techniques are also acceptable although sometimes as a compromise to other stakeholders and the wider community itself.

**The assessment of comparative costs between various forms of land application and ocean discharge highlights that:**

- For medium and larger sized schemes almost without exception the costs of land disposal and land treatment (and deep bore schemes) are usually a number of times higher than water discharge. Ratios from 3 to 10 times higher with 4 to 5 times higher reasonably typical.
- For smaller community schemes the cost spread between land disposal and land treatment is much more variable.
- For other land application techniques such as overland flow, wetlands and land passage / riparian strip the costs are usually much less than land disposal and land treatment.
- In some cases, for small communities, land disposal and land treatment offers the most economic capital cost solution when suitable land is readily available nearby.
- Investigation, consenting and ongoing monitoring costs for land disposal and land treatment are typically much higher than schemes discharging to surface waters.



## 1. Background

### 1.1 Objective of this Report

The objectives of this report (as set out in the brief) are to impartially compare the issues and costs of land application of treated wastewater with those of treated wastewater discharged to the ocean. This should allow all parties to participate in an informed debate on the options available for wastewater disposal and discharge.

While the report is to take a generic and New Zealand wide approach to the subject matter it also includes summary information of both the existing situations in the area covered by the SmartGrowth project and of other studies undertaken in the area in the last 12 years.

### 1.2 Scope and Format of this Report

This report is scoped to fit into the SmartGrowth sub-regional planning exercise. The extent of subject coverage and its presentation takes a comparison type approach. The comparison is between land application and ocean discharge.

The report traverses the “state of the nation” then targets in on the local situation. It also reviews some of the more recent treated wastewater disposal and studies that have been undertaken for communities in the SmartGrowth study area.

The report relies heavily on tables and listings to present the information particularly where the comparisons between the land application and ocean discharge are being made and also between generic matters and local factors.

### 1.3 Limitations of this Report

This report being of an overview and generic nature has a number of limitations. These include:

- Wastewater Treatment technologies and facilities / plants used in the study area are not covered in any detail. In all cases the comparison of the treated wastewater discharge options assumes the treated wastewater (effluent) will be of an appropriate quality for discharge into/onto land or the ocean. In all cases this will be secondary treated wastewater and in some cases disinfected by UV (ultra violet light) irradiation.
- No new site location specific studies have been undertaken other than the compiling of the information in the first part of Table 6.3.
- No new estimated cost studies have been undertaken of options. Previous cost estimates have however not been updated to present day costs. The relativity between different options should however still stand.

- No new community consultation nor Iwi and Hapu liaison has been undertaken. In this respect, it is the purpose of this report to provide information to assist in such next steps.
- The report does not purport to encompass the output of previous Regional and Local Maori Environment Management and Tangata Whenua considerations and findings. A number of these are, however, referred to in Section 1.5 and in Section 3.4 information is included from the New Zealand Waste Strategy 2002 that addresses Maori as kaitiaki and also kaitiakitanga.
- The report does not make comparisons between the two discharge means (ecosystems re-entry) based on the issue of people's perceptions.
- The SmartGrowth planning projections have not been used in the data presented. Instead the February 2001 Strategic Sewerage Study (MWH) figures have been used for recording that previous study and other studies use the figures then being considered.
- The New Zealand case history information included on other Local Authority schemes is based on what is understood by MWH personnel to be in the public arena. Reference and acknowledgement should be made to the appropriate Local Authorities should it be desired to use the information in more formal consultation processes.

## **1.4 Previous Local Studies and Reports**

Appendix A includes a reference list of the more relevant reports and resource consent applications undertaken in the SmartGrowth area since 1990. These include reports covering the sewered communities, the ocean as a treated wastewater receiving environment and on-site effluent disposal.

These studies, reports and resource consent applications when taken in their total context represent an extensive amount of work from which a very sound body of useful information is available in use in future options identification and assessment, and stakeholder consultation and Iwi and Hapu collaboration.

Information from a number of the community studies where wastewater discharge options, including land disposal and ocean discharge have been considered and decisions made, is summarised in section 6 of this report. This gives useful case history information on actual community and site/location specific options considered in the study area. The reports from which the information included in Section 6 has been obtained are included in the references given in Appendix A.

## **1.5 Maori Cultural and Lifestyle Values**

It is outside the scope of this report and the expertise of the authors to consider these matters. It is however, anticipated that this report will provide much useful information to assist in the consideration of them. The authors do however, acknowledge their importance and relevance to wastewater management.

It is appropriate however, to record that in addition to the legislative and planning instruments (refer Section 1.6 following) there are other documents and investigations that are likely to be of assistance in these considerations.

They include:

- Iwi Management Plans.
- The extracts from “Ngaa Tikanga Tiaki I Te Taiao” which relate to effluent treatment. These are included as Appendix H of the EBOP Operative “On-Site Effluent Treatment Regional Plan”.
- The report “Sustainable Techniques for the Provision of Infrastructure for the Urban Development Papamoa East”, particularly Appendix 4 – Tangata Whenua Values prepared by Keni Piahana – August 2002 MWH.
- Information relating to Tangata Whenua consultation on all previous wastewater studies (refer Section 6.2 for summaries on a number of these and Appendix A for a reference listing).

There are more specific issues that have been raised throughout the SmartGrowth process. These issues are outside the scope of this report and they may need more work on them. This report does however provide background information, as is its purpose, which should assist in the advancing these issues.

## 1.6 Key Legislation, Planning Instruments and National Guidelines

There are a number of key legislative documents, planning instruments and national guidelines that set what will guide choices and assist decision making on the various resource consent and other approvals (e.g. pipelines across land) necessary for implementation of any scheme. The following is a listing of these together with a brief explanation of their key purpose as it relates to options for land and ocean discharge of treated wastewater.

### A. Legislation This includes:

⇒ **The Resource Management Act 1991 (RMA)** - in particular:

- the purpose of the Act, which is to promote the sustainable management of natural and physical resources (Section 5);
- the need to take into account the principles of the Treaty of Waitangi, including the need to consult with Tangata Whenua in accordance with tikanga Maori (Section 8);
- recognition of the relationship of Maori and their culture and traditions with ancestral land, water and other taonga (treasures) (Section 6);
- the need to consider alternative options (Section 104 (3) and the Fourth Schedule);
- the emphasis on consultation (Fourth Schedule);
- the general requirement to avoid, remedy, or mitigate adverse effects on the environment (Section 5);
- the contents of policies and plans prepared under the Act (Section 104);
- consideration of the “best practicable option”.

**⇒ The New Zealand Coastal Policy Statement**

Policies 5.1.2 and 5.1.3 are particularly relevant in considerations of ocean discharge. These are matters to be included in Regional Coastal Plans.

***“Policy 5.1.2***

*Those rules should provide that a discharge of human sewage direct into water, without passing through land, may occur only where:*

- (a) it better meets the purpose of the Act than disposal onto land;*
- (b) there has been consultation with the Tangata Whenua in accordance with tikanga Maori and due weight has been given to Sections 6, 7 and 8 of the Act; and*
- (c) there has been consultation with the community generally.*

***Policy 5.1.3***

*Those rules should also provide that, after reasonable mixing, no discharge (either by itself or in combination with other discharges) may give rise to any significant adverse effects on habitats, feeding grounds or ecosystems.”*

**⇒ The Local Government Act 2002 (LGA)**

This new legislation requires Local Authorities to address the following matters when making decisions (Sections 77 and 78):

- Identify all reasonably practicable options
- Assess the options
- Consider Maori issues particularly in regard to decisions about land and water
- Consider the views and preferences of affected or interested people

The Act (Section 82) also outlines a number of matters to be addressed when carrying out consultation.

All these procedures are to be encompassed under the Purpose of the Act (Section 3) which includes:

*“provides for local authorities to play a broad role in promoting the social, economic, environmental, and cultural wellbeing of their communities taking a sustainable development approach”.*

An implicit requirement of this new legislation is undertaking quadruple bottom line reporting.

Furthermore under Part XXXI of the Local Government Act 1974 (which was not repealed by new legislation) Section 538 is particularly relevant;

***“538. Duty of territorial authority to encourage efficient waste management.***

*Every territorial authority shall promote effective and efficient waste management within its district and, in so doing, shall –*

- (a) have regard to environmental and economic costs and benefits for the district; and*
- (b) ensure that the management of waste does not cause a nuisance or be injurious to health.”*

⇒ **The Health Act 1956** – in terms of providing safe sanitation and promoting public health.

## **B. Statutory Planning Instruments**

### ⇒ **Regional Plans**

Environment Bay of Plenty has the following regional plans which all have relevance in respect to land application and ocean discharge of treated wastewater.

- The Regional Policy Statement. This includes broad objectives and policies for the regions natural and physical resources.
- Ngaa Tikanga Tiaki I Te Taiao – Maori Environmental Management in the Bay of Plenty; Regional Policy Statement.
- The Proposed Regional Coastal Plan.

Clause 9.2.3(g) reads:

*“Discharge of human sewage into coastal waters that has not passed through, land, soil or wetland, may only occur where there has been full consideration of the objectives and policies of this plan, following consultation with Tangata Whenua, and where it better meets the purpose of the Act.”*

- The Proposed Regional Water and Land Plan.

Objective 23 of this Proposed Plan is particularly relevant in respect to land application considerations;

*“Objective 23      Discharges of contaminants to land are managed to:*

- (a) Account for the natural treatment capacity of the soil.*
- (b) Prevent runoff to surface water.*
- (c) Prevent the long-term contamination of the soil.*
- (d) Prevent the contamination of groundwater.*
- (e) Prevent adverse effects on lake water quality in relation to the Tropic Level Index of the lake, where the discharge is in the catchment of the lake.”*

- The Proposed Regional Air Plan.
- On-Site Effluent Treatment Regional Plan.

### ⇒ District Plans

The following district plans control land use activities within the districts and may be relevant.

- Western Bay of Plenty District Council
- Tauranga District Council

A key consideration for a land application scheme is obtaining a designation (or plan change) for the use of the land for this purpose. If such a scheme serving a community in one Local Authority was outside its district then obviously application would need to be made to the adjoining District Council.

## C. National Guidelines

National Guidelines that are of relevance include in considering land application and ocean discharge of treated wastewater include:

- **“A Guide to Health Impact Assessment: Guidelines for Public Health Services”**, Public Health Commission, 1995. This provides guidance on public health issues that need to be considered with any resource management issue.
- **“Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas”** Ministry for the Environment, June 2002. This document provides a framework for monitoring recreational water quality and provides guideline values for marine, freshwater and shellfish gathering.
- **“Guidelines for the Safe Application of Bio-solids to Land in New Zealand**, New Zealand Water and Wastes Association (in Prep). These once finalised will supersede the “Public Health Guidelines for safe Use of Sewage Effluent and Sewage Sludge” and will be important in establishing acceptable application rates of bio-solids to land.
- **Guidelines for Land Disposal Scheme Planning**
- The NZ Land Collective and Forest Research (2000) Guidelines set out a reiterative type approach to the siting and designs for utilisation of sewage effluent on land. Part I covers the design process and Part II, issues for design and management.
- **“Australian and New Zealand Guidelines for Fresh and Marine Water Quality”** ANZECC 2000. These comprehensive guidelines provide a risk assessment framework for establishing acceptable contaminant levels in fresh and marine waters.
- **“The New Zealand Waste Strategy”** – March 2002 Ministry for the Environment and Local Government New Zealand. This strategy sets out a vision of towards zero waste encapsulated under a sustainable wastewater treatment facilities and sludge disposal.

- **The New Zealand Model General Bylaws – Part 23 Trade Waste**” Tauranga District Council have its own Trade Waste Bylaw which is generally based on the New Zealand model. Western Bay of Plenty District Council have draft Trade Waste Bylaws prepared and are planning to implement these in the future.

## **1.7 Next Steps**

The next steps will be determined as part of the SmartGrowth project’s consideration of this report and other related matters. This may encompass the determination of some policies and/or further consideration of wastewater disposal / discharge options for communities within the study area.

It is also envisaged that some of the information in this report will be used as background to the Tauranga District Council’s upcoming considerations of, and community and Tangata Whenua consultation about their Mt Maunganui ocean outfall discharge for which the present resource consent expires in April 2005. The associated resource consents for irrigation of renovated wastewater to reserve and other areas also expire at this time.



## 2. Land Application and Ocean Discharge Terminology

### 2.1 General

Unfortunately there has been much confusion in New Zealand with wastewater terminology particularly as it relates to application on land.

Education and consultation on wastewater matters is difficult enough without confusion in terminology with the many interested parties and complex issues involved. Accordingly there is a clear need for logical and understood terminology and for this to be established at the project outset and used throughout.

In this respect it was agreed at the outset of this project (SmartGrowth Services Group Meeting Friday 14<sup>th</sup> February 2003) that the following definitions would be used particularly as they relate to the land application options. Although these definitions have been used it needs to be appreciated that what is being considered is ecosystem re-entry and re-use. This is introduced in Section 2.2 below and in Appendix D covered in some detail.

### 2.2 Ecosystem Re-entry or Re-use

The Ministry of Environment has been working with a Steering Group on a handbook to assist communities, particularly smaller communities in making decisions about their wastewater. The handbook is to be titled “Sustainable Wastewater Management – A Handbook for Smaller Communities”. The handbook is to include useful information for all communities and also users of on-site effluent systems. The handbook is due for release at the end of April 2003.

The handbook appropriately takes a sustainable development approach to wastewater management and develops a systems approach to aid the decision-making processes. Within this approach, the term “Ecosystem re-entry” has been adopted to highlight that the return of appropriately treated wastewater to the environment, is part of the overall ecosystem and that this must be done in a sustainable way.

Appendix D of this report contains excerpts taken from the December 2002 draft of the handbook to highlight this appropriate ecosystem approach. It must be appreciated that the (final), published handbook may have this information presently different. When released, that handbook should supersede the draft material included in Appendix D of this report.

### 2.3 Land Application

In this SmartGrowth project, **Land Application** has been adopted as the generic word for all techniques where (appropriately) treated wastewater is applied onto, into or through the land. This is as compared to a direct discharge into a water body.



Under this generic term of “**land application**” there are a range of physical arrangements and techniques that determine what will happen to the treated wastewater and where it will go.

For this project the range of “**land application**” techniques that are considered, and defined below, are as follows. These will apply to the liquid portion of the wastewater except for the sludge and bio-solids;

- On-site (effluent) treatment
- Land disposal
- Land treatment
- Overland flow
- Mix and match
- Deep bore injection
- Land passage / riparian strip
- Re-use and renovation / reclaimed
- Wetlands
- Land application of sludge and bio-solids

This list has been ordered in a way that generally reflects the extent to which the treated wastewater is in contact and renovated by the land itself – from that of most contact and renovation in an “on-site” and “land disposal” system, through to the least contact in a land passage/riparian strip and wetland system.

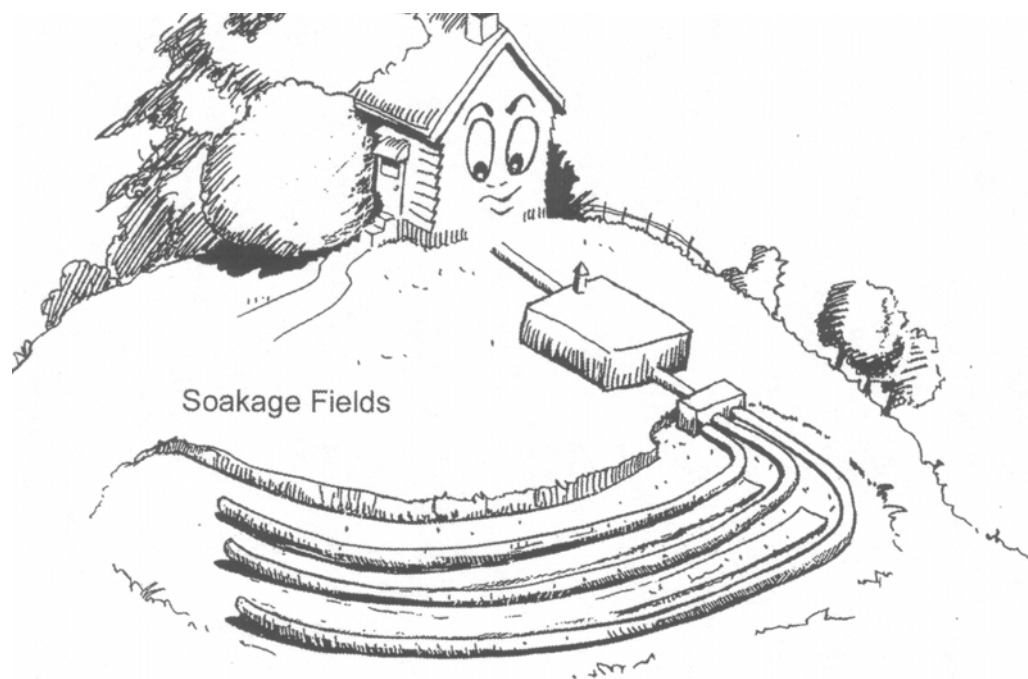
It should be fully appreciated that while the above range of techniques have in this report been grouped under “**land application**”, **some are strictly speaking land application or disposal where the wastewater is actually applied onto the land for discharge / disposal (e.g. land disposal, land treatment, deep bore injection and infiltrating wetland) and others are treatment systems.** The treatment systems (e.g. overland flow, land passage / riparian strip, wetlands, etc.) can perform both physical treatment (e.g. water quality improvement) and also Maori cultural treatment, in that they can be accepted for this purpose, albeit often as a compromise in respect to the Maori cultural position of human wastes contacting earth.

Re-use and renovation depends on what the form of these techniques are.

The individual “**land application**” systems listed below are defined as follows:

- **On-Site Effluent Treatment Systems** (from the EBOP Operative On-Site Effluent Treatment Regional Plan).

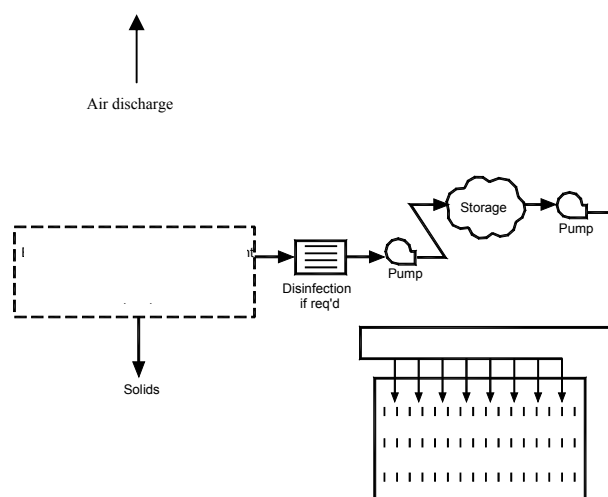
A system where kitchen, laundry and toilet wastes are collected, treated, and applied to land within the property boundaries of their place of origin. It involves three stages: the piped collection of wastewater flows, the initial treatment of those flows in either a primary or secondary pre-treatment unit, then their controlled discharged to land where additional treatment takes place via natural physical, chemical and biological processes within the plant-soil matrix. The dispersal of the resulting effluent occurs via plant evapo-transpiration and by percolation through subsoil to ultimately join natural groundwater. On-site effluent treatment systems as referred to in this plan have commonly been termed “on-site effluent treatment systems” in the past.



On-site systems are used extensively in the SmartGrowth Study area for isolated dwellings and low-density communities' areas. As dwelling densities have increased, problems with on-site systems have been experienced in some communities including Maketu, Omokoroa and Waihi Beach.

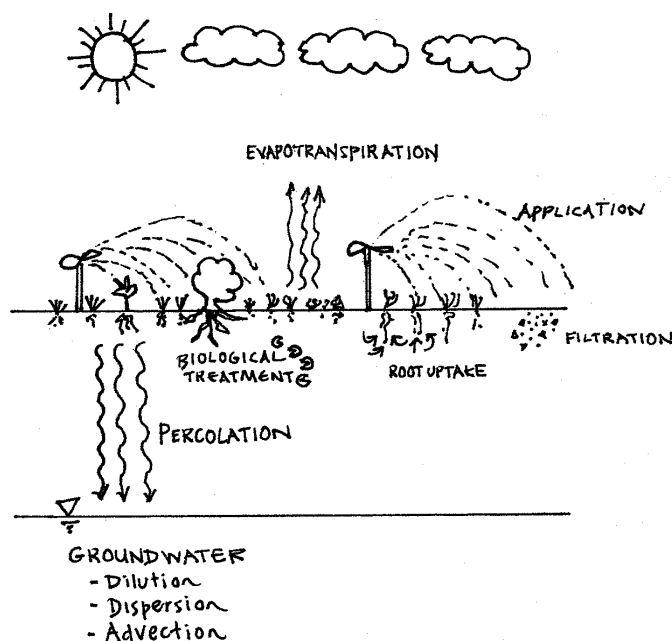
Experience shows that problems with some on-site effluent treatment systems would be reduced with appropriate septic tank construction and maintenance.

- **“Land Disposal”** is the process where appropriately treated effluent is disposed of (by various forms of irrigation) onto the land and then the effluent is either evapo-transpired by plants to the atmosphere or percolates into the ground. There is no direct runoff from the land on which the effluent is irrigated. The treated wastewater is usually either applied either as a Rapid Rate Irrigation (RRI) or a Slow Rate Irrigation (SRI) system. In New Zealand the major land disposal schemes are Slow Rate Irrigation systems.



The following diagrammatically depicts this:

### The Slow Rate Irrigation: Land Disposal Processes



Methods of application for the Slow Rate Irrigation Land Disposal System are varied and include:

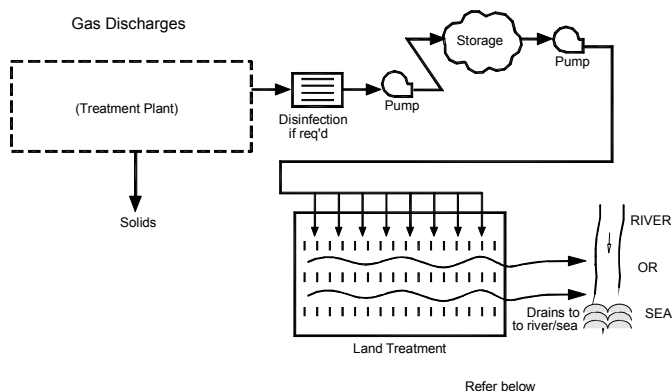
1. Surface irrigation by spray irrigation or border dyke irrigation
2. Subsurface irrigation by driplines.

The subsurface option has less potential for contact with animals and people. However, it is more difficult to maintain and the effective infiltration area is limited to the soils immediately around the dripline emitters.

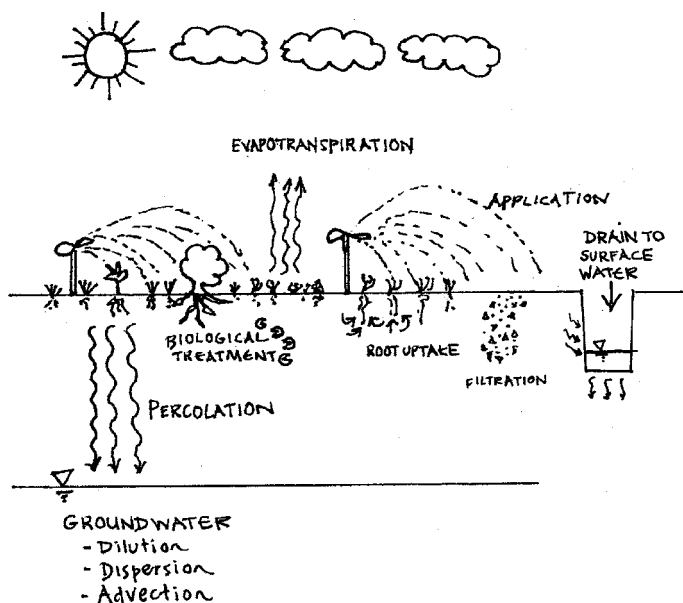
SRI land disposal has been considered for all communities served by reticulated sewerage schemes – Section 6 summarises these studies. For a range of reasons land disposal has not been adopted other than for the new Waihi Beach Scheme where a full scale trial is being undertaken.

Under this definition Land Disposal Schemes in NZ include; Taupo, Templeton, Waikowaiti, Whangamata, Warrington, Rolleston. These and others are further listed in Section 4.3.

- **“Land Treatment”** is the term applying to schemes where the effluent is applied to land, again by various forms of irrigation, but some proportion (at times practically all) passes through the land into drains and is disposed of via a drainage system to surface water or the ocean. It is proposed that the land treatment drains would discharge into existing drains, streams, rivers, estuaries or the ocean.



### Land Treatment Processes

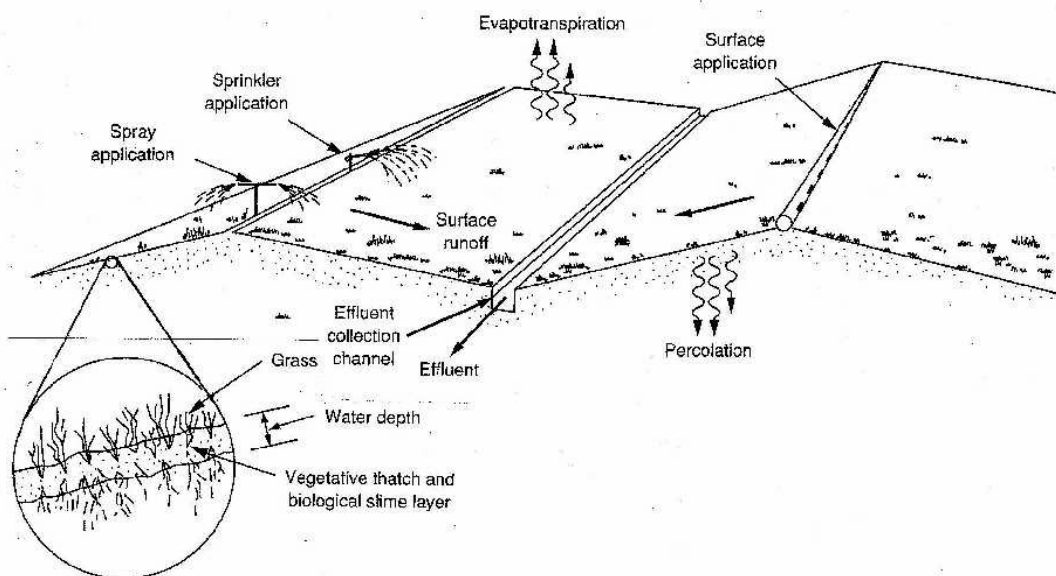
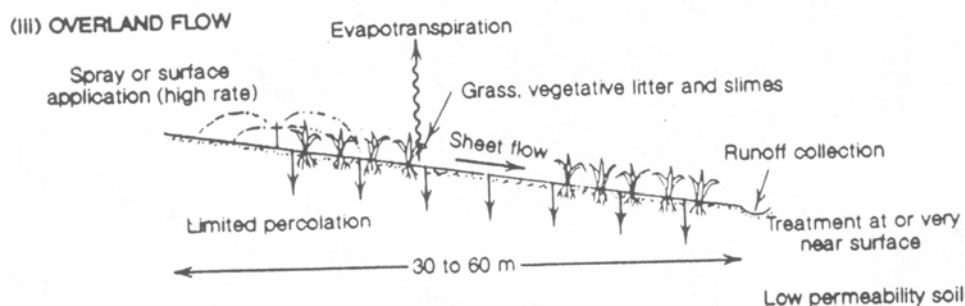


Under this definition Land Treatment Schemes in New Zealand include; Rotorua, Levin, and parts of Turangi.

#### • **Overland Flow**

Overland Flow is the application of wastewaters to sloped, grassy land areas with relatively impermeable soils. Treatment of the wastewater occurs as it flows over the soil surface in a thin film. Ditches at the bottom of the slope collect the runoff. Strictly speaking this is a wastewater

treatment system as the majority of the wastewater runs off the land slope and is collected for subsequent discharge elsewhere.



- Mix and Match**

A “mix and match” scheme is one that uses both a land application system (normally land disposal) or land treatment for part of the year and direct discharge to surface or marine waters for the other part of the year. Alternatively a “mix and match” scheme can involve part of the treated wastewater going to a land application scheme and part to a direct water discharge at the same time.

Mix and match schemes offer what is considered to be a sustainable approach from a receiving environment perspective, in that the treated wastewater can go to the land in drier / hotter times when the land can often well accept it and value be gained from the irrigation and fertilizer effect, then to water body, e.g. river in wetter periods when a river flow can be greater and provide more natural assimilation capacity.

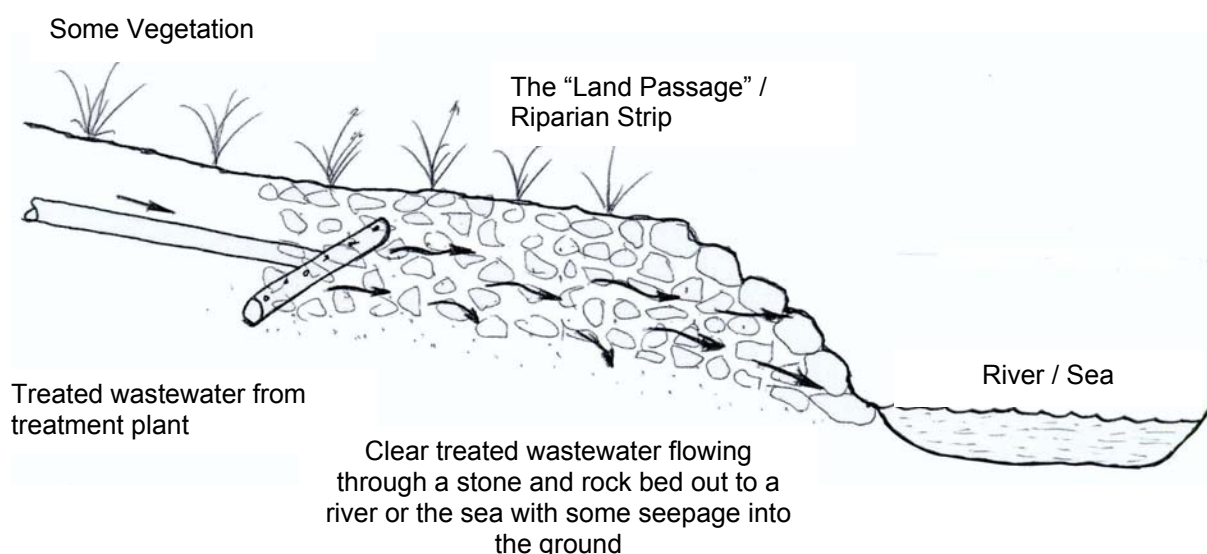
The present Tauranga Chapel Street system could be considered “mix and match” to some extent in that during summer periods some of the treated wastewater is irrigated onto parks and golf course(s). This is presently only a small proportion of the total volume however.

- **Deep Bore Injection**

Deep bore injection as the name infers, involves pumping the treated water back into the underground through deep bores. The only community scheme using this technique in New Zealand is the Russell township scheme, although it is used in the oil and gas industry in New Zealand for process wastewaters.

Some of the earlier investigations in the study area have considered it but not found such a technique to be appropriate.

- **Land Passage / Riparian Strip**



This technique is being used to an increasing extent as a means, albeit usually as a compromise, to assist Maori with respect to their cultural position, of not discharging human waste direct into water. By passing the treated human sewage through or over land or earth mother (Papatuanuka), then in some areas local Iwi and Hapu have accepted as a compromise this technique, to assist Iwi and Hapu in the spiritual cleansing of the treated human sewage.

Areas where such a land application system is used for this purpose include Te Puke (which also has a wetland), Paeroa, Taumaranui and Te Rapa dairy factory. It is further planned and agreed to by local Iwi and Hapu for Palmerston North, Hastings, Dunedin City and probably other communities.



- **Re-use and Renovation / Reclaimed**

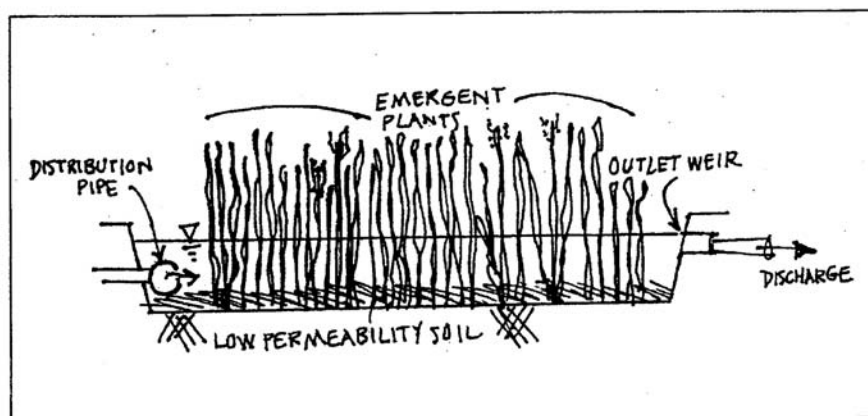
Re-use and renovation refers to techniques where treated wastewater is re-used in a beneficial way. Examples are often for parks and golf course irrigation, for horticulture use, for industrial process water and for non-potable household use, e.g. garden watering, toilet flushing, etc. This usually requires a higher degree of treatment of the wastewater, the extent of which depends on the type of re-use or renovation.

In the study area Tauranga District Council re-uses in summer a small portion of the Chapel Street wastewater for irrigation on the Omanu golf course and the Tauranga Domain and the Sulphur Point Reserve. The Council do however, hold resource consents for the discharge of up to 6,000m<sup>2</sup> of treated wastewater per day total to ten sites. These sites include the airport, central business area gardens, Mt Maunganui Intermediate School and other parks and reserves. This procedure is being further considered as part of their resource consent investigations.

As indicated in Section 6, a number of the WBoPDC communities have considered a number of re-use and renovation techniques in the options assessments including horticulture use, but to date none have been proceeded with.

- **Wetlands**

In a wetland system wastewater is applied to natural or constructed wetlands with the objective of treating the wastewater through the biological, physical and chemical interactions at the stem/root/soil/water interfaces.



Wetlands are becoming reasonably popular in New Zealand especially in the warmer Northern areas. The Te Maunga wetland is one of New Zealand's earlier and larger ones.

There are various types of wetlands. These are best grouped as:

- Engineered wetlands used extensively for wastewater treatment processes – e.g. Taumaranui and Te Puke; and
- Aesthetic and cultural wetlands used for providing an aesthetically pleasing bridge between the hard lines of a mechanical instant type treatment plant and nature, for wildlife and for Maori cultural reasons, e.g. Te Maunga and Whangarei.

In considering wetland options the key matter is probably for what purpose is the wetland being installed and then how will it be designed, and as a natural system, managed. Unfortunately the international literature is not always clear in these respects, although the majority of such literature relates to wetlands principally designed and constructed for wastewater treatment purposes.

In New Zealand we are now better understanding this issue and the reasons why wetlands are installed in different ways relating to their driver (or prime reason) which can be:

- a) Substantially for wastewater treatment purposes, e.g. fully engineered/fully planted such as Taumaranui;
- b) For aesthetic reasons;
- c) For habitat reasons;
- d) For Maori cultural reasons;
- e) For community perception at large reasons;
- f) To meet Policy 5.1.3 of the New Zealand Coastal Policy Statement and in the study area Clause 9.2.3(g) of the Regional Coastal Plan (refer Section 1.6 of this report);
- g) For various combinations of the above.

Reasons b), c), d), e) and f) could be considered to be “enhancements” to a basic, or base treatment scheme in respect to the terminology being used in the Palmerston North project as set out in Council Working Paper No. 1.

The Tauranga District Council’s wetlands at Te Maunga are, for example, understood to be have been selected for a combination of reasons b), c), d) and e) principally. The decision to install them predated the New Zealand Coastal Policy Statement.

Any wetland, other than the fully engineered/fully planted can have a different sizing and design and operation criteria. The critical feature however is the long term management of a natural system and the need to ensure, as far as possible, equilibrium with nature without substantial management difficulties or costs. An aesthetic habitat wetland, for example, could have a much shorter wastewater retention period, e.g. 1 to 3 days, compared to the more typical 6-10 days of a fully engineered/fully planted system where treatment is its primary purpose.

- **Land application of sludge and bio-solids**

Application of appropriately treated sludges, now defined as bio-solids, to land, is practised in some areas. Composting of the sludges with green waste or other materials is used in Tauranga at the Paengaroa Project, Western Bay of Plenty District Council at Belk Road and for Wellington City’s sludge.

The application to land of the sludges / bio-solids has beneficial effects in that the organic matter and nutrients are available for soil conditioning and plant update. The new New Zealand Bio-solids Guidelines (refer Section 1.5) will provide guidance on this practice.



## 2.4 Ocean Discharge

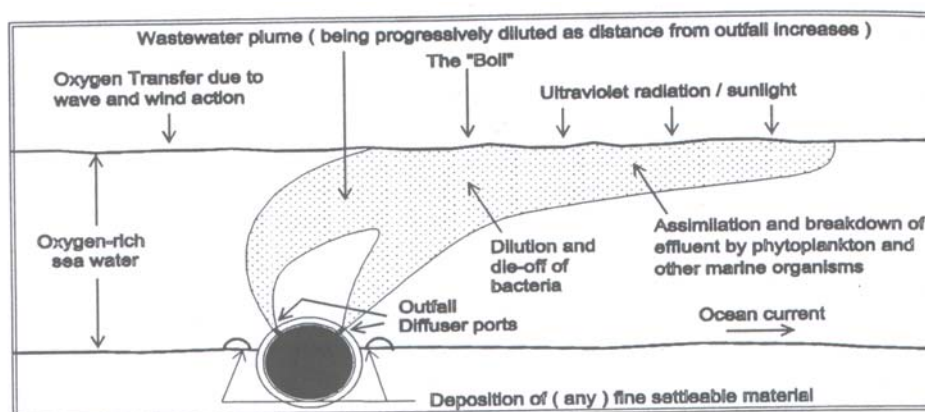
### Discharge of Wastewater into the Marine Environment

The practice of discharging appropriately treated wastewater into the marine environment is internationally accepted. In fact it is the means of disposal used by the majority of coastally located communities and cities throughout the world. This is also the case in New Zealand where it is estimated that approximately 90% is discharge to the marine environment (estuaries, harbours and ocean), albeit to an increasing extent after passing through wetlands and/or land passage (riparian strip) facilities. Another 7.5% (again a very approximate estimate) is discharge to inland (fresh) water with the remaining 2.5% disposed onto land.

### Ocean Outfalls and Natural Assimilation: Marine Treatment

The natural processes in the marine environment routinely absorb, assimilate, dilute, and disperse wastes and contaminants. Wave action, currents, sunlight, and feeding by marine organisms all play a part in the life cycle in the sea. Indeed, the ocean is a natural recycling machine, continuously breaking down enormous quantities of naturally occurring “wastes” generated by ocean-dwelling organisms.

These ocean purification processes are very similar to “secondary” and “tertiary” engineered sewage treatment processes, but operate on a much larger scale. Internationally recognised papers and texts adopt the terminology “marine treatment”.



Supporting these comments, the Ministry for the Environment’s 1997 (first) State of New Zealand Environment report stated in Chapter Seven (7.47) which “*for carefully sited, long, deep, outfalls, however most research indicates that the sea’s disposal powers quickly dilute any contaminants*”.

Notwithstanding the natural purification processes of the ocean, there is potential for bio-accumulation of some toxins (contaminants) from wastewater discharges, particularly metals and, in some cases, trace organic chemicals. These can be present in significant quantities in industrial wastewater (trade wastes). Accordingly, control measures on the amount of such contaminants entering the wastewater system need to be implemented. The Local systems are no exception. Tradewaste management through appropriate bylaws are important in this respect. Tauranga District Council currently has such a Trade Waste Management system. By contrast Western Bay of Plenty

District Council currently has few trade wastes in their sewerage systems. WBoPDC have a Trade Waste Bylaw, however it is not currently enforced. Adoption of such a bylaw by all Local Authorities is a target in the NZ Waste Strategy 2002.

In all cases of marine disposal, there is a need to assess the degree of “marine treatment” when considering site specific factors. These factors, considered together, include:

- The oceanographic situation, i.e. open waters, enclosed estuary, current patterns, etc.
- The outfall location itself and its physical and oceanographic characteristics.
- The separation in distance and travel time to the shoreline and other areas of particular significance, e.g. shellfish beds, bathing beaches.
- The water quality standards to be achieved as set out in the appropriate Regional Coastal Plan and RMA.
- The degree of wastewater treatment prior to discharge, particularly as it relates to the contaminants (pollutants) of concern.

Each situation is assessed based on its specific factors. This is undertaken on a case by case basis, with the key assessment made on the balance between the degree of treatment, the outfall length, and location.

In New Zealand, for example, we have a good number of marine discharge cases that highlight the wide spectrum of combinations of treatment and outfall location and length. These range, for example, from those with very short or shoreline discharge locations with a high degree of onshore treatment and some including effluent disinfection where shellfish and/or bathing waters are to be protected, through to those with offshore ocean outfalls discharging into open water where the onshore treatment needs are very much less.

Table 5.3 in Section 5.2 summarises outfalls in New Zealand.

In all marine discharge cases it is appropriate to remove at least settleable solids, trash, sizeable inert material and other screenable solids before discharging to the ocean.

In the Hastings Ocean consent case the Regional Council’s HBRC Officers’ Report is confirming in that the Officers accept that ocean disposal of wastewater “is not inappropriate” and the acceptance of marine treatment on a site-specific basis is an appropriate approach. The report reads:

*“Ocean disposal of wastewater has traditionally been a popular method due to the large number of communities adjacent to the coast and the relatively low cost of such disposal. Pre-treatment varies from none through to tertiary. It can be argued that ocean disposal of wastewater is not inappropriate, as the marine environment is able to provide a highly effective treatment system through potentially large dilution availability and exposure to UV radiation resulting in die-off of bacteria. The acceptability of marine treatment on a site-specific basis, however, depends on several factors, including the disposal system, environmental effects (such as the sensitivity of the receiving environment and its use), RMA requirements, cultural issues and community preferences, and options available”.*

### **Present Position with Discharge to the Marine Environment in New Zealand**

As evident from the information in Section 5 and Appendix B of this report, then for the majority of New Zealand's larger coastal settlements, wastewater discharges are either directly into estuaries, harbours, or as is the case for Tauranga and Katikati, into open coastal waters.

With the majority of New Zealand's urban population being located in coastal cities and towns the majority of New Zealand's domestic sewage and appropriately controlled and pre-treated trade waste, is discharged into the marine environment. Treatment and disposal arrangements at these localities all differ. This highlights the "case by case" approach which takes into account site specific features are outlined as above.

Outfall lengths vary from shoreline to the longest, being Hastings at 2,750m. The Tauranga District Council's ocean outfall is 900m long and the Katikati outfall 650m. Section 5 includes information on all outfalls.

### **3. Key Drivers , Generic and Local Factors and Decision Processes**

#### **3.1 Key Drivers**

In any wastewater management project there are always a number of key decision drivers that feed into the decision process. The relative importance and weighting given to each of these are important inputs to that process.

Key drivers usually included:

- The Legal Requirements
- Certain Environmental (biophysical) considerations, restraints and actual and potential adverse effects
- The Social Factors including public health, perception issues, lifestyle and people's ability to pay the costs
- The Maori cultural and lifestyle
- The Economic considerations particularly affordability to scheme users
- The beneficial, or positive, effects of the project
- The risk profile incorporating probability and severity of occurrence and means of mitigation of particular major risks

#### **3.2 The Generic Factors**

The following is a brief summary of the main generic factors that need to be considered when assessing both land application and ocean outfall discharge systems. The summaries are in no way all embracing but from New Zealand case experience, are considered to include the main issues and factors.

Section 6.2 highlights some of the key local factors for land application and ocean discharge as they relate to the SmartGrowth study area. Section 3.2 outlines possible and proven decision process outlines into which such Generic and Local Factors are fed.

##### **(a) Land Application Schemes**

For land application schemes there are often many, and is a wide range of, varied and often complex issues and factors needing consideration. This is particularly the case for larger land disposal, land treatment and even overland flow schemes. These issues all need to be assessed in the context of providing a long term sustainable system. This assessment is made more difficult by the fact that we have little long-term case history experience in New Zealand regarding the sustainability of land application. Some patterns are starting to emerge however, and some of these give rise to some concern as outlined in Section 4.

## Issues Overview

- The availability of the suitable land.
- The (high) value and alternative land uses (residential, horticultural, agricultural) of the land.
- The wisdom of utilising of some of the best agricultural soils available in the area for effluent disposal and possibly forestry.
- The often many small land parcels and the multiplicity of owners that would need to be worked through to develop a contiguous scheme of the required area.
- The possibility of large areas of land being required for buffer zones due possibly to a fragmented system that may be required due to the many small land parcels.
- The likely non-acceptance of land disposal and land treatment activities on land irrigated with effluent even if it is highly treated and disinfected.
- Market and Industry (overseas exports, etc) restrictions and perceptions of cross/landuse practices, e.g. New Zealand Dairy Industry.
- Crop use, economics/dis-economics, value of nutrients, organic content and liquid (irrigation value of applied treated wastewater).
- The consentability of any land application scheme
- The overall (possible – in fact likely) NIMBY (Not In My Back Yard) sentiments of people living or working close by.
- The risk involved with the security and reliability of long pipelines and the associated pumping systems serving land application systems.
- For the land treatment options where the excess/collected effluent would be discharged, i.e. to rivers, harbours, estuaries and/or direct to sea.

**The factors needing to be considered** can be summarised under the following groupings:

**Environmental effects** of any proposed land application scheme will need to be thoroughly investigated and documented in order that resource consents for the scheme can be obtained.

- |   |  |
|---|--|
| Δ Land Use  | Δ Soil Contamination   |
| Δ Groundwater Contamination                       | Δ Surface Water Contamination  |
| Δ Groundwater Level and Rise                      | Δ Habitats and Ecosystems  |
| Δ Areas with Cultural and/or Social Importance    | Δ Aerosol Spray Drift, i.e. pathogen levels and public health, stock and vegetation issues |
| Δ Land Use – crops/animals/contamination transfer | Δ Long term sustainability   |

- In this respect the NZ Dairy Board's Environment Committee has resolved in 1999 *"that the practice is to be discouraged to the extent that affected farmers may not have their milk collected in the future"*. This resolution has been further amended to refer to any techniques associated with land application of domestic wastewater. This includes "cut and carry" hay / silage operations and land application of sludges / bio-solids.

The implications of this Dairy Industry stance has had very significant influence against using land application in some areas of New Zealand where Diarving is a major land use, e.g. Hamilton / Waikato areas, Palmerston North / Manawatu areas and areas of Canterbury / Southland.

### Technical Factors

- |   |  |
|---|--|
| Δ Wastewater Treatment Type and related treated wastewater quality and its compatibility for land application | Δ Reliability/Risks of long pipelines and pumping to (remote) land application areas |
| Δ Flexibility of treatment and discharge system for future flow, load and treated wastewater quality charges  | Δ Mechanical nature of the land application system, e.g. multiple irrigation sprays  |
| ▽ Operating and Maintenance Requirements  |  |

### Economic Factors

- |  |   |
|--|---|
| ▽ Capital and Operating Costs  | ▽ Future flexibility of scheme and related future and issues                            |
| ▽ Reliance on Markets for Products from land application areas and associated incomes and production costs | ▽ Depreciation of infrastructural assets as required under Local Government legislation |

### Social and Cultural Factors

- |                                       |   |
|---------------------------------------|---|
| ▽ Neighbours                          | ▽ Maori Cultural and Lifestyle Values (refer Section 1.5) |
| ▽ Public Perception (for and against) | ▽ Public Health   |
| ▽ "Clean Green" Concept               | ▽ Resource Re-use Ethic                                   |
| ▽ Odour nuisance                      | ▽ Safety  |

**Risks** associated with the building and operating a land application systems, particularly larger land disposal or land treatment schemes can, as experience shows, be considerable. Key elements of risk inherent particularly to the land disposal or land treatment schemes include:

- |   |                          |
|---|--------------------------|
| Δ Security of Land Ownership                | Δ Tree Health            |
| Δ Adverse Effects Associated with Operation | Δ Changes in Legislation |

- |   |  |
|---|--|
| Δ Climate Change                            | Δ Changes in Guidelines  |
| Δ Flooding                                  | Δ Market for Product from the land application area, e.g. Dairying Situation |
| Δ Sustainability of Soil-Water-Plant Matrix | Δ Diseases and Predators, e.g. Dairying Situation                            |

## **(b) Ocean Discharge**

The issues associated with and the science and engineering of ocean discharge particularly through offshore ocean outfalls is well developed both in New Zealand and overseas.

The **Issues Overview** includes key matters like:

- The perceptions and philosophical question of discharging acceptable treated wastewater into the ocean.
- The cultural position of Iwi and Hapu with respect to their position on the abhorrence of direct discharge of human sewage into water.
- The understanding and acceptance of the natural assimilation and (marine) treatment process that take place in the ocean.
- The balance between outfall location and length and the degree of treatment of the wastewater.
- The need for at source control and minimisation of (potential) toxins particularly from industrial wastewater (trade waste) discharges.
- The acceptability of the discharge into the marine ecosystem and the long term sustainability of the practice.
- The use of the sea in the vicinity of the discharge and areas it may impart – e.g. shellfish, fish, human contact, recreation, etc.
- Costs – capital and operating of ocean discharge facilities.
- Risks, particularly in building and maintaining offshore outfalls.

**The factors needing to be considered** can be summarised under the following groupings:

### **Environmental Effects**

- |  |                           |
|--|---------------------------|
| Δ Any shoreline impacts  | Δ Ocean current movements |
| Δ Marine ecosystem including fisheries and wildlife  | Δ Any visual effects      |
| Δ Effects on physical environment of infrastructure construction, e.g. foredunes and sea bed |                           |



### Technical Factors

- △ Treated wastewater quality (concentrations and mass loadings)
- △ Degree and reliability of wastewater treatment
- △ Outfall location construction, long term security
- △ Operating and Maintenance requirements
- △ Flexibility of infrastructure for future changes, e.g. flows and loads within the economic life of the infrastructural asset, e.g. outfall pipes which typically are designed for a long (50 year) life

### Economic Factors

- △ Capital and operating costs
- △ Economic life of the infrastructure
- △ Depreciation of infrastructural assets as required under Local Government legislation
- △ Economic effects on any commercial fisheries

### Social and Cultural Factors

- △ Public perception for and against
- △ Affordability (the users ability to pay)
- △ Public health (shellfish, fish, human contact recreation)
- △ Maori Cultural and lifestyle values (refer Section 1.5)
- △ Odour nuisance

**Risks**, from experience, have been well identified and developed mitigation measures are available.

The main risk areas include:

- △ Construction of an offshore outfall
- △ Long term security / stability of an offshore outfall
- △ Flexibility of a fixed infrastructural solution to accommodate changing flows, loads and standards
- △ Obtaining the resource consents for ocean discharge and in particular public perception and Iwi and Hapu cultural position
- △ Marine ecosystem – unacceptable adverse cumulative effects occurring outside the designated “mixing zone”

## 3.3 Local Factors

For each of the generic factors recorded in Section 3.2, there will be the local situation or local factors. These will determine just what needs to be addressed in issues identification, wastewater options assessment and in the decision processes.

It is outside the scope of this report to address all these. The report does however include reference to relevant Planning Instruments in Sections 1.5 and 1.6, and in Section 6 local site factors relating to



possible land application, are summarised as are investigations into wastewater options for a number of communities.

One of the overriding local factors is the stance taken by EBOP, WBoPDC and TDC on protecting the quality of the Tauranga Harbour and other estuaries in the study area particularly by control of contamination (nutrients especially) entering these waters and adding to their enrichment.

The Western Bay of Plenty District Council's adopted policy in respect of wastewater is very clear on this:

*“Council has adopted the following policies in respect of wastewater in general:*

- A policy of forward planning for service for residents and ratepayers and Councils commitment to arrest, and where possible restore, environmental standards where these have deteriorated.*
- The Council's primary concern is to clear all wastewater, where practicable, from the Tauranga Harbour and other waterways where persistence of sewage provides the greatest risk.*
- An approach to first arresting the decline of environment standards and then a programme of upgrading on a step by step basis.*
- That all new works must comply with the above principles.*

Another important local factor is the use of the sea for contact recreation, especially Mt Maunganui, and seafood gathering. This along with the planning instruments are important factors when considering marine / ocean discharge. The change in the bacteriological recreational contact level zone from 200m to 400m offshore, will need to meet the recreational contact level, once the proposed Regional Coastal Environment Plan becomes operative.

Also as previously highlighted (in Section 1.5) the local Iwi and Hapu considerations are also important local matters to take into account in the decision-making processes.

### 3.4 Decision Processes and Trends

#### Decision-Making Generally

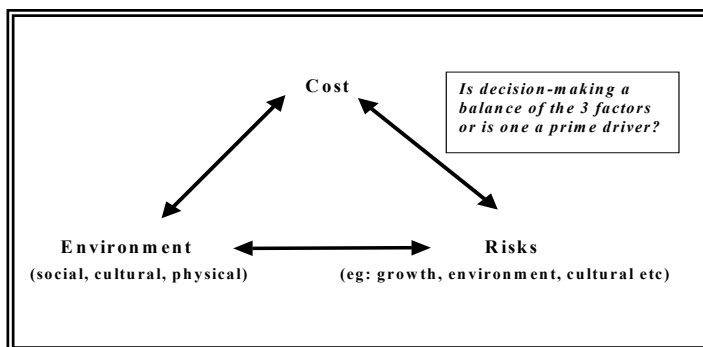
In making decisions about the way forward, a risk analysis assists in identifying gaps in knowledge and potential implications of identified risks.

Appropriate decision-making processes for wastewater management, when working within a Resource Management Act framework, should consider:

- Costs (capital, operational and affordability to customers)
- environmental effects, including social and cultural effects
- risks

The three factors are shown in the figure below as a 'Decision triangle'. There is a need for a defensible decision process, particularly when traversing the planning and legal processes.

Risk considerations are particularly important especially with land application schemes as the risks are often (potentially) much higher than with ocean discharge systems provided in the latter case, a long term secure ocean outfall is put in place. Risk issues are discussed in more detail in sections 4 and 5 respectively.



**Figure 1: Decision Triangle**

## Recent Trends

More recent developments and trends included in overall project identification, approach, assessment and decision making include:-

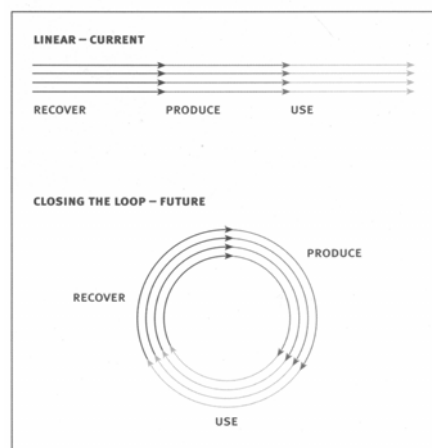
- **Sustainable development holistic approaches** that look at all social, cultural, environmental and contaminants in the greater environment and targeting those that really matter. This all fits into a sustainable development approach as encompassed in the Local Government Act 2002 and the New Zealand Waste Strategy 2002. Overarching this approach is the New Zealand Government's recently issued (Jan 2003) "Sustainable Development Programme of Action" and the Parliamentary Commissioner for the Environment's report to Parliament "Creating our Future – Sustainable Development in New Zealand" – Jun 2003.
- **More efficient resource use.** Under a sustainable development approach, there must be a move from often previously used linear "end of pipe" approaches to one where all resources and input are considered by adopting a cyclic "closing the loop" approach.

Figure 2 below, taken from the New Zealand Waste Strategy 2002, depicts this well:

In wastewater management this resource efficiency approach requires the assessment of all inputs and outputs to the total system.

Inputs such as energy use (and cost) chemicals, amounts of domestic sewage and industrial wastewater and levels of contamination, all need assessment as do the outputs and how they are to re-enter the ecosystem (refer Section 2.2). Energy use is often a major and costly input to a wastewater system particularly land disposal, land treatment and some other land application systems. The sustainability of the energy source also comes into the overall holistic approach. In Sections 6 and 7, energy costs are specifically commented on for this reason.

*Figure 2: Linear versus cyclical approaches to resource use*



- **Maori as kaitiaki.** Notwithstanding the position of Maori and Tangata Whenua within the context of the Resource Management Act and the Local Government Act 2002, it is appropriate to encompass Maori as kaitiaki (Guardians or stewards of resources who promote the integrity of the resource).

The following excerpts from The New Zealand Waste Strategy 2002 relate to Maori as kaitiaki:

*“Maori have driven improvements in wastewater treatment and disposal. Tangata Whenua have a large body of knowledge (matauranga Maori) based on customary practice, and a strong sense of their duty as kaitiaki. They have fuelled efforts to ensure that sewage sludge and bio-solids resulting from wastewater treatment are made safe before being deposited on land.”*

#### **Matauranga Maori**

Iwi, Hapu and whanau want to be sure that waste is disposed of appropriately – in harmony with their values, and without damaging the environment that sustains Tangata Whenua. This means, for instance, maintaining mahinga kai, or food-gathering areas, large enough and healthy enough for present and future needs.

Inappropriate waste disposal can damage the relationship Maori have with their lands, waters, food-gathering areas, and wahi tapu. Dumping waste into mahinga kai diminishes the site’s mauri and mahinga kai values. The interdependence of mahinga kai ecosystems means any contamination – even of one species – has a negative flow on to all species in the ecosystem, including people.

Contamination of a food source threatens the ability of Tangata Whenua to fulfil their manaakitanga responsibilities (their ability to host visitors) as well as to sustain themselves from that food source. This, in turn, puts pressure on other food sources. This, in turn puts pressure on other food sources and ecosystems.

- **The principle of kaitiakitanga / stewardship.** This is one of the six principles that are set out in the New Zealand Waste Strategy 2001 to guide central and Local Government. The Strategy in establishing the principles clearly makes the point that they are not absolute but subject to equity, practicality and cost.

The kaitiakitanga / stewardship principle as recorded in the New Zealand Waste Strategy, reads:

*“All members of society are responsible for looking after the environment, and for the impact of products and wastes they make, use and discard.”*

*The Maori concept of kaitiakitanga expresses an integrated view of the environment and recognises the relationship between all things. Kaitiakitanga represents the obligation of current generations to maintain the life sustaining capacity of the environment for present and future generations. Stewardship is similar, acknowledging the role and responsibility we each have in managing the environment for the good of all. Fulfilling this obligation means managing all wastes to lessen their adverse environmental effects.”*

- **Wastewater minimisation procedures.** These are for both domestic sewage and industrial wastewater (trade waste). These are continuing to be established and implemented in many situations. Trade waste minimisation and cleaner technology procedures are parts of Trade Waste Management as are sludge, bio-solids and other residuals.
- **Flexibility in treatment and disposal facilities** to accommodate future changes in technology, environmental standards, wastewater volumes and contaminant types / levels.
- **Setting of Project Objectives at the outset.** This approach is being adopted to an increasing extent by Communities and Councils looking at wastewater management options. Once the objectives are set, this then provides sound input into the decision-making process as all issues and options for different schemes, etc. can be evaluated against how they measure up to the objectives set.

For example, the Palmerston North City Council's approach as shown below, was to set an overall objective then underpinning this; economic, environmental and social / cultural objectives.

- **Undertaking a Best Practicable Option (BPO) approach.** This approach is often an appropriate one and sets the way forward in the decision process. The objectives (refer above) are likely to determine this.

The concept of the "best practicable option" is embedded in the RMA as part of sustainable management. It is possible for consents for contaminant discharges to be obtained with a condition requiring the Consent Holder to adopt the best practicable option to avoid, remedy or mitigate adverse effects. Such conditions are quite problematic because it is never certain whether compliance is being achieved.

However, in evaluating options and determining the particular proposed scheme, the best practicable option has also been considered.

The definition of best practicable option in Section 2 of the RMA states that the phrase:

*"means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to –*

- (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
- (b) the financial implications, and the effects on the environment of that option when compared with other options; and*
- (c) the current state of technical knowledge and the likelihood that the option can be successfully applied."*

Thus the discharge quality and effects on the receiving environment must be considered, but so must the financial implications and technical knowledge and the technical feasibility of the options.

Furthermore, a BPO approach brings in other legislative requirements including Section 538 of the Local Government Act 1974 which relates to the *"duty of territorial authority to encourage efficient waste management"* (refer Section 1.6). Furthermore the New Zealand Waste Strategy

in setting out the six core principles to guide central and local government clearly states that the principles are not absolute but subject to equity, practicality and cost.

### Approaches in the RMA Decision Making Process

It is appropriate to undertake a holistic and integrated approach for the environmental assessment of this application. This includes the RMA definition of environment and the purpose of the Act itself.

Progress towards sustainable wastewater management must be part of any Wastewater Scheme's future.

The definition of environment incorporates dimensions of the social, cultural, economic and the biophysical environment. In the identification of issues and options these dimensions must be traversed.

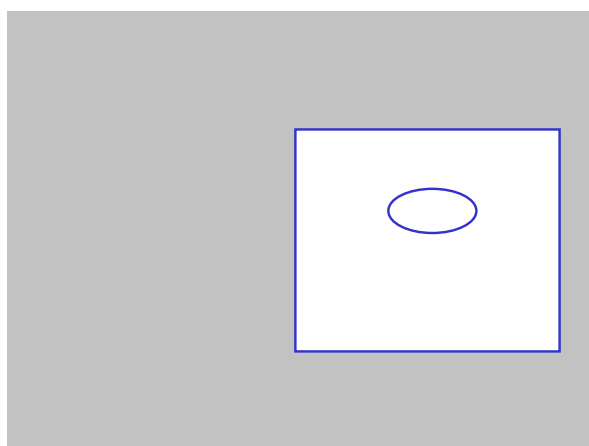
All environmental effects including benefits (positive), potential and actual adverse effects, as well as cumulative effects must be appropriately identified and assessed.

Risk based approaches to environmental management are both appropriate and implied under RMA procedures. Accordingly they are incorporated in the information supporting this application.

Decision processes must be robust and defensible with a logic progression throughout. Defensible audit trails also need to be established.

The Best Practicable Option (as per RMA definitions) is often the appropriate way to approach the solution to a wastewater management option. Maori cultural and lifestyle values do, however, need to be well considered also in accordance with the RMA and other statutory documents and Council Plans.

### An example – The Palmerston North Wastewater Project – Council Decision Process



**Council's Role & Involvement**

**Economic**

- To optimise local economic development
- To implement a financially sound financial policies and parameters in the Long Term Financial Strategy
- To minimise financial impacts
- To be receptive to new solutions during the development period of the solution.

**Environmental**

- To provide an environment management plan in accordance with the Resource Management Act.
- To obtain the longest possible life span for the solution.

**Social**

- To have iwi (mana whenua) input and support
- To have input and support from the community
- To have support of surrounding areas

**WasteWater 2006**

**Overall Objective**

- To have the best practicable solution for the treatment and disposal of the City's wastewater (that meets the timeframe of the Manawatu Catchment Water Quality Regional Plan) and is in keeping with sustainable management principles.

## Land Application Decision Processes

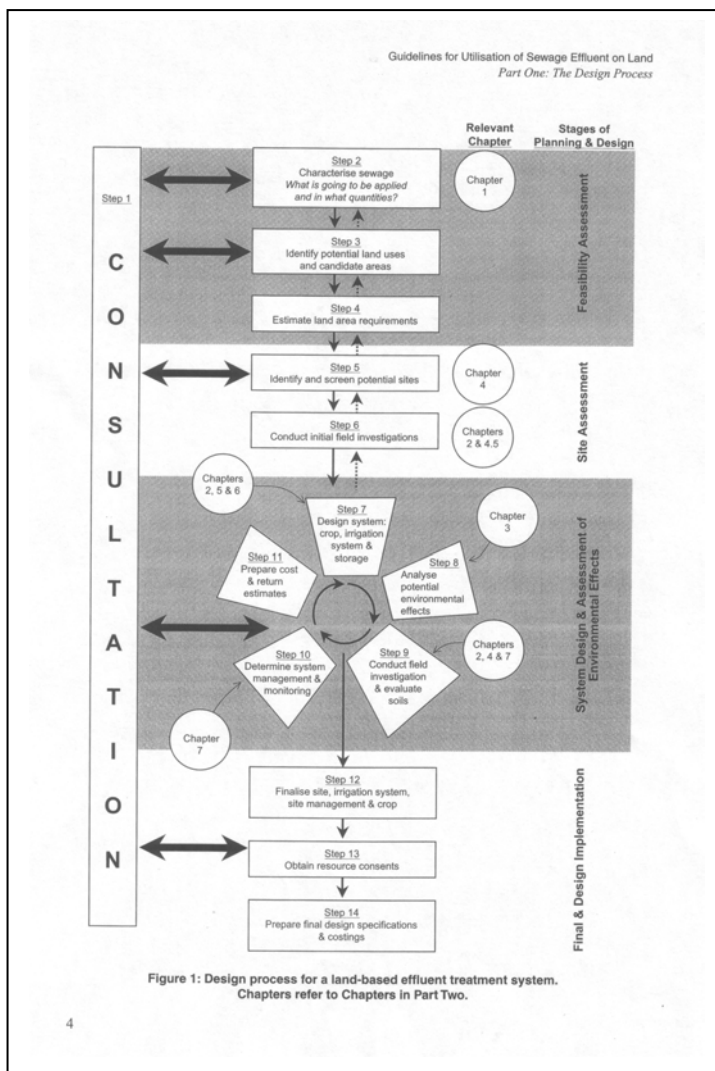
### An Effects Based Approach

The process is shown on the following diagram taken from the New Zealand Guidelines for Utilisation of Sewage Effluent on Land. (NZ Land Collective and Forest Research 2000). The following text also from the Guideline explains the approach.

The design process presented here is consistent with the consultative and effects-based approach of the RMA. This consistency requires that the guidelines do not adopt a standards-based or prescriptive approach to environmental effects. A standards-based approach would state, for example, that “at all land treatment sites, concentrations of nutrient X in leachate to groundwater must be kept below concentration Y”. By contrast, an effects-based approach states that “the concentration of X in groundwater should not be increased to a level that limits the use of groundwater or adversely affects the function of dependent ecosystems”.

An effects-based approach assesses the environmental effects of an activity in the context of the receiving environment and the values associated with that environment. Whether an effect is considered significant depends on the uses of and values associated with a site, surrounding land, soil, air and water resources. The acceptability of an environmental effect therefore differs from location to location and it is not appropriate for this manual to give prescriptive values for items such as buffer distances or concentrations of nutrients in leachate. Instead the guidelines provide sufficient information for the environmental effects of a land application site to be quantified and informed trade-offs among potential sites and system designs to be made.

Once a land application system is designed, prescriptive site-specific standards such as water quality limits can be set and made enforceable through resource consent conditions.





### **Ocean Discharge Decision Processes**

The decision processes for ocean discharge are well developed and involve two main sequenced decision processes.

- Firstly, is the overall investigations, consultation, Iwi and Hapu collaboration and decision making leading to the decision to move to, or reconfirm use of, ocean discharge.
- Secondary is the detailed investigation, consultation, Iwi and Hapu collaboration and decision making to decide on the outfall location and type, and the associated treated wastewater quality.

Factors as summarised in Section 3.2 and put into the local context, all feed into the above decision processes. As compared to the very interactive process represented above for a land application scheme, the decision process for an ocean discharge is a more linear or sequential process, once the decision of discharging to the ocean has been made as the proposed way to manage a treated wastewater discharge.

## 4. Land Application in New Zealand

### 4.1 Overview and Trends

In Section 2 background to land application and ecosystem re-entry is given and a number of land application techniques are defined for the purposes of this report.

- **Over the last 30 years or so there has been a drive towards land application schemes in New Zealand. This has particularly been the case for a good number of smaller and medium size communities.** Notwithstanding this, over at least 97% of New Zealand's reticulated Sewerage Schemes discharge to inland or marine waters, albeit an increasing number through wetlands and land passage / riparian strip facilities. The drivers for land application schemes have been fostered since the event of the RMA (1991) and the NZCPS, and also by and related to the position of Tangata Whenua with their cultural and lifestyle values associated with the abhorrence of direct discharge of human sewage to water and need for it to be returned to the land.

In summary, the key drivers towards land application, particularly land disposal and land treatment, and also to some extent wetlands, include:

- Tangata Whenua cultural position
  - The NZCPS Policy 5.1.2 (this is understood to be based on the Tangata Whenua cultural position)
  - Regional Policy Statements Coastal Plans, and Land and Water Plans
  - The “nice green” way
  - Public perception favouring land application
  - Some irrigation and nutrient / organic resource re-use
  - Cost effectiveness for some smaller schemes but this is very much case / scheme specific and not a general trend
- **Most of the communities using land application techniques' particular land disposal and land treatment, are smaller communities.**

One survey showed some 32 land disposal, land treatment and overland flow (refer Appendix C – ALGENZ Conference 2000) schemes in New Zealand and these in total covered some 700ha of areas under land application of wastewater. Of these, the three largest (Rotorua, Taupo and Levin) accounts for 455ha leaving some 245ha for 29 schemes – that is 8.5ha on average for each scheme. This confirms that the large majority of communities using land application are small communities.

- **Many of these small community schemes are understood to be cost effective, work well and to date, are considered to be relatively sustainable as to their ongoing operation.** Some are however, under investigation in order to address concerns such as groundwater contamination,



ponding and surface runoff, inadequate area, tree health, neighbour proximity and safety and health questions for forestry workers and issues associated with the land use – e.g. Dairying Restriction, Eurogap Environment reporting procedures for kiwifruit production disposal / treatment for example.

- **Rotorua, Taupo and Levin are the three largest land schemes for municipal sewage in New Zealand.** Rotorua has a 220ha land application area, but with drainage via wetlands to streams and Lake Rotorua. Taupo has a 135ha land disposal scheme (cut and carry pasture, i.e. hay) and Levin has a 100ha coastal sand hills land treatment (afforestation) system. However, there is evidence that each of these systems are having some adverse effects, including poor tree health, increased nitrogen in the groundwater, neighbour objections and restricted land access. These issues have lead to further evaluation and/or expansion of these schemes principally as a result of consent renewal processes. Notwithstanding this, there continues to be a strong driver from Iwi for wastewater to be discharged in such a manner that “land contact”, as a minimum, is achieved.
- **The value of irrigation and nutrient (nitrogen, phosphors and potassium) for crop and forest (tree) growth is often a benefit** from land application but in most cases additional net cash output (profit) does not result to any significant degree as management techniques can be more costly. Growing pasture grass is the key exception to this, although with the NZ Dairy situation advising use of human effluents not be undertaken with dairy operations, has negated some possible benefits here.
- **Marine Discharge is favoured for most large communities despite extensive options studies.** Many of New Zealand’s larger coastal communities and the two larger inland cities of Hamilton and Palmerston North have recently or are currently reviewing their wastewater treatment and disposal facilities, as part of the process for new resource consents. Almost without exception all reviews have included investigations into alternative options, including land treatment and land disposal. In all but a very few cases, the discharge of appropriately treated wastewater into the marine environment, or large river in Hamilton and Palmerston North’s case, has remained the preferred method.

These reasons either individually, or collectively, for marine discharge include:

- Unavailability of suitable land type and often very large land area required.
- Land actual and potential productive value.
- High capital and operating costs.
- Water supply, particularly underground aquifers, may be contaminated.
- Limited long term monitoring data available to confirm performance, long term trends of levels of contamination of soils and water, etc.
- Public Health and contamination questions, stock/crop issues from potential pathogen/disease/food chain issues, e.g. NZ Dairy Board stance.
- Nuisance issues, e.g. odour, mosquitoes particularly with wetlands.
- “Not in my back yard” issues (NIMBY).
- Questions of long term sustainability

- **In appropriate locations, particularly with some small communities, there is an increased use of “mix and match” schemes** where the treated effluent is discharged onto land in the drier “summer” periods and directly into rivers in the wetter “winter” periods. This type of option makes use of the assimilation capacity of the receiving environments (land and water) to accept treated effluent. This type of scheme could also potentially be considered a beneficial re-use approach in terms of providing irrigation and nutrients at times when the land requires it.
- **Use of wetlands has been enthusiastically promoted in many areas** and successfully used in a number, particularly for small communities in Northland and other mainly northern New Zealand areas. While many larger communities have included wetland schemes of one type or another in their “Issues and Options” studies, few have proceeded with them. The exceptions for larger communities are Whangarei and Tauranga where aesthetic / wildlife / Maori cultural type wetlands are successfully used and Kaiapoi that has an infiltrating wetland immediately adjacent to the Waimakariri River. There are recorded difficulties at some wetlands in respect to Pukeko control, fish control, vegetation control and mosquito control.
- **Tangata Whenua abhorrence of the discharge of human sewage into natural water, both the marine environment and inland (fresh) waters, has resulted in some recent collaborative compromises from all stakeholders. These have included “enhancements” to some schemes, such as land passage or riparian strip land application systems.** This normally occurs where full land application is not possible and/or not adopted. These enhancements include, for example, passing the treated human sewage (wastewater) through or over a bed of stones or other earth materials to assist with contact with the earth before discharge to water. Some of these case histories result from Environment Court decisions.
- Either jointly or in combination there is increasing use of wetlands and land passage / riparian strip techniques prior to discharge into the marine environment and particularly through outfalls and also into rivers. Maori cultural issues are often the key driver for these facilities being included in a schemes, albeit often as a compromise to land disposal.
- **Reclaimed / renovated treated wastewater is used in at least three areas of New Zealand for irrigation use and this use may increase.** Tauranga irrigates a small portion of its Chapel Street reclaimed wastewater to the Omanu golf course and two reserves (with another seven sites being consented), as does Wellington to the Miramar golf course. Standards for the treated wastewater are however high and public health protection requirements are also high. This technique does, however, have economic value of the irrigation and nutrient resource.
- **Land application of appropriately treated sludges and bio-solids is also receiving significant positive attention.** (Bio-solids are sludges treated to appropriate standards for defined re-use). A major Working Party has been in existence for some time and they are overseeing a project focussing on the development of guidelines for the application of bio-solids to land. The guidelines are aimed at addressing the key areas of concern, namely heavy metal content, organic chemical residual and pathogenic micro-organisms. A major hurdle associated with the land application of bio-solids still lies in the acceptability of such practices on production land and associated market resistance to any resultant produce. The draft Guidelines for Bio-solids re-use have been recently commented on by interested parties and are expected to soon be released (April 2003 ?)

- **Consent requirements and associated monitoring costs for land application schemes**, particularly land disposal and land treatment, are by and large rather complex and annual (regulation) costs high, even for small schemes.
- **Risk issues associated with land application, particularly the larger** land disposal and land treatment schemes, are often greater than with direct discharge to water schemes. Appropriate irrigation measures are necessary, notwithstanding this there are some questions about long term sustainability of some land application procedures.
- **Costs** – these are addressed in Section 7 following.

## 4.2 Scheme Types and Numbers

- Appendix C states that survey work assessed for presentation at the “Year 2000 ALGENZ Conference Workshop on Land Based Disposal” that there were some 32 schemes using land application of domestic wastewater. It is understood these did not include wetland schemes (which apart from infiltrating wetlands, are strictly speaking treatment methods not land disposal).
- The three larger schemes are Rotorua, Levin and Taupo. They cover 445ha of the 700ha total in the 32 schemes mentioned above – leaving the other 29 schemes averaging 8.5ha of land application each.
- The table below, sourced from the draft MfE, shows 59 “to land” schemes and 17 “to land and water” (i.e. mix and match schemes). The reasons for the difference between 32 and 59 are not known but it probably relates to much smaller schemes and maybe also private schemes being included in the higher number.

**Table 4.2: Main forms of wastewater effluent re-entry in New Zealand**

Form of re-entry	No. of communities	%
<b><i>Freshwater:</i></b>		
• stream flow / river	147	51.9
• lake	4	1.4
	<b>151</b>	<b>53.4</b>
<b><i>Marine:</i></b>		
• estuarine	7	2.5
• harbour	13	4.6
• coast	6	2.1
• offshore outfall	29	10.2
	<b>55</b>	<b>19.4</b>
<b><i>Land and other :</i></b>		
• to land	59	20.8
• land / excess flow to water	17	6.0
• pipeline to another treatment plant	1	0.4
	<b>77</b>	<b>27.2</b>
<b>Totals</b>	<b>283</b>	<b>100%</b>

Appendix B, which includes a summary of many of New Zealand’s schemes, shades these schemes that involve land application.

**Land Application Schemes in New Zealand** – following the Definitions as set out in Section 2.1**Land Disposal Schemes: Rapid Infiltration**

- Motueka (sand beds)
- Whitianga
- Methven
- Hawea (gravel trench)
- Onemana
- Queenstown proposed

(This is all the schemes as known to the report authors.)

**Land Disposal Schemes: Slow Rate Infiltration (SRI) – examples of these are:**

- Taupo
- Waikouaiti / Karitane
- Rakai
- Rolleston
- Turangi in part
- Rotorua (but better considered land treatment)
- Foxton Beach
- Omori and Kuatae (Taupo)
- Warrington
- Oxford
- Whangamata
- Templeton
- Ashburton (being planned)
- Waitere Beach
- Plus others

**Land Treatment Schemes**

- Levin
- Rotorua (but is considered also land disposal)
- Plus others

**Overland Flow (as per Section 2.1)**

(Strictly speaking this is a treatment mechanism)

- Oamaru
- Palmerston (South) but also a “mix and match”
- Paraparaumu (previously ?)
- Turangi in part
- Plus others maybe?
- Otaki previously

**Mix and Match**

- Palmerston (South)
- Sanson (planned)
- Plus others maybe?
- Halcombe (planned)
- Tuarangi for excess flow

**Deep Bore Injection**

- Russell

### **Land Passage / Riparian Strip**

- Te Puke
- Coromandel (formerly)
- Hastings proposed
- Paeroa
- Taumaranui
- Palmerston North proposed
- Dunedin City proposed
- Morrinsville

### **Re-use / Renovation / Reclaimed (for a small proportion of the effluent at times)**

- Tauranga for irrigation of reclaimed wastewater on the Omanu golf course, Tauranga Domain and Sulphur Point Reserve. An additional seven other sites are consented to be accepting reclaimed water. These include gardens in the CBD, the airport and the Mt Maunganui Intermediate School.
- Wellington City for Miramar golf course.
- Golden Valley for non-potable reuse of treated wastewater.

### **Wetlands**

#### **(i) Infiltration Wetland**

- Otaki
- Waihi Beach
- Kaiapoi (part of the flow)

#### **(ii) Engineered for Wastewater Treatment**

- Taumaranui
- Drury
- Beachlands
- Some 30 ± others including a good number in Northland

#### **(iii) Aesthetic / Wildlife / Cultural Wetlands**

- Te Maunga (Tauranga)
- Katikati (before ocean outfall)
- Others
- Whangarei (largest in New Zealand)
- Te Puke

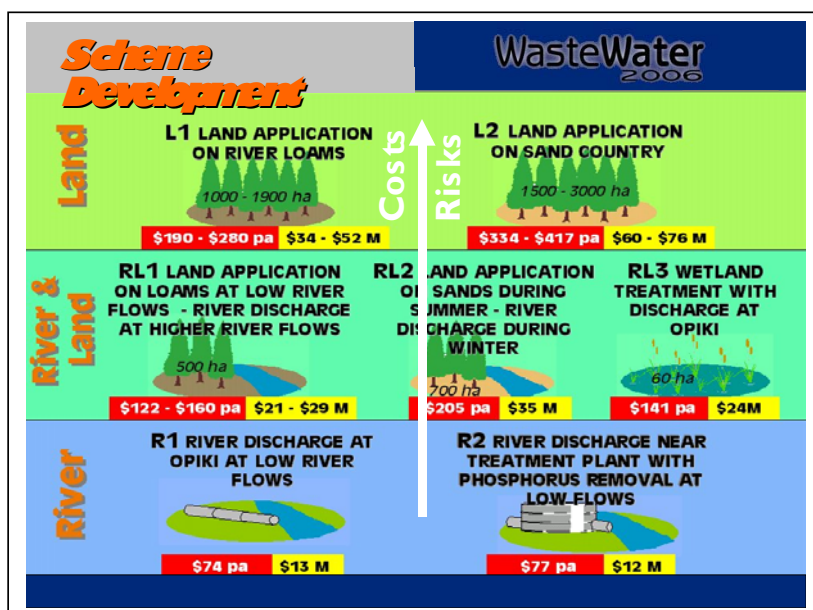
## **4.3 Some Scheme Case Histories**

The following are selected recent case histories each of which highlight some aspects of both land application and its application and problems and also the assessment between land application and ocean discharge:

- The **Rotorua, Levin, Taupo and Tauranga schemes** all have technical papers written about them – Appendix A includes a list of those papers.
- **Palmerston North City Council** has undertaken a major investigation and consultation and Iwi and Hapu collaboration over the last six years. After considering 48 options initially these were grouped and some seven Representative options were identified for detailed consultation. Ocean

outfall discharge was eliminated early on principally because of the pipeline distances to the coast. The Working Party and Council itself preferred land application initially but following detailed studies and extensive consultation and input from a Marae Ohu Working Party, a river discharge option was selected as the preferred scheme. To this scheme a wetland pond land passage and diffuse river discharge system was added as suggested by the Marae Ohu Working Party.

The following slide depicts the three groups of “to land”, “to land and water”, i.e. mix and match, and “to water” schemes. Not unexpectedly it shows that the higher cost land schemes also have the greater (higher) risks associated with them. The high operating costs for the land application schemes relates very much to high energy (pumping) costs. This comes through in Section 7 covering costs and also Table 7.2g summarising the Strategic Study (2000).



- **The Inland Towns of Timaru District Council**

Timaru District Council provides an interesting case history, possibly with some parallels to the SmartGrowth study area, as there is the one large community of Timaru and a number of (inland) coastal towns of Pleasant Point, Temuka, Geraldine and Winchester.

After extensive investigations for the inland towns and Timaru itself, the scheme chosen was to convey all the inland towns' sewage to the Timaru ocean outfall scheme. This involves some 130km or so of conveyance pipelines. This decision is interesting in that while there is large areas of flat land well suited to land application from an irrigation viewpoint, the decision was still to opt for ocean discharge. The pipelines conveyance scheme is presently nearing construction completion.

- **The Eastern (Coastal) Towns of Waimakariri District Council**

Like the Timaru case history this one similarly may have some parallels with the SmartGrowth area. Here the Council are required to upgrade a number of their township treatment and discharge schemes. Appendix C, the ALGENZ Year 2000 Conference, includes information as



it was then on the coastal towns of Kaiapoi, Woodend and Rangiora and how discharge to surface water (rivers) was becoming unacceptable.

After detailed issues and options investigations and stakeholder / community and Iwi and Hapu consultation, the chosen scheme is an offshore ocean outfall discharging possibly 1800m out into the Pacific Ocean.

Investigations and further consultation is presently underway in preparation to lodge consents for the ocean outfall discharge later this year. Similarly nearby Christchurch City is soon to lodge consents for their new proposed ocean outfall discharge.

In both the Waimakariri District Council and Christchurch City Council cases, extensive issues and options studies have been undertaken including consideration of land application schemes. Section 7.3 shows the interrelation of indicative costs for the Christchurch City options.

- **Taranaki Region – Eltham to Hawera and Ocean Outfall** Planning is underway to link (inland) townships to existing ocean outfalls. Eltham has already been linked.

## 4.4 Risks

In Section 3.2 the importance of risk identification, management and mitigation is introduced. A generic list of risks inherent in land disposal and land treatment is also presented.

In any project a comparative risk assessment should be carried out particularly when comparing options. All risks should be identified and at least the major risks evaluated in some detail. Major risks for land application (particularly land disposal and land application schemes) can often be categorised as follows - although scheme and site specific factors will influence these:

- **Risks to Implementation**

- |  |                           |
|--|---------------------------|
| – NIMBY (Not In My Back Yard)                  | – Land acquisition        |
| – Consentability                               | – Resource consent delays |
| – Higher environmental standards (2002 review) |                           |

- **Risks to Scheme Operation, etc**

- |  |  |
|--|--|
| – Process breakdown  | – Effects of Climatic change           |
| – Neighbourhood issues   | – Increasing environmental standards   |
| – Unexpected influent change   | – Aerosol (irrigation systems)         |
| – Odour  | – Sustainability of the overall system |
| – Natural disaster, e.g. earthquake, floods  |  |
| – Unacceptable adverse environmental effects (e.g. ground / surface waste contamination, soil contamination) |  |
| – Crop failure / disease (for land disposal options)   |  |
| – Market sensitivity (for products from land application options)  |  |



While these are not the full range of risks needing consideration during a project development, they are intended to encompass what are likely to be the major differences between the schemes.

For each of these risk categories a risk assessment should consider both:

- relative probability of adverse outcomes; and
- financial impact of adverse outcome.

The **experience** from both operating schemes and from options studies is that land disposal and land treatment schemes, **particularly** the larger ones, **are generally characterised as “higher risk”** schemes than those discharging to the ocean or larger surface water bodies.

## 5. Ocean Discharge in New Zealand

### 5.1 Overview and Trends

- **Approximate estimates show that about 90% of New Zealand's domestic wastewater is discharged to the marine environment** (estuaries, harbours, ocean itself), albeit an increasing amount of this through wetlands and/or land passage (riparian) strip type facilities first. **A further 7% (very approximately) is discharged to surface water** (rivers) again after through land contact type facilities.
- **The majority of larger coastal cities and towns (continue to) discharge treated wastewater directly into a marine environment either via estuaries, harbours or for larger communities as most commonly used directly into the open sea.**

In all cases, extensive “Issues and Options” studies have been undertaken where new resource consents have been required. In almost all cases, the decision has been made to continue with a direct discharge to the marine environment, albeit in some cases with increased degrees of treatment prior to discharge and in some cases with scheme “enhancements” adopted to better meet social and/or Maori cultural issues.

Oamaru is an interesting case that has been in operation for a number of years. It consists of an overland flow system where treated effluent flows over the land through a border dyke system. The majority of the effluent, particularly in winter, is discharged from the dyke system into a small watercourse and thence into the coastal gravel beach (i.e. the marine environment), rather than soaking into the ground.

- **Over the past two or so years, a number of New Zealand's large coastal towns have made the decision to keep their discharge to the marine environment**, with some intending to move the discharge location, in many cases, at least initially, with no further treatment. For example, Christchurch City Council have decided, following the decision on the Commission's resource consent applications and for a continued (15 years) estuary discharge to only grant 5 years and the assessment by review panels, to move from the estuary to an ocean outfall. North Shore are extending their outfall and Waimakariri District Council has recently decided to remove their larger wastewater eastern discharges from inland rivers and pipe them to a proposed offshore ocean outfall after the treated wastewater has passed through wetlands (refer Section 4.3).
- **For those cities and towns discharging into the marine environment, and particularly those to the open sea, each have a site and case specific combination of outfall location and type and associated degree of treatment.** These vary from very long ocean outfalls into the open coastal waters like Hastings (New Zealand's longest at 2,750 metres) with milliscreening treatment only (this is likely to continue for up to 8 years), to those with a very high degree of treatment (like Auckland's main discharge into the Manukau harbour from the Mangere plant and the Tauranga discharges), as well as shoreline discharges. In all cases of marine disposal, there is a need to assess the degree of “marine treatment” when considering site specific factors. Refer Section 2.3 for discussion or “Marine Treatment”. These factors, considered together, include:

- The oceanographic situation, for example, open waters, enclosed estuary, current patterns.
- The outfall location itself and its physical and oceanographic characteristics.
- The separation in distance and travel time to the shoreline and other areas of particular significance, e.g. shellfish beds, bathing beaches.
- The water quality standards to be achieved as set out in the relevant Regional Coastal Plan, which should reflect the requirements of the local environment, and the Resource Management Act 1991.
- The degree of wastewater treatment prior to discharge, particularly as it relates to the contaminants of concern.
- The position of and agreements with Iwi and Hapu.

Table 5.3 lists these cities and larger communities that have marine environment systems.

Appendix B further includes these cities and communities within a more comprehensive listing of the majority of New Zealand's cities and larger communities.

- **Within the last 1 to 2 years there would appear to be additional interest in and adoption of offshore Ocean outfalls as the long term sustainable solution for treated wastewater discharge.** These developments include the following – this is not an exclusive list:
  - Dunedin City Councils decision to construct a offshore (1100m) outfall off St Kilda Beach to replace its shoreline discharge
  - The extension of the Dunedin City Council 500m long outfall to 800m and associated issue of a 35 year duration resource consent.
  - The Bluff sewage treatment upgrade continuing with the short ocean outfall.
  - Timaru City both continuing its discharge via its 500m long outfall and the connecting of the inland towns (Geraldine, Temuka, Pleasant Point) to this outfall via long conveyance lines (refer to the discussion on this scheme in Section 4.2)
  - Christchurch City deciding to go to an ocean outfall (2000 to 3000m) rather than the Heathcote estuary discharge
  - Waimakariri District Council deciding to connect its Eastern (coastal) towns (Rangiora, Kaiapoi, Woodend) to a new ocean outfall
  - The Taranaki proposal to connect inland towns to ocean outfalls. Current proposal is to connect Eltham to the Hawea outfall
  - North Shore City planning a new 1000m(?) outfall to replace its present short (??m) outfall
  - Wanganui District Council revising its earlier Wanganui City plans for land disposal of the human sewage and ocean discharge through its existing 1800m outfall, to now discharge all domestic and individual wastewater through the outfall and obtaining resource consents to do this.
  - In addition to the above-mentioned places / schemes the following Cities / Towns confirming use of ocean or estuary / harbour discharge after undertaken major issues and options studies looking at alternatives including land application:

- (i) Napier
- (ii) Hastings
- (iii) Gisborne
- (iv) Nelson / Tasman DC
- (v) Blenheim
- (vi) Whangarei
- (vii) Invercargill (wetland then estuary discharge)
- (viii) Whakatane

- **The majority of (larger) inland communities continue to discharge treated effluent directly into rivers**, although by and large the degree of treatment (i.e. the effluent quality) has, or is, becoming higher in all the cases involving new resource consents. “Issues and Options” studies with the associated consultation have been undertaken as part of the process, leading to a decision for continued river discharge. This is evidenced by Palmerston North’s decision to continue discharging into the Manawatu River after initial plans to use a land application system. Hamilton City also decided to stay with their discharge into the Waikato River again after extensive land application studies were undertaken. These studies are continuing as per a condition in the resource consents. Rotorua, Taupo and Levin are the three main exceptions as these use land treatment systems. (Refer Section 4.1)

This finding is parallel to that of the Coastal Cities and Large towns discharging to the Marine Environment.

## 5.2 Scheme Types and Numbers

- The information in Section 5.1 above includes details of new marine and particularly ocean discharge being considered.
- Table 5.2 (which is also included in Section 4.2) includes a New Zealand summary of where treated wastes are disposed / discharged to ... or more appropriately, how they re-enter ecosystem. (Refer Section 2.1).

**Table 5.2: Main forms of wastewater effluent re-entry in New Zealand**

- Table 5.3 shows the majority of marine / ocean discharges in New Zealand at present.
- Those presently planned are also included in this table.
- Appendix B includes an overall summary of the cities and larger communities in New Zealand. The marine / ocean discharge schemes are shown with a bold box (and land application schemes shaded).

Form of re-entry	No. of communities	%
<b>Freshwater:</b>		
• stream flow / river	147	51.9
• lake	4	1.4
	<b>151</b>	<b>53.4</b>
<b>Marine:</b>		
• estuarine	7	2.5
• harbour	13	4.6
• coast	6	2.1
• offshore outfall	29	10.2
	<b>55</b>	<b>19.4</b>
<b>Land and other :</b>		
• to land	59	20.8
• land / excess flow to water	17	6.0
• pipeline to another treatment plant	1	0.4
	<b>77</b>	<b>27.2</b>
<b>Totals</b>	<b>283</b>	<b>100%</b>

**Table 5.3: Summary Table of Local Authority Schemes: Cities and some other Communities of Interest**

Local authority	Existing level of treatment and discharge facilities						Future planned level of treatment and discharge facilities						Expiry of existing resource consent
	Sc	Pr	Se	Ds	Te	Discharge	Pr	Se	Ds	Te	Discharge		
Whangarei	✓	✓	✓	✓	✓	Estuary (shoreline)					Estuary	✓ (in process)	
Auckland	✓	✓	✓	✓	✓	Harbour (shoreline)					Harbour	2032	
North Shore	✓	✓	✓			Harbour (200m? outfall)			✓?		Sea (new 2800m outfall)	2020	
Hamilton	✓	✓	✓	✓	✓	River					River	2006	
Katikati	✓	✓	✓	✓	✓	Sea (650m outfall)					Sea	2016	
Tauranga (two WTPs)	✓	✓	✓	✓*		Sea (900m outfall)					Sea	2006	
Rotorua	✓	✓	✓			Land (enters waterways)					Land (enters waterways)	?	
Napier	✓					Sea (1500m outfall)	✓		✓		Sea	2025	
Hastings	✓					Sea (2750m outfall)	✓				Sea	2022	
New Plymouth	✓	✓	✓	✓		Sea (short outfall)					Sea	2014	
Wanganui	✓					Sea (1800m outfall)		✓	✓?		Sea	2026	
Palmerston North	✓	✓	✓			River			✓	✓	River	✓ (in process)	
Hutt	✓	✓	✓	✓		Sea (shoreline)					Sea	2011	
Wellington	✓	✓	✓	✓		Sea (1800m outfall)					Sea	2008	
Porirua	✓	✓	✓			Sea (50m? outfall)					Sea	✓ (in process)	
Nelson	✓	✓	✓			Sea (shoreline)					Sea	✓ (in process)	
Lyttelton	✓	✓	✓			Sea (50m outfall)					Sea	?	
Christchurch	✓	✓	✓			Estuary (shoreline)			✓	✓?	Sea (new 2000m to 3000m outfall)	2007	
Timaru	✓					Sea (500 m outfall)	✓ ✓	✓	✓?		Domestic - Sea Industry – Sea	2010	
Oamaru	✓		✓			Sea after across land					Sea (after across land)	✓ (in process)	
Dunedin (Tahuna)	✓	✓				Sea (shoreline)			✓		Sea (new 1100m outfall)	✓ (in process)	
Dunedin (Green Is)	✓	✓	✓	✓		Sea (850m outfall)					Sea	2032	
Invercargill	✓	✓	✓			Estuary (shoreline)			✓?	✓?	Estuary (after wetland)	2027	
Bluff	✓	✓	✓	✓		Sea (50m outfall)					Sea	2025	

**Key**

Sc = screening, Pr = primary settling, Se = secondary treatment, Ds = Disinfection, Te = tertiary treatment (wetland or sand filter)

\* only Chapel St WTP disinfects by UV irradiation. Te Maunga does not but there is some natural disinfection in the wetland.

### 5.3 Risks

Sections 3.2 and 3.3 introduce the range and importance of risk assessment associated with land application and ocean discharge respectively while Section 3.3 highlights the importance of taking risks into the decision-making process.

**For ocean discharge risk assessments and operating case history have highlighted that the overall risk profile is low to medium providing the outfall is appropriately sited and a sufficiently robust and physically secure sound outfall structure is put into place.**

## **6. Previous Wastewater Treatment and Disposal Investigations in the SmartGrowth Study Area**

### **6.1 Overview**

As evidenced by the reference list in Appendix A, considerable amount of in-depth investigation has been carried out over the last 12 or so years. There have been extensive studies for all the main communities within the Western Bay of Plenty District Council area (Waihi Beach, Katikati, Omokoroa, Te Puke, Maketu Little Waihi Beach) and other smaller settlements along with more rural and on-site systems. Similarly Tauranga District Council has investigated alternatives. Additionally there was the joint Strategic Sewerage Study undertaken in 1999-2000 by Montgomery Watson Harza (now MWH).

- Section 6.2 and Table 6.2a and Figures 6.2A and 6.2B summarise local factors particularly as they relate to land application possibilities and potential.
- Section 6.3 summarises the current and planned position for each main community.
- Section 6.4 and Table 6.4 includes summaries of a number of the former key community studies in the SmartGrowth study area.
- Section 6.5 and Table 6.5 includes summary information on the 1999-2000 Strategic Sewerage Study undertaken for the whole district (i.e. the SmartGrowth Study area).
- Section 6.6 brings together the common themes coming out of the previous studies and further assessment of local factors and features undertaken as part of this project.

### **6.2 Local Factors**

In Section 3.2, Generic Factors associated with land application and marine / ocean discharge and summarised in Section 3.3, some of the key Local Factors are introduced.

That previous information highlights the many, and often related and complex, factors that need assessment. Table 6.2 and Figures 6.2A and 6.2B have been prepared to summarise the main factors needing assessment particularly for land disposal and land treatment schemes but also for other forms of land application. In presenting this information, it should be appreciated that it is generalised and approximately only. It does however, highlight the many constraints and limitations that are associated with land application schemes. This is particularly the case for those requiring significant areas of land, also those where the treated wastewater is actually applied onto or into the land (e.g. land disposal, land treatment, deep bore, overland flow to some extent and infiltrating wetlands).



In considering Figure 6.2B, it should be well appreciated that while the shaded areas potentially available for land treatment are reasonably extensive there are many other factors, such as listed on the note on the drawing, that would otherwise exclude some, if not all, forms of land treatment.

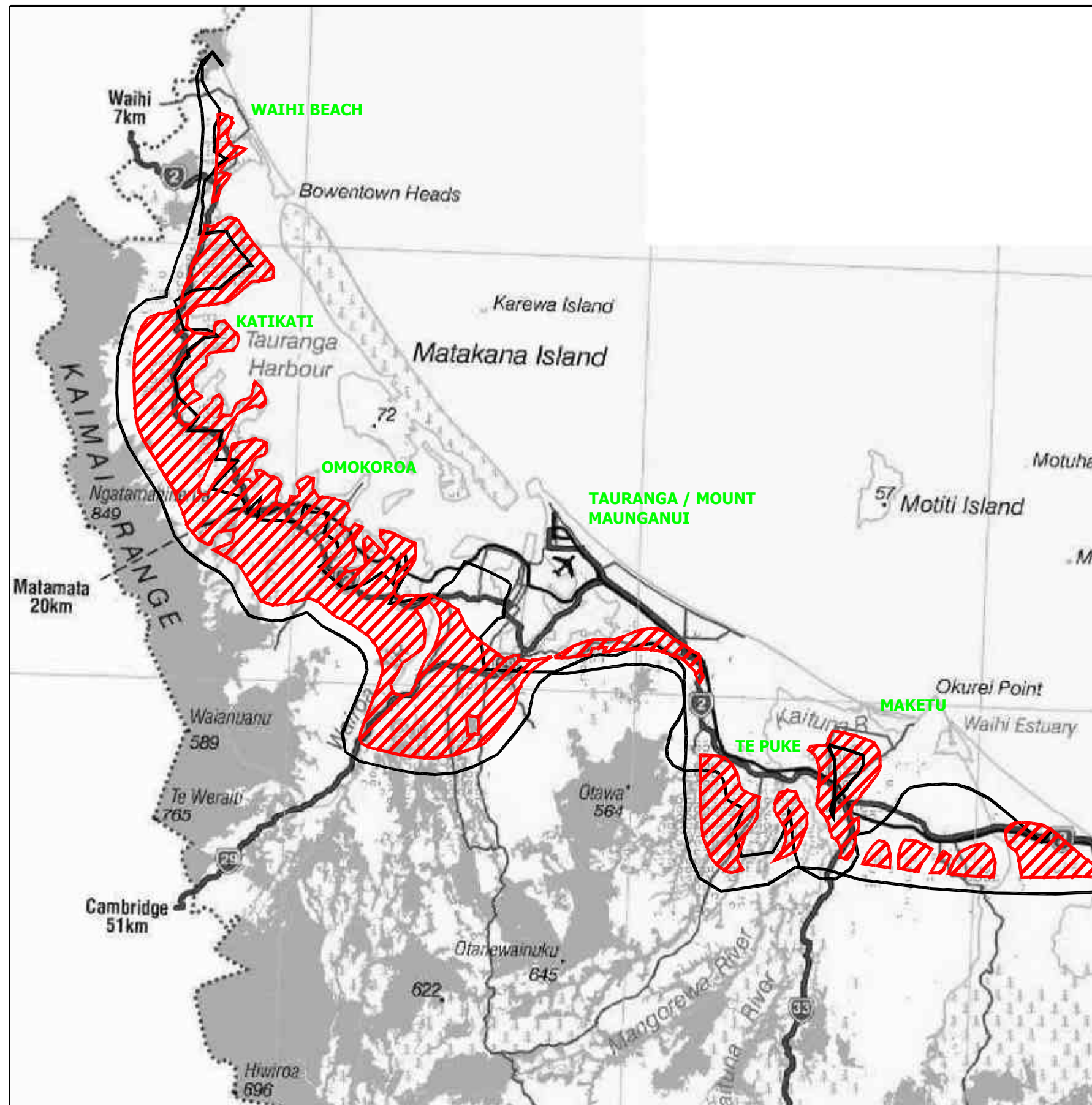
The individual Community studies summarised in Section 6.3 well highlight the local factors associated with the various communities and how these have allowed, or not allowed as the case may be, particular land application techniques to be proposed, and in some cases, implemented.

**Table 6.2a – Summary of Land Factors as They Relate to Potential Land Application Schemes**











SITE CHARACTERISTICS	LAND APPLICATION CHARACTERISTICS	WAIHI BEACH	KATIKATI	OMOKOROA	TAURANGA (BOTH CATCHMENTS)	TE PUKE	MAKETU
	Topography 1. Seaward 2. Inland	1. Flat 2. Flat to easy rolling	1. Flat to easy rolling 2. Moderately steep to steep	1. Flat to easy rolling <u>NB:</u> Stability issues 2. Moderately steep to rolling	Flat to undulating at Matakana Island and Mt Maunganui. 1. Flat to easy rolling 2. Easy rolling - rolling into Moderately steep / broken moving inland	1. Flat 2. Undulating moving inland into rolling to easy rolling	1. Flat 2. Flat with undulating areas
	Soil Types 1. Seaward 2. Inland	1. Peaty sandy loam, loamy peat 2. Black sandy loam (Waihi Ash)	1. Black sandy loam (Waihi Ash) 2. Sandy Loam (Waihi Ash / hill soil)	1. Black sandy loam (Waihi Ash) 2. Sandy loam (Waihi Ash / hill soil)	Matakana and Mt Maunganui – Brown dune sand. 1. Black sandy loam 2. Shallow sand into sand (hill soil)	1. Shallow sand (Kaharoa Ash on Waihi Ash) 2. Oropi sand (Kaharoa Ash)	Maketu Peninsula and inland – shallow sand. Low lying areas to east and west – Variable peaty loam, clay loam / peaty loam, peaty sand / sand.
	Water Tables - proximity of highest groundwater sources from records	High in Urban areas 3 – 30 mbgl > moderate restrictions	Medium in Urban areas 10 – 40 mbgl > some restrictions	Medium in urban areas 10 – 50 mbgl >some restrictions	Severe limitations on Matakana Island as groundwater < 2 metres deep Moderate throughout Mt Maunganui and Papamoa as GW < 5 metres deep	Te Puke & towards coast; moderate to severe limitations as GW less than 5m in majority of area. Inland from Te Puke Gw depths range 5 - 50m	Moderate limitations as depths commonly 3 - 20m
	Water Supply - Existing / Future - Bores	Bores/Bores	Surface water/Bores	Surface water/ Bores	Large designated water supply areas; Wairohi stream and future Waiari River (within WBOP area)	Surface water (Raparapahoe stream + Waiari River) / bores	Surface water (via Te Puke)
	Runoff / Seepage - Receiving Environment	Seaward into the Bay of Plenty	To Tauranga Harbour	To Tauranga Harbour	To Tauranga Harbour	Kaituna River	Kaituna Estuary
	Energy use Running Costs- L/M/H (based on distance & elevation of potential land treatment/disposal sites)	High – due to elevation	High	High – Distance and elevation to suitable site	Very High – Any disposal site out of district hence long distance and likely elevation.	High – distance	High – distance and elevation to avoid floodable area / high GW
	Predominant Land Use/ Significant Features 1. Urban 2. Rural	1. Residential Noted floodable areas 2. Grazing Significant landscape & ecological features	1. Residential 2. Grazing / intensive horticulture Minor designated sites. Some significant features & minor floodable areas.	1. Residential Some reserve areas 2. Horticulture Significant landscape features and ecological sites.	1. Residential / Industrial 2. Grazing Note rural areas limited and high land value. Minimum opportunity for land disposal. WBOP Catchment; designated ecological sites and landscape features.	1. Residential Noted floodable areas 2. Grazing / intensive horticulture Large floodable areas, reserves, significant ecological sites and landscape features.	1. Residential Floodable areas, Large significant landscape features & ecological sites. 2. Grazing Large floodable areas.







## Reference

-  regional boundary  
 district boundary  
 railway, tunnel  
 state highway  
 major road  
 airport  
 elevation (in metres)  
 native forest  
 exotic forest  
 horticulture

Key:-

Potential area for land application not ruled out by factors illustrated in Fig 6.2. However, there are many other factors to consider. Refer to sections 3.2 & 6 of the accompanying report and other issues noted below.

Note:-

1. Future growth areas (outside current district plan zones).
2. Productive land use restrictions e.g. crops, horticulture and dairying.
3. Localised land soil and stability issues.
4. Private water supply bores / surface water contamination.
5. Seepage / Runoff to Tauranga Harbour.
6. Nutrient loading issues.
7. Land availability in contiguous areas.
8. Localised heritage and cultural issues.
9. Neighbourhood issues (NIMBY).

THE ABOVE FACTORS EITHER SINGULARLY OR IN COMBINATIONS COULD ELIMINATE AREAS INDICATED FROM BEING EITHER SUITABLE AND/OR AVAILABLE FOR LAND APPLICATION TECHNIQUES.

[illegible]

<b>TAB/DWG</b>	Base Plan/DWG	<b>FILE NUMBER</b>
<b>SHEET</b>	MULTIPLE SHEETS	<b>REVISIONS</b>
<b>NOTES</b>	unexpanding	<b>REVISIONS</b>
<b>DESCRIPTION</b>		<b>REVISIONS</b>
<p>These drawings shall only be used for the purpose for the          indicated unless the written permission of the Engineer is          obtained.</p>		<b>APPROVED</b>

Time	Info
GM	08/04/2017
GM	08/04/2017



## SMARTGROWTH WASTEWATER INVESTIGATIONS

**SCHEMATIC PLAN - Potential Areas  
for Land Application**

<b>Job No.</b>	<b>DRAFT</b>
<b>Date</b>	03/03/03
<b>SCALE</b> (1/8"=1'-0")	
<b>Job No.</b>	<b>Sheet No.</b>
801 004480-2	Fig 6.2B

### 6.3 Current and Planned Position

Table 6.3 summarises the present and planned position. Some of these schemes are further discussed in Section 6.4 and Table 6.4.

### Table 6.3: Present and Planned Position

Community	Present Wastewater Treatment	Present treated Wastewater Discharge / Disposal	Present Discharge Permit (consent) Expires	Future Planning (refer Section 6.3 also)
Waihi Beach	<p>Sequential Batch Reactor (SBR) Lagoons Secondary Treatment</p> <p>↓</p> <p>wetlands</p> <p>↓</p> <p>UV disinfection</p> <p>↓</p> <p>Infiltrating wetland (no direct discharges)</p> <p>plus a small proportion (2 to 5%) the treated wastewater going to the subsurface irrigation trial in an Eucalyptus area. This is part of R.Consent – review in 2004.</p>	Infiltrating wetland plus small portion to land disposal trial	2008 (review 2004)	Report back in 2004 as to land disposal or ocean discharge.
Katikati	<p>Aerated Lagoon Secondary Treatment</p> <p>↓</p> <p>wetland</p> <p>↓</p> <p>UV disinfection</p> <p>↓</p> <p>Ocean Outfall (650m long)</p>	Wetland then 650m ocean outfall	2016	As appropriate later.
Omokoroa	On-site systems	On-site (septic tanks, etc.)	N/A	Proposed to convey raw sewage to Tauranga DC's Chapel Street Wastewater System.
Tauranga	<ul style="list-style-type: none"> <li>Chapel Street (Secondary Contact Stabilisation) + UV disinfection</li> <li>Te Maunga (Secondary extended aeration) + wetland</li> </ul>	<ul style="list-style-type: none"> <li>Wetlands and then 900m ocean outfall at Mt Maunganui</li> <li>Some re-use of Chapel Street treated wastewater for golf course and reserve irrigation in summer</li> </ul>	<p>April 2005</p> <p>April 2005</p>	Investigations commenced for obtaining new resource consents after April 2005.

(NB: Table continued over page)

Community	Present Wastewater Treatment	Present treated Wastewater Discharge / Disposal	Present Discharge Permit (consent) Expires	Future Planning (refer Section 6.3 also)
Te Puke	Activated Sludge Secondary Treatment ↓ UV disinfection ↓ Vertical Flow Wetlands ↓ Riparian Wetland ↓ Diffuse discharge to Wairau Stream	Riparian Wetland ↓ Diffuse discharge to Wairau Stream	2016	Further considerations in future.
Maketu (etc.)	Septic tanks and other on-site	On-site	N/A	Four Options shortlisted – future evaluation to take place.

## 6.4 Previous Studies

The following case histories have been prepared from reports available. These have been selected both as the more recent and representative of the extent of work undertaken in recent years. Table 6.4 further summarises them. A more comprehensive listing of reports is included in Appendix A. These studies well highlight the extensive amount of investigation and consultation and Iwi collaboration that has been undertaken over the last 12 years or so.

Various land application options have been included in all options, but with the exception of the present Waihi Beach land disposal subsurface irrigation trial and the Tauranga District Council's summer time irrigation of treated wastewater on the Omanu golf course and two reserve areas, the techniques of land disposal, land treatment and deep bore injection have not been adopted. By contrast land passage / riparian strip and wetland techniques have however been adopted in all community schemes these in part for Iwi and Hapu cultural reasons albeit often as a compromise to a full land disposal approach.

## WAIHI BEACH SEWAGE TREATMENT AND DISPOSAL WESTERN BAY OF PLENTY DISTRICT COUNCIL

### Key Documents

Fraser Thomas Ltd and Kingett Mitchell and Associates Ltd, 1995

### Studies Involved

- Effectiveness of and further potential for on-site systems.
- Options for a reticulated sewerage scheme and treatment and disposal / discharge.
- Working Party and Iwi involvement.
- Appraisal of options and recommendations.

### Key Findings

- A sewerage system is needed for Waihi Beach as upgrading of on-site systems is inappropriate.
- For Island View and Athenree upgrading of “on-site” system is possible but not recommended.
- Horticultural crop irrigation considered – option rejected (reasons included negative impact on international markets.)
- Forest irrigation has serious issues. Four sites looked at and each ruled out for a range of issues – but it was noted “that forest irrigation appears at this stage to be the only disposal option acceptable to Iwi”. Individual site areas and sizes identified (Wilson Site 2 x 16ha; Grogan Drive Site 2 x 22.5ha; Athenree Site 3 x 68ha.)
- Sand infiltration and sea outfalls (1000m) disposal ruled out due to planning, cultural and legislative issues. Iwi communities within the Waihi Beach indicated they do not accept the passage of treated effluent through wetlands as a satisfactory pre-treatment to an ocean outfall.
- Wetland seep disposal gained some preference including a positive response from a representative of the local Iwi. Three sites identified.
- The preferred option was by surface flow wetlands, UV disinfection with a wetland seep as the disposal option. Three sites for the wetland seep were identified, Goldwood / Capamaigian Drive; Wilson and Capamaigian. Ultimate outlet for effluent from the first two is Three Mile Creek which flows across Waihi Beach, the later the Waiau River which flows in Tauranga Harbour. Consultant’s preference is the Capamaigian Drive / Goldwood option but community and Iwi preference will determine final section.

### Indicative Costs

Refer above-mentioned reports.

### Resource Consents

Granted to 2008 with review in 2004 as to land disposal or ocean discharge. (Note: land disposal trial part of the present discharge consent – refer Table 6.3)

### Disposal Location / Scheme Finally Selected

Goldwood / Campamaigian Drive plus subsurface irrigation land disposal trial.



**KATIKATI  
WESTERN BAY OF PLENTY DISTRICT COUNCIL**

***Studies and Resource Consents 1994-1997***

**Key Documents**

Reports and Consents hearing evidence of Brian Duncan of Bruce Wallace and Partners – plus Resource Consents

**Studies Involved**

Full investigation into treatment and disposal / discharge options. Disposal / discharge options included:

- (a) Slow Rate Irrigation (SRI) to land on the mainland – (40ha at Busby Road considered but would need more land than this);
- (b) Discharge to Tauranga Harbour direct or via the Uretara Stream – (unacceptable from nitrogen loading to harbour);
- (c) SRI on sand country on Matakana Island – (agreement with land owner not then possible);
- (d) Discharge to Pacific Ocean – (investigations found this environmentally acceptable);
- (e) Re-use of effluent for horticulture or pastoral irrigation or for irrigation of recreational areas – investigations did not indicate any demand, and it would only be a partial solution – subsurface irrigation on parks also considered but lead to nitrogen loadings on the harbour).

**Conclusion / Recommendation**

Best practicable option was discharge to the ocean via the existing 650m long outfall pipe – outfall is off Matakana Island via a submarine pipeline across Tauranga Harbour.

**Treatment**

Includes wetland followed by UV disinfection prior to Ocean discharge.

**Indicative Costs**

Refer Table in 7.2 of this report.

**Resource Consents**

For discharge to ocean via 650m outfall to 2016.

**WASTEWATER SCHEME OPTIONS  
WESTERN BAY OF PLENTY DISTRICT COUNCIL****OMOKOROA - TE PUNA - MATAKANA CATCHMENT****CASE HISTORY STUDY OMOKOROA NO. 1****Key Document**

Report by Bruce Henderson Consultants Ltd, 1992

**Studies Involved : Key Output**

- A public consultative process.
- Forty-three options for collection, treatment and disposal were considered.
- A best practicable Option and hence then recommended option, was identified involving collection, treatment in a facultative pond system on the Omokoroa Peninsula with discharge of treated wastewater through an ocean outfall off Matakana Island via a submarine pipeline across Tauranga Harbour.
- Implementation of the recommended ocean outfall option would achieve the WBoPDC's Council policy objective (refer Section 3.3) of arresting any decline of environmental standards and preventing, where possible, wastewater from entering the Tauranga Harbour Waters.

**Individual Options Findings*****Land Based Disposal Options***

- No rapid infiltration rate land disposal options.
- Slow rate irrigation (SRI) options included 40ha pasture at slopes less than 15 degrees; grazing limitation / spell periods; tertiary effluent standard needed for citrus crops; no effluent to eatable crops including berries; forest irrigation an option but high costs.
- Land disposal sites included two areas selected for pasture or forest systems these being: southwest of Omokoroa Road and on the Peninsula north of Omokoroa, and the railway between Pahora and the Tauranga Harbour. Disadvantage of both sites is proximity to and (potential) contamination of the harbour by pathogenic organisms and enrichment by nutrients (pasture application rate 20mm/week, 7 day cycle. Forest application rate 30mm/week, 7 day cycle).
- Surface water options limited to ocean discharge. Length of ocean outfall considered varied from 200m with no treatment to 150m with tertiary treatment. Recommended scheme ocean outfall 1350m with secondary treatment.
- A wastewater conveyance pipeline to Tauranga was also considered.

**Indicative Costs**

Table 7.1 of the Bruce Henderson Report shows these. They are 1992 costs.

**Later Studies**

Refer to Case History Study Omokoroa No. 2 and No. 3.

**OMOKOROA WASTEWATER  
WESTERN BAY OF PLENTY DISTRICT COUNCIL****CASE HISTORY STUDY OMOKORA NO. 2****Key Documents**

Reports and Woodward-Clyde (now URS) presentation to Council 1-6-99

**Studies Involved**

- Local Factors, e.g. growth, land stability, septic tank use and pollution.
- Ten options for wastewater management by a community scheme – 11 site investigations for Land Application options.
- Open days → preference for land disposal towards the Kaimai's.
- Legal issues / planning instruments set out in detail.

**Findings**

- On-site septic tank systems not sustainable for dwellings at the tip of the Peninsula.
- Some opposition to urban growth of area, but general support for a Community Wastewater Scheme.
- Suitable land for disposal identified in the upper Kaimai's and on Rangiwaia Island, Wall Estate, Rangiwaia Island and Omokoroa Golf Course.
- Take a wider, more district view.
- Iwi "buy in" for options was considered.
- No recommendation as to preferred scheme.

**Indicative Costs**

UAC (Uniform Annual Charge) estimates for the ten options are included in Section 7.2 of this report.

**Later Studies**

Refer Case History Study – Omokoroa No. 3.

**OMOKOROA WASTEWATER  
WESTERN BAY OF PLENTY DISTRICT COUNCIL****CASE HISTORY STUDY OMOKORA NO. 3****Key Documents**

Report URS – July 2002 and Compiled Reports Binding Nov 2002

**Studies Involved**

- Assess a possible scheme population and wastewater demand.
- Further “wide” scoping of scheme options.
- First shortlisting of eleven options including a range of land disposal, harbour and ocean discharge options and one mixed option (mix and match option) with land and harbour discharge.
- Detailed investigation of estimated costs and additional public and Tangata Whenua consultation for four shortlisted options, namely:
  - Option A: Disposal by High Rate Infiltration on the Turnbull property on Omokoroa Peninsula
  - Option B: Pumping of untreated wastewater to the Tauranga District Council Chapel Street Treatment Plant
  - Option C: Subsurface drip irrigation on Rangiwaea Island
  - Option D: Managed septic tank programme and use of aerated systems of septic tanks for individual lots

**Findings**

- Option A: Decided not to pursue it due to potential for adverse effects on receiving environment and low probability of gaining resource consents. Iwi representatives indicated unlikely to be acceptable to Tangata Whenua.
- Option B: WBoPDC preferred option – three pipeline routes considered. The Piriraka’s Environmental Centre supported this option conditional on a moratorium being declared until the sub-regional growth strategy is completed and that meaningful consultation continues.
- Option C: Considered the most practicable but most expensive. Agreements to use Rangiwaea land long term necessary.
- Option D: Considered unlikely to resolve current pollution or land stability issues in a satisfactory manner.

**Indicative Costs**

Refer Omokoroa Case No. 2 as included in Section 7.2.

**Resource Consents**

For Option B – various for pipeline

- inclusion in TDC’s wastewater discharge consents

## TAURANGA AREA SEWERAGE STUDY TAURANGA DISTRICT COUNCIL

### Key Document

Tauranga Area Sewerage Study – Stage 1 Report (Second Revised Edition); June 1990 – Beca Steven

### Studies Involved

- Preparation of Development Plan for Sewage Treatment and Disposal for next 30 years then further 20 years = 50 years total.
- Review of catchments and infrastructure and options assessment.
- Options assessed included:
  - Land disposal onto Matakana Island;
  - Land disposal onto coastal flatlands from Papamoa to Te Puke;
  - Harbour outfall (extending Chapel Street);
  - Ocean outfall (Mount Manganui);
  - Combinations of above;
  - Land disposal (land irrigation) of a proportion of the treated wastewater on golf courses, and other areas reserves and gardens, school and airport;
  - Visit / review of land application schemes elsewhere in New Zealand.

### Key Findings

- Land disposal on Matakana Island not economically viable – (150 to 300ha required for 20,000 cubic metres per day).
- A Welcome Bay land disposal scheme not economically viable – (would require 200ha of forest area for 7,020 cubic metres per day).
- Coastal flatlands maybe acceptable for land disposal in summer but low lying high water table in winter could severely restrict use in winter.
- Removal of treated wastewater from the Harbour is a desirable objective and the resolution of the Sewerage Liaison Committee.
- Ocean discharge through the Mount Manganui Ocean outfall (900m long) is the Consultants preferred scheme.
- There were difficulties at most other land disposal schemes investigated.

### Indicative Costs

Refer Section 7.2 of this report.

### Resource Consents

Treated Wastewater consent for Mt Manganui Outfall expires April 2005 including renovated wastewater irrigation consents. Investigations for new consents presently being carried out. Some treated wastewater irrigation (re-use) by Omanu golf course and into two reserve areas is carried out in summer months. Nine areas in total are consented for allowing treated (renovated) wastewater. These include the CBD gardens, the airport grass runways, and the Mt Maunganui Intermediate School. Further consideration for re-use of renovated wastewater are part of the overall investigations being undertaken as part of obtaining resource consents for after April 2005.

## TE PUKE WESTERN BAY OF PLENTY DISTRICT COUNCIL

### Key Documents

Resource Consent Application "Te Puke Sewage Treatment Plant Consent Renewal" and  
"Short listing of options for the Te Puke Sewage Treatment and Disposal"  
Worley Consultants Ltd, Nov 1995

### Studies Involved

- Effects assessment of Te Puke discharge on Waiari Stream and Kaituna River where in both cases nutrient levels are elevated. Enterococci levels also elevated.
- Six options considered, disposal / discharge being:
  - (i) Discharge to Waiari Stream through long dispersed exfiltration trench;
  - (ii) Discharge to Waiari Stream through short dispersed exfiltration trench after some pasture irrigation;
  - (iii) Discharge to Waiari Stream through short exfiltration trench and via surface flow wetland;
  - (iv) Wetland with zero direct discharge;
  - (v) Land Disposal to 40ha and 80ha forests (zero direct discharge);
  - (vi) To Waiari Stream through riparian.

*Note: All treatment upgrades included UV disinfection.*

### Key Findings

- Nutrient levels in both Wairari and Kaituna are elevated above level to stimulate growth of aquatic weeds – hence additional nutrients from the sewage effluent discharge have little additional effect.
- First ranked option for discharge is a rock rubble exfiltration trench (e.g. land passage) providing a diffuse discharge area at the Waiara Stream to address in particular cultural concerns – (rock rubble exfiltration trench included a 5m wide rock width).
- Surface flow wetland or pasture irrigation both with the rock rubble exfiltration trench also ranked high.
- Working Party and Iwi input needed to rank / decide on most preferred option.

### Indicative Costs

Refer Table in Section 7.2 of this report.

### Resource Consents

Current consent expires 2016.

**MAKETU - PUKEHINA BEACH SEWERAGE PROJECT  
WESTERN BAY OF PLENTY DISTRICT COUNCIL****CASE HISTORY No. 1****Key Document**

Fraser Thomas Ltd, 1997

**Studies Involved**

- Investigate and define the problem with sewage disposal.
- EBoPRC had advised of shellfish contamination in both estuaries from existing on-site systems.
- Is low level contamination from groundwater seepage along the open coastline of Pukehina Beach?

**Key Findings**

- Do nothing option not viable.
- Are areas unsuitable and marginal for on-site disposal particularly as urban density increases?
- Carry out options study for off-site (i.e. community) treatment and disposal.
- Undertake community and Tangata Whenua consultation.
- A larger issue, is run-off and associated contamination from the rural catchment.



**MAKETU / LITTLE WAIHI AND PUKEHINA BEACH  
WESTERN BAY OF PLENTY DISTRICT COUNCIL****CASE HISTORY No. 2****Key Document**

Maketu / Little Waihi and Pukehina Beach Wastewater Study Background Report  
Fraser Thomas – [date]

**Studies Involved**

- Investigate current situation for sewage disposal.
- Review the demographics.
- Assess community ability to pay.
- Options for community wastewater schemes. These included:
  - (i) treatment at Maketu Gully with HRI disposal;
  - (ii) treatment at Little Waihi Hills with Deep Bore Injection disposal;
  - (iii) treatment at Little Waihi Hills with Slow Rate Irrigation (SRI).
- Cost estimates.
- Conclusions.

**Key Findings**

- Consideration of Tangata Whenua's cultural and spiritual values is a critical component of resource management and Council's (WBoPDC) initiative.
- Pollution of estuaries and warnings not to eat shellfish.
- Contamination of groundwater.
- Retention of septic tank systems not recommended at Little Waihi or low lying Maketu due to site constraints and high groundwater conditions.
- Preferred reticulated wastewater scheme is one with treatment at Maketu Gully (Option 1.3) (Aerated lagoons wetlands and UV treatment) followed by High Rate Irrigation (HRI). Land disposal.

**Indicative Costs**

Preferred option (Option 1.3) capital \$11.15M – year ??? basis equates to a UAC of \$787 (Uniform Annual Charge) for each ratepayer for capital, operating and maintenance and depreciation costs.

Table 6.4 – Summary of Various Previous Investigations into Community Scheme Options

OTHER LOCAL STUDIES (Report Section 6.3 for each Scheme – Refer Section 7.2 For Costs Estimates)	LAND APPLICATION CHARACTERISTICS	1	2	3	4	5	6	7	8	9
		WAIHI BEACH	KATIKATI	OMOKOROA (1)	OMOKOROA (2)	OMOKOROA (3)	TAURANGA (BOTH CATCHMENTS)	TE PUKE	MAKETU (1)	MAKETU / LITTLE WAIHI & PUKEHINA BEACH (2)
	Study / Date	Fraser Thomas Ltd, 1995	Bruce Wallace & Partners (Brian Duncan)	Bruce Henderson Consultants, 1992	Woodward-Clyde, 1998-99	URS; Nov 2000 & July 2002	Tauranga Area Sewerage Study – Stage 1 Report, 1990, Beca Steven	Worley Consultants 1995 Allendale Group, 1996	Fraser Thomas, 1997	Fraser Thomas ??
	Wastewater design loading	??	SRI ?	<ul style="list-style-type: none"> <li>20mm per 7 day pasture</li> <li>30mm per 7 day forest</li> </ul>		Refer detailed reports Detailed work done			Not investigated other than for inadequate on-site systems.	HRI ? SRI ? DBI considered
	Indicative Land Area		<ul style="list-style-type: none"> <li>40ha Bushy Rd (too small); and</li> <li>Sand at Matakana Island</li> </ul>	<ul style="list-style-type: none"> <li>40ha for pasture</li> <li>Part of 200ha block</li> </ul>		Various for schemes Refer reports and detailed maps showing areas	<ul style="list-style-type: none"> <li>Matakana Island for all Tauranga 150-200ha</li> <li>For Welcome Bay only 200ha</li> </ul>	For land disposal SRI option 4 – 40ha and 80ha forests	Not investigated	??
	Land Location (if identified)		<ul style="list-style-type: none"> <li>Bushy Road Area; and</li> <li>Matakana Island</li> </ul>	<ul style="list-style-type: none"> <li>SW of Omokoroa Road; and</li> <li>Peninsula between Pahina and Tauranga Harbour</li> </ul>	<ul style="list-style-type: none"> <li>Land towards the Kaimai's and</li> <li>Rangiwaea Island</li> <li>Omokora golf course</li> </ul>	Various for schemes included: <ul style="list-style-type: none"> <li>Turnbull Property Omokoroa Peninsula</li> <li>Rangiwaea Island (most of)</li> <li>Other areas</li> </ul>	<ul style="list-style-type: none"> <li>Matakana Island</li> <li>Coastal flatlands from Papamoa to Te Puke</li> <li>Golf course / reserves in TDC (as used now)</li> </ul>	??	Not investigated	Maketu Gully and Little Waihi Hills
	Land Value(s)	??	??	\$20,000 / ha (1992)	??	? See estimates	??	??	Not considered	??
	Land Application Scheme Type	Various: <ul style="list-style-type: none"> <li>Land disposal</li> <li>Wetlands</li> <li>Seep areas</li> </ul>	SRI Spray irrigation	<ul style="list-style-type: none"> <li>SRI</li> <li>spray irrigation</li> <li>also considered drip irrigation for horticulture</li> </ul>	<ul style="list-style-type: none"> <li>SRI irrigation</li> <li>Plus horticulture use</li> <li>Golf course (Omokoroa)</li> </ul>	<ul style="list-style-type: none"> <li>High rate infiltration on Turnbolls</li> <li>Subsurface drip on Rangiwaea Island</li> <li>Also other above and below ground SRI and Deep Bore Injection</li> </ul>	SRI	SRI (forest irrigation)	Not investigated	HRI } SRI } All considered DBI }
	EBOP Issues	Possible contamination of Tauranga Harbour.	Run off and seepage of treated wastewater to Tauranga Harbour.	Run off and seepage of treated wastewater to Tauranga Harbour	Protection of Tauranga Harbour Water Quality	<ul style="list-style-type: none"> <li>Ground and surface (harbour) water contamination</li> <li>Land stability</li> </ul>	<ul style="list-style-type: none"> <li>Contamination of Tauranga Harbour</li> <li>Reclamation's</li> </ul>	??	Contamination of shellfish in both estuaries	<ul style="list-style-type: none"> <li>Existing groundwater and estuary contamination</li> <li>Unacceptable septic tank systems</li> </ul>
	Other key factors – Findings	Options not favoured for: <ul style="list-style-type: none"> <li>Forest irrigation</li> <li>Sand infiltration</li> <li>Ocean discharge</li> <li>Horticulture irrigation</li> </ul> Preferred option: <ul style="list-style-type: none"> <li>UV disinfection and wetland seep disposal</li> </ul>	Ocean Outfall Matakana Island best practicable option.	Ocean Outfall off Matakana Island chosen as best practicable option.	<ul style="list-style-type: none"> <li>Need Community Sewerage Scheme</li> <li>Many of the sites investigated for land application not suitable</li> </ul>	<ul style="list-style-type: none"> <li>Septic tanks not acceptable</li> <li>Land application schemes not preferred</li> <li>Conveyance to Tauranga DC's Chapel Street plant / system preferred</li> <li>Tangata Whenua issues varied and some yet to be resolved</li> </ul>	<ul style="list-style-type: none"> <li>Land disposal not economically viable</li> <li>Coastal flatlands have severe limitations in winter for land application</li> <li>Elimination of harbour discharge preferable</li> <li>Preferred scheme is ocean discharge through 900m long Mt. Maunganui outfall</li> </ul>	<ul style="list-style-type: none"> <li>Report ranked diffuse discharge to Wairari Stream after exfiltrating trench as first option.</li> </ul>	<ul style="list-style-type: none"> <li>Septic tanks not appropriate in some areas</li> <li>Community sewerage scheme needed in some areas</li> <li>Is seepage to estuaries and contamination</li> </ul>	<ul style="list-style-type: none"> <li>Tangata Whenua cultural and spiritual values a critical component</li> <li>Septic tank systems not appropriate in some areas</li> <li>Need community wastewater scheme</li> <li>Preferred scheme based on HRI (High Rate Irrigation) at Maketu Valley</li> </ul>

## 6.5 Western Bay of Plenty and Tauranga District Council's Joint Strategic Sewerage Study (2001 – Montgomery Watson)

The goal of the two Councils was to identify an affordable, technically feasible and environmentally acceptable regional sewerage scheme for the western area of the Bay of Plenty, for the long term.

Montgomery Watson was engaged to carry out a Strategic Sewerage Study to provide a series of best practicable options for wastewater treatment and disposal for aggregations of urban areas from Waihi Beach to Maketu.

The Study involved:

- investigating residential and industrial growth within the districts for a period from the present to 2046, and the demand it would generate for sewerage schemes;
- carrying out pre-feasibility design and analysis of strategic sewerage options;
- initial consultation with Iwi;
- investigating the future capacity available at the Chapel Street Wastewater Treatment Plant (WWTP) in Tauranga.

The Study provided information for further assessments of strategic options including preliminary comment on decision-making and risk assessment.

The results of the Study, along with the results from the Strategic Water and Transportation studies, were to be used for the Sub-regional Growth Strategy, hence the summary in this report.

### Strategic Sewerage Options

For the purpose of the Study, three basic Strategic Sewerage Scheme options were analysed. These are:

- Option 1 – Stand-alone Sewerage Schemes for each ward of the Western Bay of Plenty District and for Tauranga District, except that Omokoroa would connect with Tauranga
- Option 2 – Centralised Sewerage Scheme where all wastewater would be conveyed and treated at the Tauranga WWTPs
- Option 3 – West-Central-East Sewerage Schemes where:
  - Waihi Beach and Katikati wastewater would be treated in a Western WWTP
  - Tauranga and Omokoroa wastewater would be treated at the Tauranga WWTPs
  - Te Puke and Maketu wastewater would be treated at the Te Puke WWTP

Disposal of treated wastewater to water and to land was considered for Option 1, respectively Option 1a and Option 1b. Only disposal of treated wastewater to water was considered for Options 2 and 3.

## Future Growth and Sewerage Service

Each option was analysed for a range of residential and holiday population flows and industrial flows. Four separate growth (low and high) and service (low and high) cases were considered. These growth scenarios were undertaken prior to the SmartGrowth Study and have not been compared to it at this stage.

Land application (assumed to be land disposal) was based on an assumed hydraulic loading basis of 35mm/week and a 7 day cycle. This was considered reasonable taking into account the free draining nature of the pumice soils in the area. No detailed siting work was undertaken. The assumptions for cost modelling were land disposal sites would be available within 5km of the Treatment Plant sites and that the site elevation would be 100m average above the treatment sites except for Waihi Beach and Maketu which would be 10m.

Community	Land area required Hectares	Distance to land disposal area Km	Average elevation of land disposal area m	Power required to transfer wastewater to disposal area kW
Waihi Beach	114 to 166	5	10	16 to 24
Katikati	42 to 94	5	100	33 to 73
Omokoroa	82 to 252	5	100	64 to 197
Tauranga	1,340 to 1,410	5	100	1,000 to 1,050
Te Puke	62 to 128	5	100	48 to 100
Maketu	28 to 42	5	10	22 to 33

*Note:*

1. Land area required is based on minimum and maximum forecast flows (MWH, 2001) and an effluent area loading rate of 35 mm/week
2. Distance from a wastewater treatment plant site to a land disposal site is assumed to be 5 kilometres
3. The elevation of a land disposal site above a wastewater treatment plant site is assumed to be 10 metres for Waihi Beach and Maketu and 100 metres for the other communities
4. The power requirement is indicative. It is based on the distance and elevation of a disposal site from a wastewater treatment plant site, the estimated flow rates, an assumed pipeline friction factor, and 24-hour pumping.

Detailed **cost modelling** of the various options was undertaken. A summary of this is included in Section 7.2.

A **Risk Assessment Overview** was also undertaken of the options. The following summarises this. It confirms the previous statements (Section 4.1 and 4.4) that the risks associated with land disposal / land treatment schemes are generally for greater than with ocean discharge.

**Summary: Risk Overview – Disposal and Discharge Options**

<b>Risk Category</b>	<b>Sea Outfall</b>	<b>River Discharge</b>	<b>Land Disposal</b>
Iwi concern	high	high	low
Community non-acceptance	low	highest	high?
Land need and cost	low	low	high
Not sustainable in terms of:			
▪ Natural resources	low	high	high
▪ Life capacity	low	high	high
▪ Environmental	low	high	high
Higher Environmental Standards	low	high	high

The study identified a wide range of issues relating to the disposal and discharge of treated wastewater. These are summarised as:

**Summary: Key Issues – Disposal and Discharge**

<ul style="list-style-type: none"> <li>• Marine Disposal <ul style="list-style-type: none"> <li>– Currently Katikati and Tauranga</li> <li>– Cultural sensitivity</li> <li>– Little adverse ecological effect (no significant effect outside mixing zones)</li> </ul> </li> <li>• Tauranga Harbour Disposal (and estuaries) <ul style="list-style-type: none"> <li>– Not favoured (against WBoPDC's Wastewater Policy)</li> <li>– Nutrient sensitive</li> <li>– Regional Coastal Plan</li> </ul> </li> <li>• Inland Waters <ul style="list-style-type: none"> <li>– Low flows / low dilution</li> <li>– Cultural sensitivity</li> </ul> </li> <li>• Land <ul style="list-style-type: none"> <li>– Large areas</li> <li>– Nutrient runoff</li> <li>– Land availability</li> <li>– High pumping / energy costs</li> </ul> </li> </ul>
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## 6.6 Common Themes

- An extensive range of wastewater treatment and disposal / discharge studies have been undertaken for all significantly sized communities in the SmartGrowth study area.
- These studies have included the full range of land application techniques introduced and defined in Section 1.
- Local factors such as soil types, ground and surface water characteristics including potential contaminant runoff and seepage to the Tauranga Harbour and estuaries in the area, water supply protection, land use and development have resulted in many areas either not being suitable or only marginal for those land application techniques where the treated wastewater is applied onto or into the ground principally as a disposal technique (e.g. land disposal, land treatment, deep bore and infiltrating wetlands as defined in this report).
- Recent studies have confirmed some of the present urbanised community areas in Omokoroa and Maketu are unsuitable for on-site septic tank disposal systems particularly as the dwelling density increases.
- The detailed studies, including those in 1990 for Tauranga City, have highlighted the siting and other difficulties, as well as higher costs to implement long term sustainable land disposal, land treatment and deep bore injection schemes.
- By contrast, all Community Sewerage Schemes in the study area include some form of wetland and/or a land passage / riparian strip land treatment system. In a number of cases these have been installed to assist, albeit as a compromise, Iwi and Hapu with their cultural position against direct discharge of (treated) human sewage to a water body. This is understood to have been the position with Tauranga in respect to the decisions to have wetlands before ocean discharge. Such land treatment / land contact techniques are also acceptable albeit sometimes also as a compromise to other stakeholders and the community itself.
- Two notable exceptions to the above generalisations are that:
  - Tauranga District Council irrigates the Omanu golf course and two reserves with reclaimed wastewater in the summer. A further six areas are also consented to allow this practice.
  - Western Bay of Plenty District Council is trialling, as per their resource consent condition, subsurface irrigation as part of the new Waihi Beach Scheme.

## 7. Comparative Costs of Land Application and Ocean Discharge

### 7.1 Overview

The following includes information from options studies in the study area and also some other studies in New Zealand covering both larger and small schemes. All estimates have been left in the cost values at the time of the investigation reports. For comparative purposes however, ratios are calculated between land disposal / land treatment type schemes (i.e. treated wastewater going onto or into land in an application way) to direct discharge to surface water, particularly marine / ocean waters.

### 7.2 Local Schemes (WBoPDC and Tauranga DC)

The following tables are presented to illustrate cost differences between land application, particularly land disposal and direct discharge to surface water – i.e. stream, harbour and ocean through the ocean outfall. The three examples taken from the previous investigations are Te Puke (1995), Omokoroa (1999) and Tauranga (1990). Limited data was readily available for the other schemes. The data presented also includes estimates for some of the other land application options including wetlands and land passage / riparian strip arrangements.

While these costs are outdated, the ratios comparing land disposal (and other on land techniques) with surface water (including ocean) discharge should still hold. In this respect it could be argued that land disposal costs would now be higher relative to ocean and the surface water discharge. This is because of increased land costs, increased consenting and consent monitoring costs and the need for more foolproof (lower risk) land application schemes than was the norm some years ago when these studies particularly Tauranga and to a lesser extent Te Puke were undertaken.



**Table 7.2a : Te Puke Cost Estimates 1995 – Worley Consultants**

SCHEME NO.	METHOD OF DISPOSAL / DISCHARGE OF TREATED WASTEWATER	TOTAL ESTIMATED CAPITAL COST	ANNUAL OPERATING & MAINTENANCE COST
1	Dispersed discharge to Wairari Stream through long dispersed exfiltration trench	\$1.8 million	\$0.07 million
2	Dispersed discharge to Wairari Stream through short dispersed exfiltration trench and after some pasture irrigation	\$2.5 million	\$0.08 million
3	Dispersed discharge to Wairari Stream through short exfiltration trench and via surface flow wetland	\$2.8 million	\$0.08 million
4	Wetland with (zero direct discharge from it)	\$3.5 million	\$0.13 million
5	Land disposal to forest (zero discharge from it)	5A : for 40ha forest: \$8.3 million	\$0.35 million
		5B : for 80ha forest: \$10.9 million	\$0.41 million
6	Through riparian rootzone wetland to Wairari Stream	\$3.1 million	\$0.08 million

*Note* – costs include treatment plant upgrades, exclusive GST, are in 1995 terms.  
– All treatment upgrades include UV disinfection  
– Highland disposal operating costs relate to high energy (pumping) costs

**Table 7.2b : Te Puke – Cost Ratios for Options Above**

	LAND DISPOSAL – TO – SURFACE WATER DISCHARGE		
CAPITAL COSTS RATIO	(i) Scheme 5A: (large forest)	6 to 1	Exfiltration trench (Scheme 1)
	(ii) Scheme 5B: (small forest)	3.5 to 1	Through riparian root zone wetland (Scheme 6)
OPERATING AND MAINTENANCE COSTS RATIO	(i) Scheme 5A: (large forest)	5.8 to 1	Exfiltration trench (Scheme 1)
	(ii) Scheme 5B: (small forest)	5.1 to 1	Through riparian rootzone wetland (Scheme 6)

**Table 7.2c : Omokoroa**

The costs show a worst case and best case scenario for an estimated UAC charge (1999):

No.	Description	Worst	Best
Option 1	Tmt & Disp of Exstg Residential	\$1,708	\$1,708
Option 2	Omokoroa / Kaimai Tmt + disposal	\$1,812	\$1,812
Option 3	Rangiwaia Disposal	\$1,575	\$888
Option 4	Rangiwaia Disposal Tmt.	\$1,814	\$1,127
Option 5	Ocean Outfall	\$1,759	\$1,072
Option 6	Harbour Discharge	\$1,365	\$678
Option 7	Connect to Te Maunga	\$1,443	\$756
Option 8	Motuhoa Disposal	\$1,687	\$1,000
Option 9	High rate infiltration to ground / Harbour	\$1,217	\$530
Option 10	Septic Tanks maintained	\$1,445	\$807

**Table 7.2d : Omokoroa Case 2 1998/1999 Study  
Woodward-Clyde**

Cost Ratios for options above:

UAC (UNIFORM ANNUAL CHARGE) RATIOS	LAND DISPOSAL – TO – SURFACE WATER DISCHARGE		
	Land disposal Kaimai Area (Option 2)	2.7 to 1	Harbour Discharge (Option 6)
	Land disposal Kaimai area (Option 2)	2.4 to 1	Mt Maunganui Ocean Outfall – connect to Te Maunga (Option 7)

**Table 7.2e : Tauranga April 1990  
Beca Steven**

The costs of upgrading the Tauranga and Mt Maunganui treatment facilities to accommodate growth to their design capacities (\$3M and \$5.5M) and to divert Welcome Bay sewage to Mt Maunganui (\$8M) are not included.

Option	Description	Cost (\$M)
TAURANGA TREATMENT PLANT DISCHARGE ALTERNATIVES		
A1	Secondary treatment with continuous discharge to Otumoetai Channel (existing situation)	0
A2	Secondary treatment with ebb tide discharge to Otumoetai Channel	9.8
A3	Secondary treatment with continuous discharge to the Western Channel	7.3
A4	Secondary treatment with ebb tide discharge to the Western Channel	17
A5	Secondary treatment with ocean discharge off Matakana Island	26
A6	Partial treatment at Plant with oxidation ponds on Matakana Island and ocean outfall	30
A7	Secondary treatment with forest irrigation on Matakana Island	33
A8	Primary treatment at Plant with oxidation ponds and forest irrigation on Matakana Island	38
A9	Secondary treatment at Plant with pipeline discharging to Mt Maunganui outfall	18
A10	Partial treatment at Plant with pipeline to Mt Maunganui oxidation ponds (pond upgrading cost not included)	12
A11	No treatment at Plant with pipeline to Mt Maunganui oxidation ponds (pond upgrading cost not included)	11

**Table 7.2f : Tauranga 1990  
Beca Steven**

Cost Ratios for option above:

CAPITAL COST RATIO	LAND DISPOSAL – TO – HARBOUR AND OCEAN DISCHARGE		
	Primary treatment Forest Irrigation on Matakana Island (Scheme A8)	3.2 to 1	Partial treatment and Mt Maunganui ocean outfall (Scheme A10)
	Secondary treatment Forest Irrigation on Matakana Island (Scheme A7)	1.8 to 1	Secondary treatment and Mt Maunganui ocean outfall (Scheme A9)
	Primary Treatment Forest Irrigation on Matakana Island (Scheme A8)	3.9 to 1	Secondary treatment with ebb tide Harbour discharge (Scheme A2)

**Table 7.2g : The WBoPDC and TDC Joint Strategic Sewerage Study – 2001**

Financial Modelling Results - Total Estimated Costs For 50 Year Study Period Net Present Value						
Load Case	Stand alone water disposal	Stand alone land disposal	Centralised water disposal	West-Central- East water disposal	RATIO Stand alone land disposal to Stand alone water disposal	
Low growth / low service	\$102M	\$317M	\$112M	\$104M	3.1 to 1	
Low growth / high service	\$105M	\$320M	\$114M	\$107M	3.0 to 1	
High growth / low service	\$124M	\$342M	\$126M	\$120M	2.8 to 1	
High growth / high service	\$127M	\$347M	\$128M	\$123M	2.7 to 1	
<b>Results:</b>						
<ul style="list-style-type: none"><li>• Disposal to land most expensive</li><li>• Disposal to water similar for all options</li></ul>						

*Note:* – The estimated NPV (Net Present Value) is given in millions of dollars \$M  
– Discount rate of 6.5% used  
– Estimated costs compromise capital and operating

**Table 7.2h : The WBoPDC and TDC Joint Strategic Sewerage Study – 2001**

<b>Financial Modelling Results Relative Property Charges - Within Wards/District Average over Study Period</b>				
<b>Ward/ District</b>	<b>Standalone <u>Water</u> disposal</b>	<b>Standalone land disposal</b>	<b>Centralised water disposal</b>	<b>West - Central - East water disposal</b>
<b>Waihi Beach</b>	<b>100%</b>	<b>120%</b>	<b>200%</b>	<b>100%</b>
<b>Katikati</b>	<b>100%</b>	<b>90%</b>	<b>90%</b>	<b>100%</b>
<b>Omokoroa</b>	<b>100%</b>	<b>220%</b>	<b>100%</b>	<b>100%</b>
<b>Tauranga</b>	<b>100%</b>	<b>440%</b>	<b>100%</b>	<b>100%</b>
<b>Te Puke</b>	<b>100%</b>	<b>100%</b>	<b>90%</b>	<b>100%</b>
<b>Maketu*</b>	<b>100%</b>	<b>120%</b>	<b>70%</b>	<b>90%</b>
<b>*includes Little Waihi and Pukehina</b>				

Table 7.2h shows the relative charges of various options to the standalone Water Option, i.e. the form of wastewater disposal currently used by each community – this is taken as 100%. The modelling is based on each community paying its proportion of the facilities encompassed in each option.

**Table 7.2i – The WBoPDC and TDC Joint Strategic Sewerage Study – 2001**

<b>Financial Modelling Results Relative Property Charges - Between Wards/District</b>				
<b>Ward/ District</b>	<b>Standalone <u>Water</u> disposal</b>	<b>Standalone land disposal</b>	<b>Centralised water disposal</b>	<b>West - Central - East water disposal</b>
<b>Waihi Beach</b>	<b>250</b>	<b>70</b>	<b>550</b>	<b>250</b>
<b>Katikati</b>	<b>500</b>	<b>100</b>	<b>450</b>	<b>500</b>
<b>Omokoroa</b>	<b>300</b>	<b>140</b>	<b>250</b>	<b>300</b>
<b>Tauranga</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Te Puke</b>	<b>300</b>	<b>100</b>	<b>250</b>	<b>300</b>
<b>Maketu*</b>	<b>400</b>	<b>120</b>	<b>300</b>	<b>350</b>
<b>*includes Little Waihi and Pukehina</b>				

Table 7.2i shows the relative charges of various options taking Tauranga as 100% for each option. The table only allows comparison within each option relative to Tauranga – not across options. The modelling is based on each community paying its proportion of the facilities encompassed in each option.

### 7.3 Examples from Elsewhere in New Zealand

The following presents examples of two large city schemes, namely Christchurch and Palmerston North, for which thorough investigations have recently been undertaken and also a number of smaller schemes. As for the assessment of local schemes included in Section 7.2 above, ratio's of land application (all land disposal) to surface water (river or sea / ocean) have been calculated.

#### (a) Christchurch City Wastewater Costs of Discharge Options (Source: Consents AEE – URS March 2001)

Capital and annual operating costs of the most promising discharge options were estimated. Table 7.3.1 gives a breakdown of the costs of the three disposal options; estuary discharge Stage 1 and 2, ocean discharge Stage 2, and two land disposal. These costs include both treatment and disposal aspects.

**Table 7.3.1: Cost Comparison between Discharge Options**

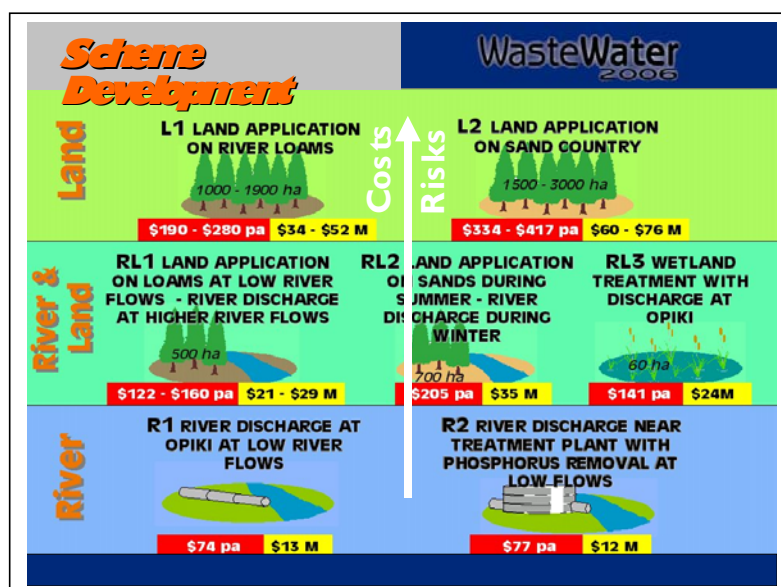
	Initial 15 year programme (Estuary outfall) (Stage 1)	Long term estuary outfall (Stage 2)	Long term ocean outfall (Stage 2)	Land High Rate Disposal Option	Land Agricultural Option
<b>Capital Cost</b>	\$32.1M	\$11.75M	\$41.7M	\$258M	\$350M
<b>Annual running cost (excluding debt servicing and depreciation)</b>	\$1.3M	\$0.8M	\$0.38M	\$6.22M	\$7.46M

**Table 7.3.2: Cost Ratios – Land Disposal to Ocean Outfall**

	LAND DISPOSAL – TO – OCEAN OUTFALL		
<b>CAPITAL</b>			
▪ Agricultural Land Use	\$350M	8.4 to 1	\$41.7M
▪ High Rate Land Disposal	\$258M	6.2 to 1	\$41.7M
<b>ANNUAL RUNNING</b>			
▪ Agricultural	\$7.46M pa	19.6 to 1	\$0.38M pa
▪ High Rate Land Disposal	\$6.22M pa	16.4 to 1	\$0.38M pa

#### (b) Palmerston North City Council – Year 2000

A very extensive issues and options study was undertaken with over 45 options being initially investigated. These included disposal / discharge to land river and ocean and combinations. The following seven representative schemes were adopted for the final consultation (refer Section 4.3 also).

**Table 7.3.3: Palmerston North Wastewater Project**

**Table 7.3.4: Cost Ratios – Land Disposal to River Discharge**

	LAND DISPOSAL – TO – RIVER DISCHARGE		
CAPITAL			
(i) River Loans (nearby)	\$52M (Scheme L1)	4.3 to 1	\$12M (Scheme R2)
(ii) Sand Coast (distant)	\$76M (Scheme L1)	6.3 to 1	\$12M (Scheme R2)
ANNUAL RATEPAYER COSTS (Additional p.a. over present wastewater rates)			
(i) River Loans (nearby)	\$280 p.a. (Scheme L1)	3.6 to 1	\$77 p.a. (Scheme R2)
(ii) Sand Coast (distant)	\$417 p.a. (Scheme L1)	5.4 to1	\$77 p.a. (Scheme R2)

*Note: For land treatment use the lower figures for Schemes L1 and L2 – these give a lower ratio.*

**Table 7.3.5: Smaller New Zealand Schemes – Examples of Recent Investigations of Land Disposal vs Disposal to Ocean / River**

Community	Upgrading cost to continue existing disposal / discharge	Existing disposal	Land disposal cost	Ratio Land Disposal : Existing River / Ocean Upgraded
Thames	\$554,000	To mouth of the Waihou River	\$1.82M - \$2.26M	3.3 to 1 and 4 to 1
Balclutha	Nil	To Clutha River	\$1.497M	N/A land much more costly
Milton	\$187,000	To Tokomairiro River	\$874,000 +	4.7 to 1
Kaka Point	Nil	To ocean	\$119,400	N/A – much more expensive
Tapanui	\$85,600	To Pomahaka River	\$395,100	4.6 to 1
Owaka	\$38,000	To Owaka River	\$168,800	4.4 to 1
Whakatane	\$1.2M	To ocean	\$2.11M	1.8 to 1
Murupara	\$98,000	To Rangitaiki River	\$1.628M	16.6 to 1

*Note: These estimates undertaken for Local Authority clients by MWH are all understood to be in the public arena.*

## 7.4 Patterns and Trends

While every wastewater treatment and disposal scheme has its own “case and site specific” factors that determine costs, there are however, a number of **well documented trends** in comparing land application and direct surface water (river, sea, ocean) discharges. These trends can be summarised as:

- For **medium and larger sized schemes then almost without exception the costs of land disposal and land treatment** (and deep bore schemes) are usually **a number of times higher** than water discharge. The information shown in Sections 7.2 and 7.3 **give ratios from 3 to 6 times higher with 4 to 5 times higher reasonably typical**. This applies both to capital and operating costs. The higher operating costs often reflecting the energy (pumping) costs associated with these.
- For **smaller community schemes the cost spread between land disposal and land treatment and surface water discharge is much more variable**, in fact sometimes land disposal and land treatment can be less expensive than ocean discharge if an offshore outfall is required.
- For **other land application techniques** such as overland flow, wetlands and land passage / riparian strip the **costs are usually much less than** land disposal and land treatment but of course there is still the discharge of treated wastewater coming from these systems. This is typically to surface water or marine waters, in fact in New Zealand the largest majority is to the ocean.

Accordingly, the use of these types of land application techniques add to the costs, but in many cases, the additional cost is acceptable to the community when taking into account the enhancements they provide over a direct discharge to surface / ocean waters.

- In **some cases** (possibly 10 to 15% of New Zealand’s schemes) **for small communities, land disposal and land treatment offers the most economic** capital cost solution when suitable land is readily available nearby. Operating costs are however still usually reasonably high.
- **Deep bore injection does not have proven application or cost history** in New Zealand at this time, nor do recent investigations including those in the study area support its use.
- **Investigation, consenting and ongoing monitoring costs for land disposal and land treatment schemes are typically much higher than schemes discharging to surface waters**. For small schemes monitoring costs can be particularly high by portion.
- Under Local Government legislation, Local Authorities have a **duty to ensure cost efficient waste services**. This includes services for wastewater.
- **Risk assessment** of land treatment, particularly land disposal and treatment, and deep bore injection schemes as compared to river and marine / ocean water discharge schemes, shows that in most cases the **land disposal, etc types of schemes carry higher risks, hence high costs risks**. There are exceptions however.
- **Costs and therefore affordability to the actual scheme users always need to be considered**, e.g. domestic and commercial ratepayers and trade waste discharges. In this respect the typical ratios outlined in this section directly apply to the typical ratepayer costs now. For example, if the annual sewerage / wastewater dwelling rate (as a Uniform Annual Charge (UAC) say) was now \$200 p.a. and the ratio for land disposal 4 times, then for the land disposal scheme, the UAC would be \$800 p.a.



## **Appendix A: References – Local Studies, Reports and Papers on Land Application Schemes**

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### **Western Bay of Plenty District Council**

Strategic Plan – 1998-2020, Western Bay District Council

Katikati WWTP Resource Consent Report 1996, Alandale Planning 1996

Groundwater Resource Investigations – Appendix D, Pattle Delmore

Katikati Sewerage – Evidence of Brian Duncan – Bruce Wallace & Partners, date?

Katikati Sewerage – Ocean Discharge Effects 1996, Bioresearchers

North–West Communities Wastewater Collection and Disposal Scheme 1991, Bruce Henderson

Community Sewage Treatment Scheme for Maketu and Pukehina – Newsletter, September 1998

Maketu-Pukehina Beach Sewerage Project – Stage 1 Report – Investigation and Evaluation of Problem 1997, Fraser Thomas

Maketu / Little Waihi Beach and Pukehina Beach Wastewater Study Background Report

Omokoroa Wastewater Study - Stage 2 Report 1998, Woodward Clyde, URS Council Presentation 1-6-99

Omokoroa Wastewater Study – URS Reports, Jul 2002-Nov 2002

Report on Septic Tank Desludging Trial 1997, Manukau Consultants

Sewerage Options Study - Waihi Beach 1995, Fraser Thomas.

Te Puke WWTP Resource Consent Application 1996, Alandale Planning

Te Puke RC Technical Appendices 1996, Alandale Planning and Worley Consultants

Waihi Beach Sewerage – Fraser Thomas, 1995

### **Tauranga District Council**

Tauranga Area Sewerage Study Stage 1 Report 1990, Beca Carter

Final Effluent Discharge Environmental Testing results, Tauranga District Council

Evidence from Bruce McCabe on behalf of TDC and WBoPDC against EBoP's Coastal Environment Plan, September 1998

Tauranga Area Sewerage System Strategy Update 1998, Beca Carter

Strategic Directions – Vision 2020, Tauranga District Council

Te Maunga WWTP Summary Sheet, Tauranga District Council

Chapel Street Summary Sheet, Tauranga District Council

Tauranga Area Sewerage Study Stage 1 Report, June 1990 – Beca Carter

Tauranga Sewerage 1990-2020 Newsletter Nos 1-3, Tauranga District Council

Strategic Direction 1998-11-16 TDC A1 – Summary of District Plan Zones

Tauranga District Council – Sustainable Techniques for the Provision of “Infrastructure for Urban Development Papamoa East”, August 2002, MWH

### **Joint – Western Bay of Plenty and Tauranga District Council Studies**

Strategic Sewerage Study Contract CS 123/98 February 2001

MWH in association with Alandale Planning and Harris Consulting

### **Environment Bay of Plenty**

Investigation of Septic Tank Effluent Disposal 1992, Environment Bay of Plenty

Resource Consent Applications by TDC for Te Maunga TP 1993 (including results of oceanographic studies), Environment Bay of Plenty

Introducing Tauranga Harbour - Information publication, Environment Bay of Plenty

Introducing the Operative On-site Effluent Treatment Regional Plan 1997, Environment Bay of Plenty

Operative On-site Effluent Treatment Regional Plan 1997, Environment Bay of Plenty (including Plan Change No. 1).

Soil Conservation Practice – Disposal of Effluent on Farm – Fact Sheet SC23/98.

#### ***Miscellaneous:***

Fox G (1975) Wastewater Treatment Plant Costs, Water and Wastewater Treatment Plant Operators Newsletter, Vol 15, N<sup>o</sup> 4

### **Other**

“New Zealand Wide Survey of Local Authority Approaches to Municipal Wastewater Treatment and Disposal” by M. Burkhardt Macrae – Project Report No. 2002-CEO02; Department of Civil and Environmental Engineering, University of Auckland

Various technical papers on Rotorua, Taupo, Levin and Turangi Land Application Schemes. Refer Land Collective’s publications and the appropriate Local Authorities.

“Where is New Zealand at with Constructed Wetlands”; C Tanner and J Sukia – Water & Wastes in New Zealand, July 1999

## Appendix B: Summary Comparison of Wastewater Management Schemes for other New Zealand Cities and Some Other Communities (Ordered from North to South)

**Important Note: Disclaimer – This information has been compiled from the general knowledge of MWH personnel. It is based on information understood to be in the public arena. Notwithstanding this, MWH asks that this information remain within this immediate SmartGrowth project. However, if it is to be used in the public arena then respective Local Authorities are contacted to verify the information. Issue No 1**

*\*Note table does not include sludge management procedures*

City/ Community	Population (Very Approx.) and Trade Waste Importance	Present Treatment and Disposal/Discharge Facilities*		Issues and Options Investigations and Consultation Undertaken				Future Direction and Key Driver	Other Key Points
		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Whangarei</b>	45,000 plus meatworks and other trade waste	Secondary plus <ul style="list-style-type: none"> <li>▪ Tertiary sand filtration</li> <li>▪ UV disinfection</li> <li>▪ Wetland of aesthetic/wildlife type/cultural</li> </ul>	Estuary discharging into Whangarei harbour, through tributary creek.	Yes	In Late 1980's and again now for new Resource Consent.	Options.	In late 1980's (pre RMA) lead to aesthetic / wildlife / (Maori) cultural wetland being installed as last stage of treatment before discharge to the marine environment.	NZCPS, RCP, Iwi, community plus?	Present scheme consultation/options, selection undertaken pre RMA. Wetland (aesthetic / wildlife / Iwi cultural), one of New Zealand's largest of this type.
<b>Auckland (Watercare, Mangere)</b>	900,000 plus all Auckland's tradewaste (a considerable amount)	Mangere plant being upgraded to <ul style="list-style-type: none"> <li>▪ Secondary with nitrogen removal</li> <li>▪ Filtration and UV disinfection</li> </ul>	Manukau Harbour at the shoreline.	Yes	Extensive over last 10-15 years.	Very wide ranging options including land disposal, ocean outfall, Manukau harbour discharge options. Adopted existing (but with upgraded treatment), option for discharge to Manukau Harbour.	Led to upgrade of Mangere plant with outgoing tidal discharge to Manukau Harbour.  \$360 million upgrade in progress.	Wet weather flow management.	Ongoing studies into disinfection, sludge management, health impacts are being undertaken.

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		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>North Shore</b>	160,000	Secondary plus (polishing/ maturation) oxidation ponds	Short outfall to Waitemata Harbour	Yes	Early 1990s and again now	Implementing recommendations. Master programme to define improvement – many wet weather overflows to shoreline and beaches.	Higher treatment. Deeper harbour outfall, probably longer.	Stormwater contribution. Public reaction to oxidation pond. Accommodate population growth	Further upgrade planned. Recently overflows of raw sewage to Auckland Harbour.
<b>Hamilton</b>	100,000 plus some trade waste	Primary plant with secondary recently added.	Waikato River.	Yes	1996-1997	Land disposal, option. River discharge option.	Upgrade plant for continued river discharge, but after aesthetic river percolation, in future possibly.	Iwi preference for land and river water quality.	Land disposal trial taking place to prove feasibility and sustainability for future consideration.
<b>Gisborne</b>	Large trade waste component.	Milliscreening.	Ocean through 1800m long outfall.	Yes	1996 – ongoing	Wide range treatment and disposal/discharge options.	Remain with ocean discharge.	NZCPS, RCP, Costs Trade Waste aspects	Upgrade options considered. RCs soon to be lodged
<b>Tauranga Chapel Street</b>	60,000 plus (small) trade waste	Secondary with UV disinfection and wetland.	Marine environment (sea) after wetland 900m outfall, coupled with Te Maunga	Yes	1970s/80s and more recent.	Some effluent reuse on reserve land (golf course) and wetlands prior to sea discharge.	See previous column	<ul style="list-style-type: none"> <li>Expansion issues</li> <li>Aeration upgrade in late 2002</li> <li>New discharge consent needed 2005</li> <li>New consent for ocean discharge in progress</li> </ul>	

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		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Tauranga Te Maunga (Mount Manganui)</b>	20,000 plus significant trade waste	Secondary (extended aeration) + new wetlands	Marine environment (sea) after wetland 900m outfall, coupled with Chapel St	Yes	Recently	Wetland more recently installed prior to sea discharge.	Wetland installed	<ul style="list-style-type: none"> <li>Sludge treatment, possible expansion and trade waste</li> <li>New consent for ocean discharge in progress</li> </ul>	
<b>Rotorua</b>	45,000 plus some trade waste	Secondary BNR nutrient (nitrogen and phosphorus) removal.	Land application 220ha (land treatment) then drainage passes through natural wetlands with residual discharge to streams draining to Lake Rotorua.	Yes	1980's and again recently	Treatment and discharge/disposal options.	Previous land application system. This present review in progress – outcome yet to be determined.	Previously Tangata whenua non- acceptance of discharge direct to water - also eutrophication problem of the lake.	Tree health and nitrogen levels under review from sustainability viewpoint. Nitrogen levels are being monitored.
<b>Taupo</b>	15,000	Secondary.	Land disposal (135ha) “cut and carry” grass system	Yes	Early 1990's.	River discharge and land disposal options. Decided on land application.	Remove effluent discharge from river and go to land disposal.	River water quality to Tangata whenua plus community and hence land disposal scheme.	Needing to expand land application area as nitrogen levels in groundwater are showing evidence of being elevated.
<b>Napier</b>	55,000 plus some trade waste	Milliscreening	1,500m long ocean outfall	Yes	1994-1998	Wide range of options including land disposal – to stay with ocean disposal.	Proposal is for staged upgrade with advanced primary and UV disinfection at first stage followed by secondary treatment and possibly wetland.	NZCPS, RCP, Iwi	RC decision has been appealed by industry.

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City/ Community	Population (Very Approx.) and Trade Waste Importance	Present Treatment and Disposal/Discharge Facilities*		Issues and Options Investigations and Consultation Undertaken				Future Direction and Key Driver	Other Key Points
		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Hastings</b>	50,000 plus very large organic trade waste amounts in food processing season	1 mm milliscreening	2,750m long ocean outfall	Yes	1994 – 1997 + now	Wide range of options including land disposal.	Decided to remain the status quo, i.e. milliscreen and long (2,750m) ocean outfall. Some domestic sewage treatment (primary) to be implemented in 5 to 8 years. Major industry to be separated and remain with on site milliscreening, Council screening then discharge.	Cost, Maori cultural position, some public perception	New RC for 12 yrs with primary type treatment in 5 yrs. Minister of Conservation reduced consent period down from 18 yrs.
<b>New Plymouth</b>	45,000 plus trade waste including chicken abattoir	Secondary (racetrack) activated sludge with chlorination for disinfection	Ocean through short outfall	Yes	Options			Sludge has been big environmental issue	Award winning sludge drying unit operational.
<b>Wanganui</b>	45,000 plus large trade waste.	Milliscreened at present.	Ocean through 1800m long outfall	Yes	Late 1980s early 1990s and against presently.	All options including separated large trade discharges from domestic sewage.	In 1990 separate domestic sewage to land application scheme and trade waste to ocean, now being reassessed.	Costs, Iwi presently considering all wastewater (after appropriate treatment) being discharged to ocean.	Council have revisited previous decision for land disposal on grounds of high cost. Recently obtained RC for ocean discharge and future treatment.

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		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Levin</b>	15,000?	Secondary trickling (filters, clarifiers)	Land near Coast	Yes	1999 – ongoing	Treatment upgrades and extension of land disposal.	Under consideration.	Main problem with high wet weather infiltration into sewers and treatment plant overflow	Limited lease period of land disposal area. Also, area may need expansion.
<b>Paraparaumu</b>	25,000	Secondary with some phosphorus removal, and UV disinfection recently completed upgrade	Drain discharging to Waikanae River estuary then coastal environment	Yes	mid 1990	Options included UV disinfection.	Increase level of treatment with same place.	Relocate at end of consent.	Have long term consent.
<b>Porirua</b>	60,000	Secondary (race track) activated sludge and UV disinfection	Ocean shoreline but near Titahi Bay	Yes	Early 1980s	Options		Drivers for recent RC were seawater quality microbiological contamination re shellfish and recreational standards	Major RC hearings recently where Public Health (pathogens) was the major driver.
<b>Hutt Valley</b>	110,000 plus trade waste	Secondary treatment plus UV disinfection	Ocean - Cook Strait through 50m long shoreline discharge	Yes	major late 1980's into 1990's	All practicable options.	Secondary treatment and UV disinfection with sea (ocean) discharge	Environmental monitoring, review outfall 2009-2011	<ul style="list-style-type: none"> <li>Major 20 yr duration DBO contract for treatment plant and sewerage network operation.</li> <li>Treatment plant now in operation (early 2002).</li> </ul>



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City/ Community	Population (Very Approx.) and Trade Waste Importance	Present Treatment and Disposal/Discharge Facilities*		Issues and Options Investigations and Consultation Undertaken				Future Direction and Key Driver	Other Key Points
		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Wellington</b>	130,000 plus abattoir (main trade waste discharge)	Secondary treatment (Kaldness process) + UV disinfection	Into ocean-Cook Strait through 1800m long outfall	Yes	1980s early 1990s	Range of options including joining with Hutt Valley	High quality secondary effluent	Wet weather flows into the harbour	Exceeds environmental requirements for ocean discharge in this location
<b>Nelson/ Tasman</b>	Nelson, Richmond, Stoke, etc + 3 large organic type industries and others	Secondary by aerated lagoon and oxidation ponds (Bells Island) with sludge removal/ treatment	Into Tasman Bay (i.e marine environment) off Bells Island	Yes	1970's/80's	Options	Present scheme	Sustainability issues – sludge disposal/ reuse	<ul style="list-style-type: none"> <li>Looking at effluent reuse at water short times in area. Sludge disposal and reuse also being considered.</li> <li>RC hearing recently held for the wastewater discharge</li> </ul>
<b>Blenheim</b>	20,000	Oxidation ponds	Coastal estuary.	Yes	mid 1990's	Upgrading options.	Upgrade existing oxidation ponds.	?	?
<b>Christchurch</b>	300,000 + trade waste	Secondary trickling filter plus polishing oxidation ponds	Heathcote estuary	Yes	1997- Present	All options, including land disposal	Council decided to remain with estuary discharge for 15 yrs. RC decision granted for only 5 yrs. Council has now decided to proceed to an offshore ocean outfall, possibly 2km offshore	Desirability for a sustainable solution	Council decided to stay in the Estuary although a (non Council) working party preferred an ocean outfall. Now, given RC decision, Council have decided to move the discharge to the open sea.

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		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Timaru</b>	45,000 plus large (organic) industry	Milliscreened	Ocean discharge out 500m long outfall	Yes	1997-99	Various options	Separate domestic and industrial systems proposed. Domestic – lagoons and ponds. Industry – anaerobic lagoons.	<ul style="list-style-type: none"> <li>Community and industry wishes</li> <li>Costs</li> </ul>	Large industry base
<b>Oamaru</b>	12,000 plus some industry	Aerated lagoon + oxidation pond and overland flow	Overland flow discharges to watercourse then the Ocean Beach	Yes	Late 1980's	Various options	Land based overland flow wetlands, then beach discharge via small watercourse	?	Wetlands were included but have since been removed.
<b>Tahuna (Dunedin CC)</b>	85,000 (based on 1997 census and including harbour discharges) plus some trade waste	Primary	Ocean at shoreline	Yes	Early 1990's and revisited for "Tahuna 2006" project in 2001/2002	All options	By 2006, 1100m offshore outfall and disinfection with chlorination at times when the plume may contact beaches. In 2009/12, if necessary following environmental monitoring, may upgrade to secondary treatment and disinfection.	Bathing quality on beaches	Best practicable option adopted. Regional Council Plan sets significant direction for an off shore discharge.
<b>Green Island (Dunedin CC)</b>	11,000 (1997 Census). Now includes Mosgiel (see below). Plus large trade waste	Milliscreened + high rate secondary + UV disinfection	Pacific Ocean 850m long outfall	Yes	Early 1990's	All options including land application	Upgrade treatment from milliscreen and extend 500m outfall to 850m	Bathing and shellfish standards near sea shoreline	High trade waste input

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		Treatment	Treated Wastewater Disposal / Discharge to	Yes/ No	When	Covered	Outcome		
<b>Balclutha</b>	3,500	Oxidation pond	Clutha River	Yes	Early 1990's	All options	River discharge appropriate	None at present	-
<b>Gore</b>	6,000 plus abattoir	Oxidation pond with aerators	Mataura River	Yes	1996	All options	Continued with river discharge	Improvement of Mataura River water quality	-
<b>Queenstown</b>	7,000 base plus large tourist/holiday	Oxidation pond (with aerators)	Shotover River	Yes	1997 and 2001	Options including land disposal. Land disposal reviewed in 2001.	Proposed change to a rapid infiltration land disposal system.	Iwi and recreation groups wanted the discharge removed from the river	Some pressure for land application. Trials on gravel discharge in progress.
<b>Wanaka</b>	3000 base + holiday/tourist	Oxidation pond	Clutha River	Yes	1997 & 2002 onwards		?	Land value of current site and public opposition to river discharge	Some pressure for land application
<b>Invercargill</b>	45,000 + woolscour	Secondary (trickling filter)	New River Estuary	Yes	2000?	Range of options	UV disinfection and wetland prior to discharge.		

## **Appendix C: ALGENZ Conference June 2000 – Land Based Wastewater Disposal**

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### **ALGENZ Conference**

**Workshop: 11.10a.m. – Friday 16 June 2000**

**Topic: Land Based Wastewater Disposal**

**Facilitators: Jim Bradley and Murray Sorrell, Montgomery Watson**

### **Overview Topics**

- 1. State of the Nation**
- 2. Land Application - The Drivers**
- 3. Terminology and Communication**
- 4. Case History in New Zealand**
- 5. Recent Canterbury Case Histories**
- 6. The Issues**
- 7. Lets Workshop: Going Forward – The Biggies**

**June 2000**



## 1. State of the Nation

- Coastal cities discharge to the marine environment
- Majority of inland communities to rivers
- Some exceptions
- Good number of smaller land application schemes
- Output from many I&O Studies
- Place for 'Mix & Match' systems
- Microbiological quality driver
- New Land Collective Guidelines

## 2. Land Application - The Drivers

- Tangata whenua - NZCPS Policy 5.1.2
- R P Statements - Regional (Land, etc) Plans
- The 'nice green' way
- Some public / community preference
- Some resource reuse
- Some smaller schemes - cost effectiveness

## 3. Terminology and Communication

- Confusion (in the past)
- Land based?
- On the land - through the land
- Land disposal versus land treatment
- SRI, Rapid I - Land disposal
- Overland flow, wetlands, others

## 4. Case History in New Zealand

- Limited duration
- Limited extent (700ha with 32 schemes)
- Some good (smaller) schemes
- The three biggest municipalities: Rotorua, Levin, Taupo

## 5. Recent Canterbury Case Histories

### (a) Upgraded Existing Land Disposal System

- Methven - Dosed rapid infiltration basins
- Kaiapoi - 34ha infiltration wetlands
- Woodend - 7.9ha bunded infiltration basin

### (b) New Age Systems

- Land Disposal the Logical Choice
- Rolleston
  - No surface water option
  - Irrigation system within rural/residential development
  - 13ha fixed sprays system
  - high land cost justifies nitrogen reduction
- Rakaia
  - Issues of discharge to Rakaia River
  - Suitable land disposal sites
  - Centre pivot irrigation with plant between sites
  - Sludge disposal to pines adjacent to plant
- Oxford
  - Seasonal dry rivers
  - Suitable land disposal sites
  - Centre pivot irrigation, simple and low cost

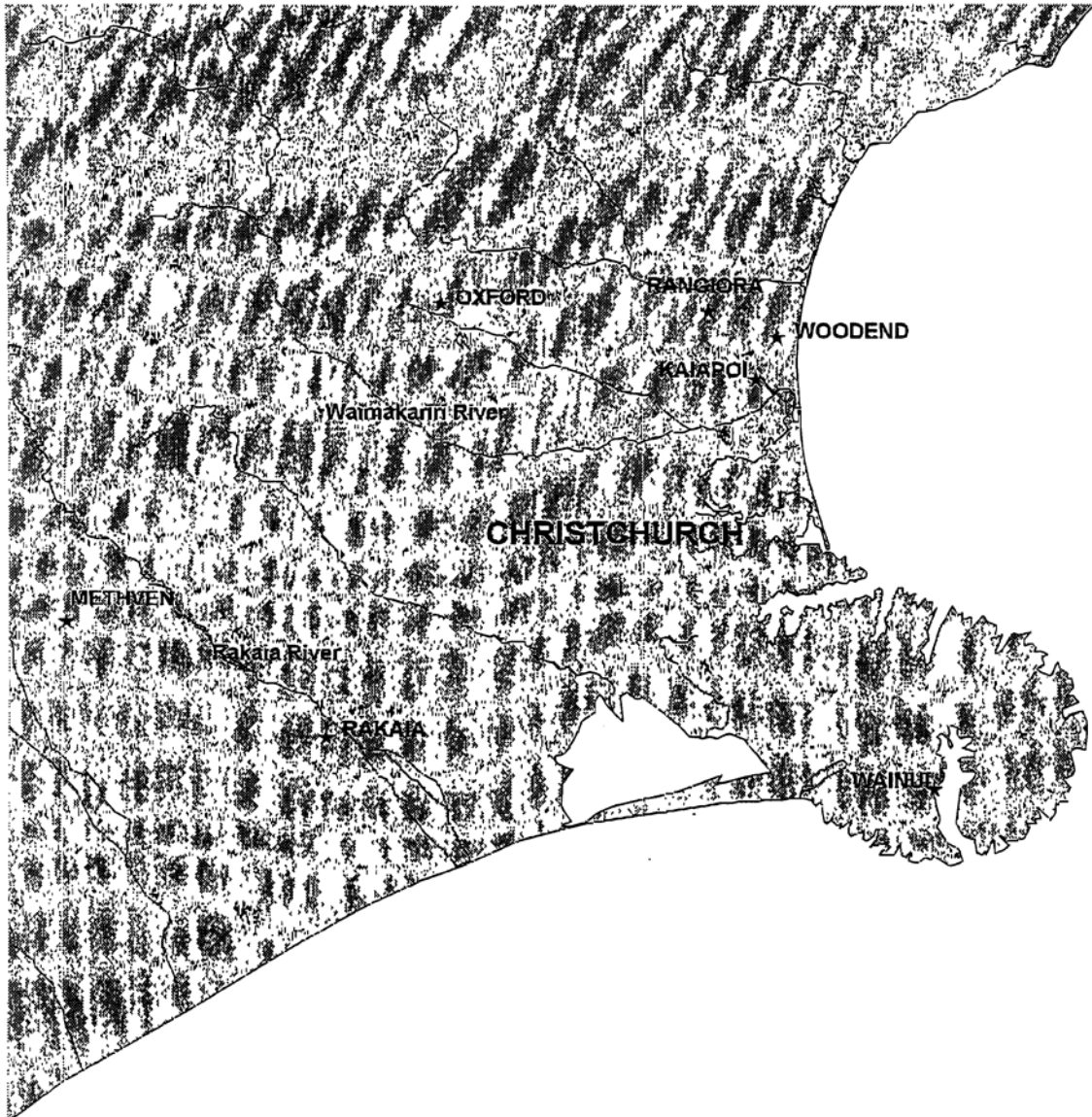


## 5. Recent Canterbury Case Histories (cont)

### (c) The Future Systems

- Public opposition to surface water discharges
- High cost accepted
- Wainui
  - Small harbour outfall
  - Existing land disposal example
  - Community wants land disposal
- Rangiora
  - Pond discharge to small stream
  - High quality discharge with wetlands proposed
  - Increasing opposition to any river discharge
  - Land disposal at twice the cost
  - 150ha Cut & Carry
  - Supplementary forestry irrigation

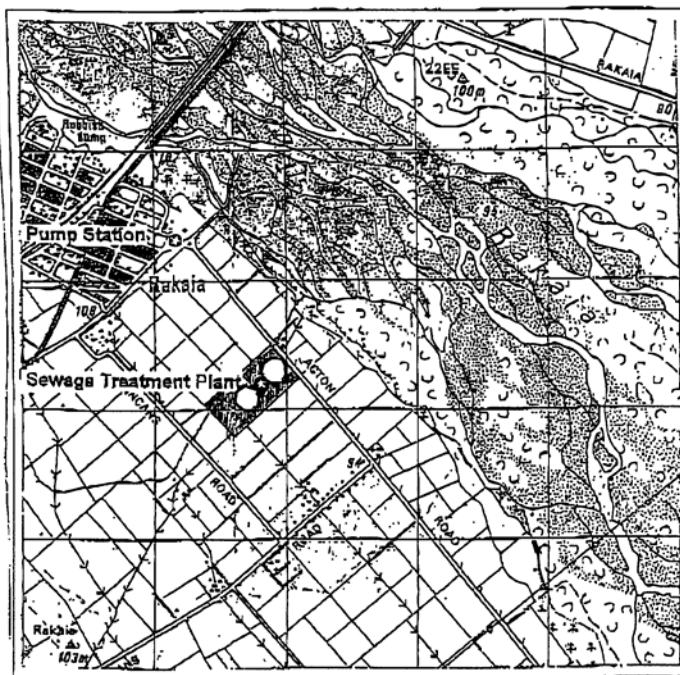




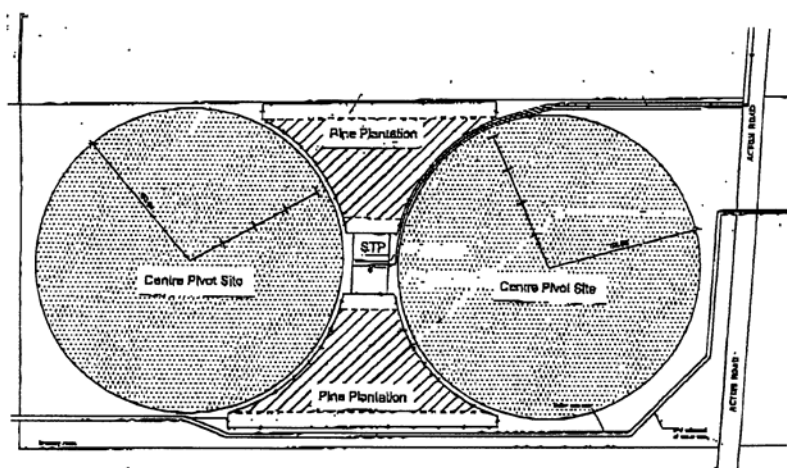
## Recent Canterbury Case Histories

### Location Map

## Rakaia Sewage Treatment and Disposal System



**1. Location Plan**



**2. Site Layout Plan**



### Canterbury Sewage Effluent Land Disposal Schemes

	Methven	Kaipara	Woodend	Rolleston	Oxford	Rakaia	Waimu	Rangiora
<b>Status</b>	Operating 20 years	Operating 4 years	Operating 4 years	Operating 3 years	Operating 3 years	Operating 2 years	Proposed	Proposed
<b>Construction Date</b>	1979	May 1996	December 1996	February 1997	September 1997	February 1999	2001?	2002?
<b>Design Population</b>	4,000	10,550	3,000	4,400	2,200	1,700	600	17,000
<b>Design Flow (m<sup>3</sup>/day)</b>	1,000	2,600	1,500	1,100	500	425	120	7,800
<b>Treatment Process</b>	Oxidation ponds	Aerated lagoon plus oxidation ponds.	Oxidation ponds	Extended aeration	Extended aeration	Trickling Filter	Package plant	Aerated oxidation ponds plus UV
<b>Irrigation Area (ha)</b>	0.45	34	7.9	13	20	14	1.2	150
<b>Cover</b>	Bare soil	Planted wetland	Planted wetland	Pasture (cut & carry)	Pasture (cut & carry)	Pasture (cut & carry)	Pine trees	Pasture (cut & carry)
<b>Type</b>	Rapid infiltration basins	Unlined surface flow wetland that allows infiltration.	Unlined surface flow wetland that allows infiltration.	Fixed sprinklers. Drip irrigation used in tree buffer zone.	Centre pivot	Centre pivot	Sub-surface drip line	Centre pivot
<b>Ave. HLR (mm/day)</b>	220	8	19	8	2.5	3	10	5
<b>Application (mm/day)</b>	660	8	19	40	10	20	30	20
<b>Nitrogen L.R (kg/ha/y)</b>	20,000	570	1400	207	200	360	1,000	450
<b>Other Features</b>	Recently installed basin system, upgraded from previous trench system.  Groundwater not an issue due to depth below surface (40 m).	Upgraded from previous border-dyke system.  Excess wetland effluent run-off is filtered and UV disinfected prior to discharge to river.	Upgraded from previous border-dyke system.  High water table during winter reduces infiltration.	Nitrogen removal in treatment process allows higher application rate.	Nitrogen removal in treatment process.  Farmer co-sharing.	Sludge from treatment process applied to pine plantation located between pivot sites.	Proposed new sewer scheme to replace septic tanks.  Disposal onto existing pine plantation	Distant site (18 km).  Opportunity for K line irrigation to adjacent existing pine forest (250 ha).
<b>Why land disposal?</b>	Lack of nearby surface water.  Suitable for rapid infiltration.	Minimise discharge to Waimakariri River.	Lack of nearby suitable surface water.  Cultural issues.	Lack of nearby suitable surface water.	Lack of nearby suitable surface water.	Problems with discharge to Rakaia River.  Suitability of land disposal.	Discharge to Akaroa Harbour not favoured.  Land disposal proven feasible.	Public desire to cease river discharge.

\* Resource consent condition



## 6. The Issues

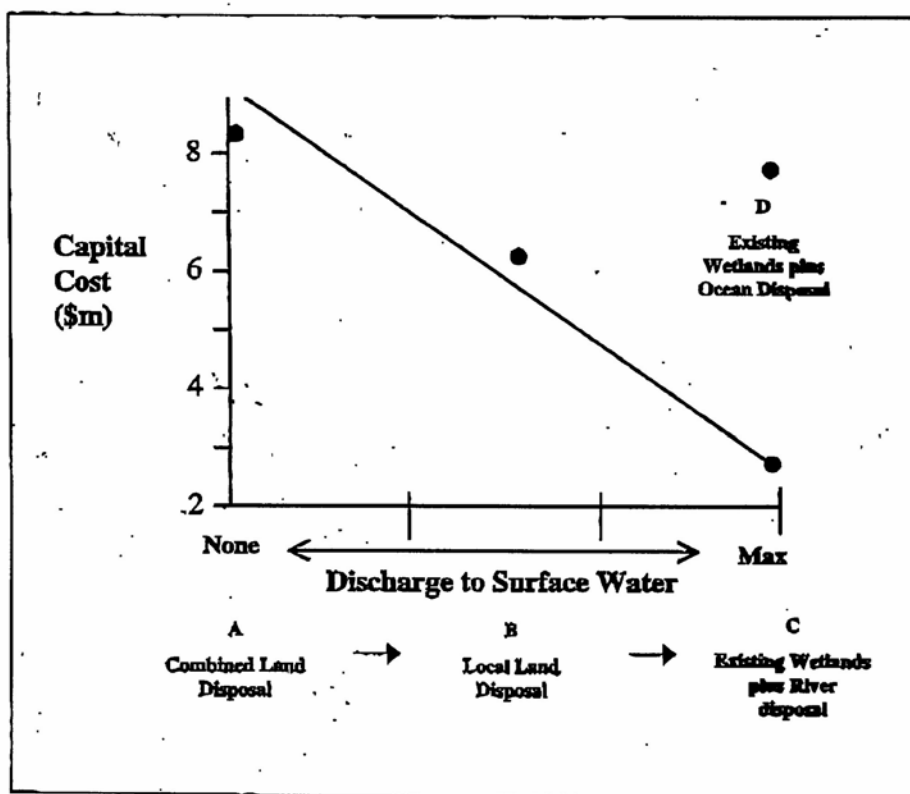
- Risk Management Necessary
- Long Term Sustainability
  - Market / End product acceptability
    - \* Livestock / crops
    - \* Cut & Carry
    - \* Saw logs
    - \* Coppicing
  - Climate Changes
  - Do we know what is sustainable
  - What flexibility is needed
- Education / Consultation
  - Necessary
  - At what stage
  - Direction and opinions may change
- Negative Perceptions
  - Is it sludge?
  - Public education necessary
  - Potential valuation issues for adjacent owners
- Land Availability
  - Suitable soils
  - Suitable sites
  - Is it for sale? (PWA!)
  - Increasing difficulty with size
- Operating Issues
  - Land management / agricultural skills required
  - Simple or automatic to be sustainable
- Winter Irrigation Practices
  - Worst design situation
  - To discharge to groundwater or not

## 6. The Issues (cont)

- Effects Concerns
  - Groundwater contamination and direction
  - Amenities / recreational issues, buffering aerosols and odour
- Effluent Quality
  - Disinfection often expected
  - May influence treatment system
- Cost
  - High

## 7. Lets Workshop Going Forward - The Biggies

- Increasing problems with larger schemes (size scale factors)
- Must be simple in concept
- Many issues to consider
- Market / End Use issues
- Sustainable - do we know?



**Figure 7: Graph of Disposal Capital Cost v Amount of Surface Water Discharge**

## **Appendix D: Excerpts from the MfE December 2002 Draft Handbook “Sustainable Wastewater Management – A Handbook for Smaller Communities”**

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### **Section 9: Ecosystem re-entry or re-use**

Having collected and treated your wastewater (see Section 7) you need to look at systems and technologies for its re-entry to the ecosystem. In some cases, water and biosolids can be reclaimed for re-use, and the options for this are briefly discussed below.

#### **9.1 Re-entry of treated waste into the ecosystem**

Sixty to seventy years ago the way wastewater re-entered the environment was not a major focus for communities or technicians. For on-site systems the main concern was to ensure that septic tank fields were able to absorb the wastes: periodically the tank would need to be cleaned out and the wastes buried. Various levels of treated waste from centralised systems would be discharged directly into streams, rivers or the sea. Untreated waste, especially sewage, would often be discharged via ‘sewer outfalls’ onto coastal areas. This, of course, has changed and significant levels of treatment now occur.

Treated wastewater may be returned to the ecosystem through direct point discharge to a water body such as a river, lake, wetland or estuary, or to sea. In this case the RMA will require high discharge standards, and Maori values often prohibit direct discharge to natural waters. Alternatively, the treated wastewater may be returned to land by various irrigation methods, such as flood irrigation, overhead sprinklers or sub-surface drippers.

Towns and cities close to the coastline tend to return the treated wastewater to the coastal ecosystem. Inland treatment plants may discharge their treated wastewater to a lake, a river, or to land via irrigation. The other waste product from a treatment plant is the processed sludge (biosolids). This may be disposed to a landfill site, spread on to land, composted, pelletised or treated for use as a soil conditioner.

Options for returning the treated wastewater to the ecosystem within the site boundaries (often referred to as on-site disposal) depend very much on the site’s characteristics, such as soil types, area and slope of land available, location of groundwater, and local climate. Options include seepage into the soil subsurface, irrigation (surface or subsurface) and evapo-transpiration.

#### ***Types of wastewater residuals***

There are four kinds of wastewater residuals that must re-enter the natural environment after treatment.

#### **Gases**

These include gases such as ammonia, methane and hydrogen sulphide, and odorous organic gases such as mercaptans, indole and skatole. These can re-enter at various points, such as if water turns septic from an overload of organic material, or at the point sludge is landfilled. Methane can build up within a site and will need to be managed to reduce risks to surrounding properties. Risk



management and site management plans for landfills to manage combustible gases and odour will be an important part of the re-entry process. The costs of landfill management are often not factored by communities into wastewater management costs when choosing options.

### **Wastewater aerosols**

These are very small airborne droplets that can carry pathogens and other contaminants. Aerosols are created by mixers and aerators, which disturb the surface of wastewater tanks and ponds, or by overhead sprinklers. The distance these aerosols can carry in winds and the survival time of pathogens is variable and will depend on the site. A risk management plan and regulation of where and how any treatment plant or land irrigation area is to be located will be important.

### **Liquids**

The characteristics of treated wastewater to be returned to the environment will depend on the level of treatment it has received (see Section 7).

### **Solids – sludge and biosolids**

These can be classified as semi-solids and semi-liquids depending on the amount of water left in them. Unprocessed solids from primary and secondary treatment processes are referred to as sludges. Local authorities invest significant effort into converting sludges to biosolids and reducing the level of water in the processed solids in order to improve handling problems when they are disposed to landfills. The New Zealand Waste Strategy calls by 2007, for such wastes to be beneficially used or appropriately treated to minimise the production of methane and leachate.

The Ministry for the Environment is placing strong emphasis on improving landfill management, and many smaller landfills have closed. Some landfills will not take biosolids. The Ministry is keen to promote re-use of biosolids, but there are issues with some processes in terms of available markets. The re-use of biosolids that have been composted is not straightforward because of concerns about the impacts of remaining heavy metals and other substances.

## **9.2 Types of re-entry systems**

There are six main ways in which liquid and solid wastewater residuals re-enter the ecosystem, as shown in Table 9.1.

**Table 9.1: Types of re-entry system**

<b>System</b>	<b>Residuals managed</b>
Freshwater ecosystems (streams, lakes and wetlands)	<ul style="list-style-type: none"> <li>• treated wastewater effluent (various levels of treatment)</li> </ul>
Marine ecosystems (estuaries, harbours and ocean – coastal and offshore)	<ul style="list-style-type: none"> <li>• treated wastewater effluent (various levels of treatment)</li> <li>• some untreated wastewater (more rare)</li> </ul>
Land ecosystems (agricultural, horticultural, forestry or landscaped areas)	<ul style="list-style-type: none"> <li>• treated wastewater effluent (various levels of treatment)</li> </ul>
Atmosphere	<ul style="list-style-type: none"> <li>• gases (indirect and flaring of landfill gases)</li> <li>• wastewater aerosols (a by-product of treatment processes)</li> </ul>
Landfills (closed systems)	<ul style="list-style-type: none"> <li>• sludges and biosolids</li> </ul>
Waste-to-energy plants (not used in New Zealand at present)	<ul style="list-style-type: none"> <li>• dried sludge/biosolids</li> </ul>

As you saw in Part 1, ecosystems are dynamic, complex interacting webs of human, biological and physical processes. People are dependent on natural ecosystems for goods, services, and products they provide. Consequently our long term wellbeing is totally dependent on maintaining healthy ecosystems well into the future. The impact of wastewater re-entry on these systems will not just depend on the quantity and quality of residuals released into them. It will also depend on the sensitivity of the ecosystems and the relative importance of the ecosystem's goods and services.

There are procedures for assessing impacts and managing them. These include assessment of environmental effects (AEE) and hazard identification analysis and monitoring programme (HIAMP). The RMA requires that these impacts be assessed before consents will be issued. The main agency for managing these effects is your regional council. These and other groups with a role in managing impacts are discussed in section 4.

**Table 9.4: Main forms of wastewater effluent re-entry in New Zealand**

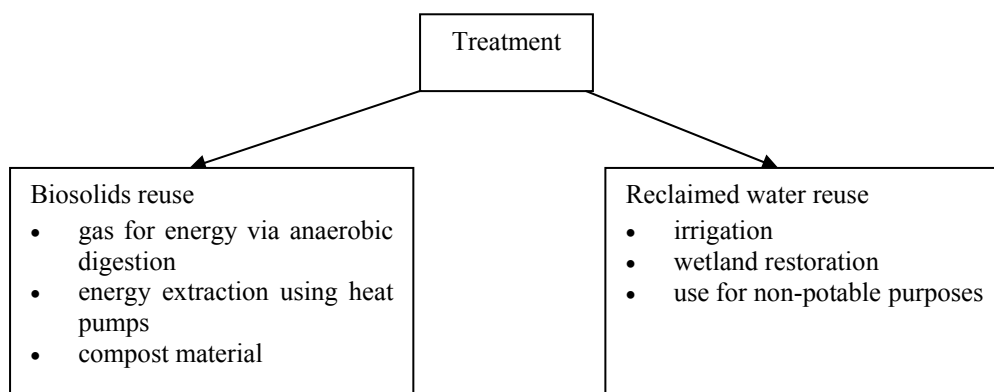
<b>Form of re-entry</b>	<b>Number of communities</b>	<b>%</b>
Freshwater:		
• stream flow	147	51.9
• lake	4	1.4
	<b>151</b>	<b>53.4</b>
Marine:		
• estuarine	7	2.5
• harbour	13	4.6
• coast	6	2.1
• offshore outfall	29	10.2
	<b>55</b>	<b>19.4</b>
Land and other :		
• to land	59	20.8
• land/ excess flow to water	17	6.0
• pipeline to another treatment plant	1	0.4
	<b>77</b>	<b>27.2</b>
<b>Totals</b>	<b>283</b>	<b>100%</b>

## 9.4 Re-use of water and biosolids reclaimed from wastewater

Traditionally wastewater has been managed as a product that is a threat to both human and ecosystem health. Consequently, the infrastructure design for handling such a material will reflect this. Domestic wastewater contains essential resources such as water, nutrients and organic material.

Treated wastewater produces liquid wastewater and primary and secondary sludge, which is the material that remains once the original waterborne waste is 'dewatered'. Both these wastes can be processed to recover reusable water and composted biosolids for horticultural application as a soil conditioner.

Re-use of biosolids requires a higher level of treatment to take it beyond what is achieved with the normal treatment of primary and secondary sludges.



There are a number of technologies commonly used for realising the resource value of wastewater, most commonly with centralised systems, where the volumes of treated wastes are likely to be large enough to encourage investment. It is also possible with the smaller cluster systems, although this is a fairly new area. Re-uses include biogas production for energy (a process that converts the organic component of primary and secondary sludges to methane), irrigation of water and wastewater nutrients for biomass production, and the use of the treated wastewater for wetland restoration. Other practices overseas include aquaculture, energy extraction (from the wastewater) by heat pumps, urine separation and nutrient stripping for the production of nutrients.

It is rare for an on-site system to involve re-use, although some of the options include recycling treated wastewater or greywater for non-potable uses such as toilet flushing and irrigation, or feeding landscaped wetlands, and the use of composting toilets and production of humus.

Reclaimed water has non-potable uses for garden irrigation or industrial processes. Wetland restoration involves artificially putting water back into a wetland to offset the loss of water from drainage of surrounding areas and the lowering of the water table.

Re-use of reclaimed water is a new part of wastewater management in New Zealand. It is also where Maori have concerns about the re-entry of wastes. There are concerns about irrigation direct on to food crops, and uncertainty about compost as an end use. Non-potable use is acceptable if it is not used for food production, where it must pass through soils first. There is also wider community concern about some of these processes (e.g. heavy metals in composts).

Health authorities also have concerns regarding the use of reclaimed water sourced from wastewater because of the possibility of direct contact with pathogens if something goes wrong with the treatment process, or the system is not adequately maintained.

A wide range of technologies can be explored, even if the area is relatively new. Like managing water use at source, biosolids and reclaimed water re-use have the potential to reduce the overall cost of the wastewater system. For a small community it may be worth looking at how the waste streams, especially sludges to be converted to biosolids, might be combined with other communities in a centralised process. Re-use is well worth exploring as part of your wastewater thinking.

## **Appendix E: Tauranga Area Sewerage Study – Stage 1 Report, June 1990 Beca Steven (Appendix C – Land Disposal Additional Information)**

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C-1

### **APPENDIX C**

#### **LAND DISPOSAL OPTIONS – ADDITIONAL INFORMATION**

##### **1. Matakana Island Option**

###### **1.1 Physical Inspection**

The southeastern end of Matakana Island was inspected both from the air and on the ground on 8 June 1990.

The longshore, seaward extent of the island is a sand bank formed by Bay of Plenty littoral sand drift which has stabilised with time. The sand is relatively coarse marine white sand.

The island has been afforested and where trees are growing there is a humus covering to the forest floor. The trees have been planted in blocks at different times and they range in age from 5 to 20 years.

Various areas have been cleared, some quite substantial. Cleared areas are debris littered and in some areas hold ponded surface water, although this is not extensive.

On-ground inspection showed that in many areas the trees are very closely spaced, having seeded naturally, and have not been pruned. It would be very difficult to lay a spray irrigation system in these areas.

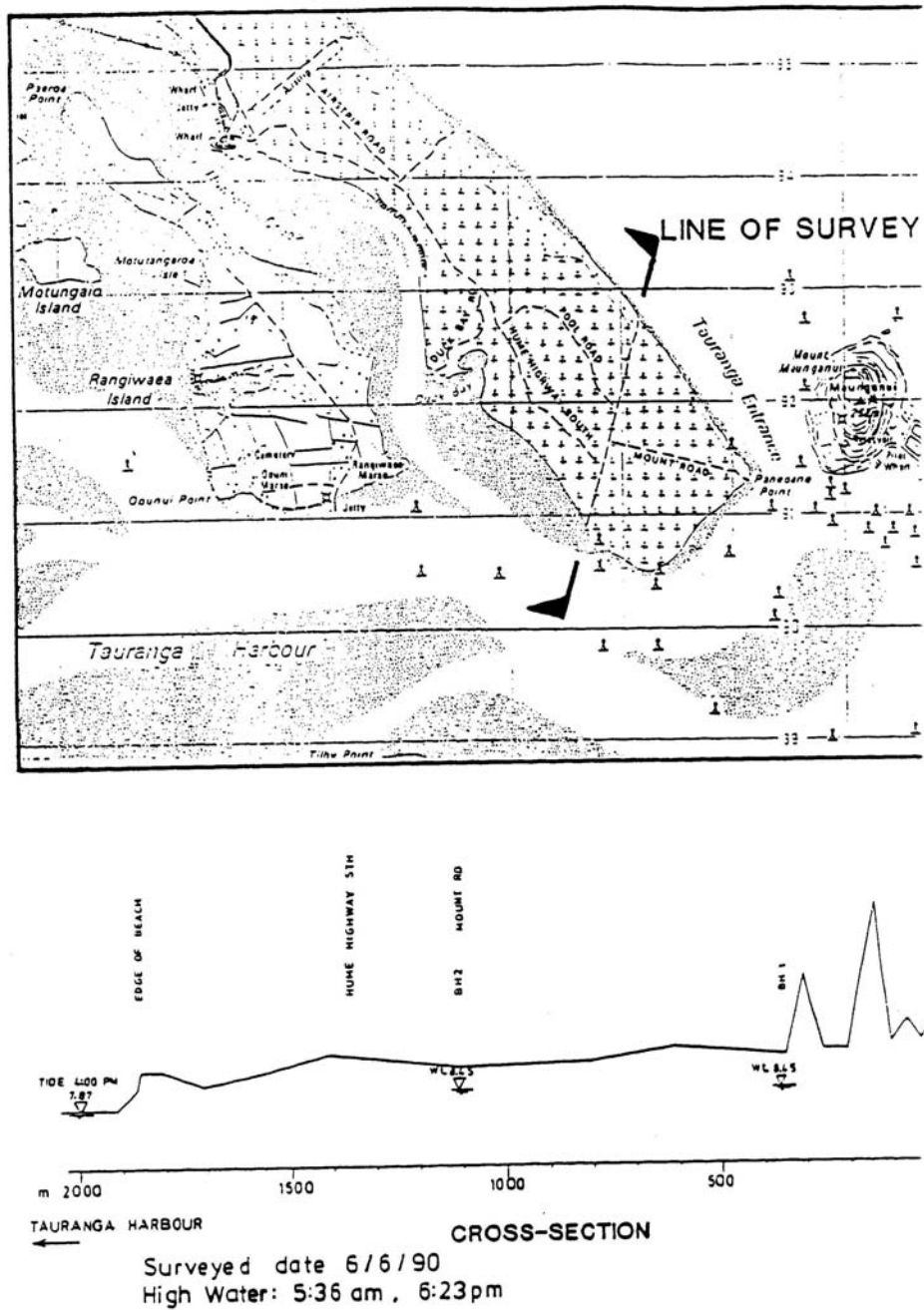
###### **1.2 Water Table Profile**

A profile of levels across the island from Tauranga Harbour to the Pacific Ocean had been surveyed on 6 June 1990 and this profile was inspected, together with boreholes sunk to determine the water table level.

The level profile and borehole locations are shown on Figure C-1.

The island is relatively flat and generally some 2 metres above MSL and about one metre above MHWS. Coastal dunes on the ocean side of the island rise to a maximum of 9 metres above MSL.

Bore water levels at the locations shown were reasonable consistent at just under 0.5 metre above MSL. Levels were unchanged on the two days observed. These levels would indicate that ground water would migrate equally to the harbour and the sea.



Matakana Island  
FIGURE



### 1.3 Land Cost

Some endeavour was made to ascertain the availability of the land for effluent disposal purposes.

The land is owned by London Pacific Ltd, an offshore investor, and the forest is operated on its behalf by Elders Resources NZFP Ltd.

Some 300 hectares would be required, which is a substantial portion of the approximately 500 hectares of the island between the harbour entrance at Mount Maunganui and the airstrip shown on Figure C-1.

The land would be either purchased and the forestry operated as a municipal undertaking in conjunction with effluent land disposal, or leased under similar operating conditions, or an easement to occupy for the purpose of effluent disposal obtained.

Should the area required for land disposal have to be purchased, it could cost as much at \$5.0m. Thus estimate is made up of 300 hectares of land at \$10 000 per hectare plus the value of the trees taken as \$5 000 per hectare, a total of \$4.5m which, with contingencies, could amount to \$5.0m.

### 1.4 Forestry

Discussion with the forestry manager indicated that an effluent disposal scheme in the forest would not be unwelcome and that the trees would benefit from additional nitrogen application.

An excessive rise in the natural water table could impair tree growth. The present ground-water level, as disclosed by the boreholes, is a little more than one metre below ground level. While this is quite close to the surface, the open porous nature of the sand subsoil indicates that excessive groundwater rise would not occur as a result of effluent disposal if restricted to normal spray irrigation rates.

Any further groundwater level rise, as could be caused by long term sea level rise, would cause tree root systems to be very shallow and could impair continued growth of the established deeper rooted tree crop.

### 1.5 Scheme Costs

Combining the Matakana Island effluent disposal option for disposal of Tauranga wastes with other options for Mount Maunganui to provide an overall disposal scheme gives the following capital and operating costs and net present worth:

Option	Capital Cost	O & M Costs	Net Present Worth
A7 + C2	\$ 59.5 M	\$ 2.46 M p.a.	\$61.5M
A7 + C4	\$ 69.5 M	\$ 3.46 M p.a.	\$74.3M

The above costs are presented in the same form as Table 10-3 of the report, where A7 is continued secondary treatment at Tauranga and forest irrigation of the effluent on Matakana Island and C2 and C4 are the options relative to Mount Maunganui for dual power lagoons and oxidation ponds and secondary treatment ahead of oxidation ponds, respectively.

The overall cost of scheme strategies involving land disposal on Matakana Island can be compared with the costs of the other overall schemes discussed in the report. These costs are scheduled in Table C-1 under, Scheme G being Options A7 + C2 and Scheme H being Options A7 + C4.

Table C-1 : Scheme Costs		
Scheme	Description	Net Present Worth
A	Discharge to harbour Reclamation at Mount	\$ 39.5m
B	Discharge to harbour - advanced treatment Reclamation at Mount	\$ 41.1m
C	Ocean discharge Reclamation at Mount	\$ 45.3m
D	Ocean discharge Land based - secondary	\$ 52.4m
E	Discharge to harbour - advanced treatment Land based - secondary	\$ 54.2m
F	Ocean discharge Land based - secondary	\$ 58.1m
G	Land disposal Matakana Is Reclamation at Mount	\$ 61.5m
H	Land disposal Matakana Is Land based - secondary	\$ 74.3m



The cost of Scheme G and the cost of Scheme H do not include the cost of land on Matakana Island for effluent disposal. The cost of the land, whether by lease or purchase, is considered to be recovered by the increased tree crop yield over the life of the scheme. However, if purchased, a considerable further capital financial outlay is required. Furthermore, forest irrigation schemes inspected throw considerable doubt over the ability of increased crop yield to recoup land purchase or lease costs.

## 1.6 Estimates Review

The estimates used in determining the scheme costs presented above have been reviewed, with particular regard to the cost and choice of route of harbour pipeline from the Tauranga sewage treatment plant to the Matakana Island effluent distribution system and the cost of the forest irrigation system on Matakana Island.

The direct harbour crossing route, as depicted in Option A7 and as has been used in the estimates, costs \$14.2m while a longer route further to the north but away from the deeper part of the western channel of the harbour, costs \$20.1m. This confirms the choice of the shorter route at the cost used in estimates.

The cost of the forest irrigation system for Matakana Island has been compared with actual costs reported for the Rotorua scheme. The Tauranga scheme would represent 95 percent of the Rotorua scheme on a population basis, and 85 percent on a design flow basis. These proportions of the Rotorua land disposal system give costs of \$16.2m and \$14.5m respectively. The lower cost has been used in the estimates for Option A7 for effluent disposal on Matakana Island because of the easier terrain for pipework laying.

## 2. Welcome Bay Option

### 2.1 Siting

This option would serve the Welcome Bay area alone. In addition to 23 hectare oxidation ponds to be sited in the lower reaches of the catchment, the Welcome Bay land disposal option requires 200 hectares of afforested area for land disposal of treated effluent.

The catchment extends from the Kaitemako Stream in the west to the Waitoa Stream in the east and is heavily dissected by some seven stream systems discharging directly to Welcome Bay. The area required is 12 percent of the catchment area, and will be difficult to site appropriately because of the dissected nature of the land form.

Considerable development has occurred in the lower reaches of the catchment. This is stretching into the hinterland up the roads which traverse up the valleys to the intermediate and higher levels of the catchment. There are a considerable number of historic Maori pa in the intermediate levels of the catchment – no less than 13 in the area of interest.

A forest area of the size required would probably have to be sited up towards the 100 metre contour line. It would be a dominant feature in the catchment.

The upper area of the Kaitemako Stream Valley would appear to be a possible suitable site.

## 2.2 Likely Performance

The soils of the site are predominately consolidated ash of volcanic origin, relatively free draining but subject to scour with high runoff over heavily sloping areas.

With the conservative application rates proposed for effluent spray irrigation onto the afforested area, little acceleration of erosion is expected.

The afforested areas would have to be developed from scratch and it would be a considerable time before irrigation could begin as not only does the initial stage of the forest have to be planted but some three to five years' growth should be established before irrigation commences.

## 2.3 Overview

An afforested area of the size required for the Welcome Bay development, although minor relative to serving the overall region, would be difficult to site without conflict with development which has already occurred within the catchment.

This is the main reservation relative to the proposal.

Functionally, the proposal would be satisfactory, although interim provisions of some duration are required before the scheme could be commissioned.

Financially, the scheme is not competitive with other options, as has been pointed out in the body of the report. This is confirmed by the inspections carried out as part of this review.

### 3. Papamoa Option

#### 3. Physical Inspection

The Papamoa area is an extensive coastal plain extending from Bay Park Raceway at Mount Maunganui to the Kaituna River and inland to Te Puke.

Because of its extent, an aerial inspection of the area was undertaken as part of this review of land disposal options.

#### 3.2 Soil Types and Drainage Characteristics

The coastal plain area is essentially sandy with peat and organic humic topsoil material in many places. Where undeveloped, longshore dune undulations are still clearly evident.

The organic topsoil and pronounced flatness of the area make it extremely poor draining and there are extensive swampy areas, particularly immediately inland of the coastal residential development.

There are extensive canal and drain systems in the area, aimed at improving surface drainage.

#### 3.3 Sub-area Drainage Patterns

The area was reviewed, sub-area by sub-area, for suitability for land disposal of effluent by spray irrigation to possible afforested areas.

##### 1) Bay Park – Mangatawa

Unsuited because of development

##### 2) Mangatawa – Domain Road

Unsuited because of potential for development

##### 3) Domain Road – Parton Road

Coastal area developed. Area behind development unsuitable because of swampy, poorly drained area. Rear of Tara Road too limited in extent. Hills to rear have numerous Maori pa.

##### 4) Parton Road – Kaituna River

Extensive coastal development to rear of which is swampy, poorly drained ground. Beyond to Bell Road has potential for development. Beyond Bell Road flat and poorly drained with man-made drainage improvements.

### 3.4 Drainage Difficulties Experienced

The Parkdale and Beachgrove subdivisions in sub-areas (1) and (2) above have experience difficulties in disposal of treated effluent from package sewage treatment plants.

These difficulties were so troublesome that relief was necessary and the effluent was transferred to the Mount Maunganui oxidation ponds.

### 3.5 Future Urban Development Plan

The population growth potential of the Papamoa area is such that any area of land dedicated to effluent disposal must be a considerable distance from this coastal development.

The flat areas beyond coastal development are unsuited because of drainage characteristics.

The hill country behind Papamoa is too limited in suitable areas to provide for any comprehensive land disposal scheme. It could probably cater for the Papamoa development only, for which some 200 hectares would be required to dispose of a daily effluent loading of 13 000 cubic metres per day.

## 4. Existing Schemes

### 4.1 Schemes Inspected

As part of this review of land disposal options, a number of operational land disposal systems were inspected by members of the Sewerage Liaison Committee.

Schemes inspected were:

- . Paraparaumu : Overland flow
- . Levin : Spray Irrigation
- . Waitarere : Spray Irrigation
- . Otaki : Overland flow
- . Waikanae : Spray Irrigation

Brief notes on the operation of these schemes follow.

### 4.2 Paraparaumu

Effluent from an activated sludge plant serving a population of 15 000 persons is discharged to a two-stage overland flow system.

The first stage consists of 1.2 hectares of grassland flooded daily at a loading rate of 840 mm/day. The second stage of 3 hectares of grassed overland flow plot is designed to receive 350 mm of effluent per day.

Both the overland flow plots were experiencing considerable direct short circuiting with effluent following defined preferential streams and presumably achieving little treatment.

Effluent from the grass plot irrigation had such pronounced 'streaming' that considerable erosion to the edge of the final effluent ditch was occurring.

A number of trial constructed wetlands have been established as well as one operational constructed wetland. At present less than ten percent of the total flow is passed through these wetlands prior to discharge.

#### 4.3 Levin

Effluent from a trickling filter plant serving a population of 15 000 persons is pumped to a once dry natural depression in sand hill country to the west of Levin called 'The Pot' for storage, and thence pumped through a reticulated pipework system and spray irrigated onto an especially planted 80 hectare pinus radiata plantation.

The scheme has stabilised the sand dune country surrounding The Pot and reduced nutrient run off to Lake Horowhenua, the former effluent disposal point. Although sewage origin nutrients to the lake have been eliminated, dairy farm pollution and other natural nutrient runoff is such that no marked improvement to Lake Horowhenua has been effected.

Problems were experienced with initial tree growth and tree establishment to date is still patchy but growth is consolidating.

The Levin effluent disposal scheme won the Institution of Professional Engineers 1990 Environmental Award as unique in its use of effluent irrigation for forest establishment on previously unproductive land.

#### 4.4 Waitarere

Effluent from an oxidation ditch treatment plant serving a population of approximately 1500 persons is spray irrigated to an adjacent pinus radiata forest. The application area is divided into 7 blocks, each block sprayed once weekly. The design application rate is 75 mm per week.



This is slightly higher than that proposed for Matakana, but the Waitarere forest is substantially more mature. To date the Waitarere application rate has not exceeded 15 mm per week and is generally even less than this. Groundwater level is 3 metres below the ground. The scheme operators consider this marginal but unlikely to moist stress the trees.

Irrigation has increased tree girth and foliage but seemingly has had no effect on height.

The sand dunes in this forest are deficient in nitrogen and this extra growth is attributed to the nitrogen in the effluent.

#### 4.5 Otaki

Oxidation pond effluent is discharged to grassed overland flow paddocks before soaking into coarse alluvium of the Otaki River.

Again, the uniformity and effectiveness of this type of overland treatment was not impressive, the overland flow areas being untidy and unkept and the distribution of flow far from uniform.

#### 4.6 Waikanae

Oxidation pond effluent is spray irrigated to grassed areas with sparse *pinus radiata* tree planting. The relatively open grassed areas presented a neat mown appearance but the tree specimens were very poor and of distorted shape – possibly "nitrogen speed wobbles", as the effects of excess nutrient application is sometimes called, or possibly due to the very high irrigation etc.

Disposal at this plant was satisfactory although additional spray irrigation area is required.

### 5. Proposed Rotorua Effluent Disposal

Because of the similarity of the Rotorua land treatment system to the land disposal methods discussed for the Tauranga area, there was particular interest in inspecting this system.

#### 5.1 Scheme Outline

Effluent from the Rotorua Bardenpho advanced wastewater treatment plant is pumped to storage ponds in the Whakarewarewa Forest. From the storage ponds it is spray irrigated to the forest area.

Emergent groundwater and any residual run off is directed through wetland areas before flowing to the Waipa and Puarenga streams which discharge into Lake Rotorua. The system is designed to cater for a population of 75 000 persons and an average flow of 27 000m<sup>3</sup> per day.

The effluent from the Bardenpho plant has received tertiary treatment, removing some 80 per cent of the nitrogen and phosphorus from the raw wastewater. The plant effluent has approximately 8 g/m<sup>3</sup> nitrogen and less than 2 g/m<sup>3</sup> phosphorus.

## 5.2 System Layout

The spray irrigation system occupies an area of some 300 hectares, and effluent is applied at a maximum loading of 80 mm/week, this dosing applied one day in seven.

The effluent is pumped from the storage ponds through an under-ground pipework header system and distributed to the spray irrigators by above-ground pipework. There are 100 kilometres of above ground pipework and 80 kilometers of underground pipes.

## 5.3 Function of Land Treatment

The process utilised for phosphorus removal, following the in-plant biological reduction, are crop uptake and adsorption to clay minerals in the soil. Those for nitrogen, following in-plant reduction, are crop uptake and denitrification in the forest floor and in the wetland areas.

Phosphorus adsorption is dependent on the presence of alophane or high valency aluminium ions commonly present in clay soils, these ions attaching to the phosphorus ions.

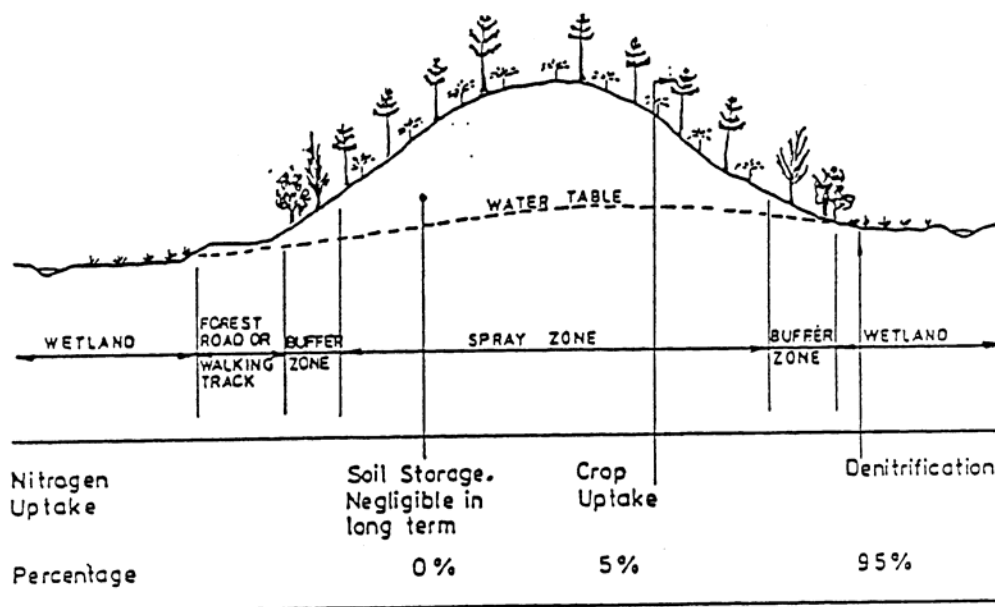
Nitrogen reduction is dependent on its being released as a gas to the atmosphere. Nitrogen in sewage is in the form of nitrates which are denitrified in anaerobic or anoxic (oxygen deficient) conditions, progressively to nitrites and then nitrogen gas.

Only a little of the nitrogen available in sewage effluent is taken up by the tree crop and the anoxic zones in wetlands are an essential component of the nutrient removal system in land treatment.



Furthermore, there is a limit to the amount of nitrogen which can be applied to an afforested land disposal system. *Pinus radiata* are not a good crop choice for nitrogen removal. Estimates for annual nitrogen uptake range from 40 kg/hectare for a sawlog crop of radiata pine to 140 kg/hectare for an energy crop of eucalyptus. Some grasses have an annual nitrogen uptake capability of 600-800 kg/hectare.

These processes and the percent of nitrogen uptake in the land treatment process are shown in Figure C-2.



**Figure C-2 Nitrogen Uptake Mechanisms**

#### 5.4 Forest Management

The district council neither owns nor leases the forest area used for irrigation, but has an easement or 'right to occupy', the forest owner still working all the forest.

This has led to conflicts in some aspects of irrigation management. This is seen as a long term problem. An example is the lack of preservation of a buffer zone of undisturbed native bush adjacent to roads or walkways through the forest to which the public has access. The buffer zones are essential because the effluent sprayed to the forest has not been disinfected and consequently is not bacteria free.

#### 5.5 Operation and Maintenance of System

The extended reticulation system for the spray irrigation is seen by the district council staff as a very difficult and expensive operation and one not without its dangers to personnel working, often alone, in the dense bush.

The renovation of the Rotorua Sewage Treatment Plant and the introduction of the Bardenpho extensions for nutrient reduction cost \$18m and the land treatment component cost \$17m. The total asset value, including pipeline from plant to the forest etc, is \$60m.

Operating costs for the system are quite high. Apart from the cost of pumping to the storage ponds, the power charges for the spray irrigation distribution pumping alone will amount to \$700 000 per year. This is very high – the total 1989 operational budget for the Tauranga Chapel Street sewage treatment plant was \$840 000. At Rotorua, in addition, a very expensive monitoring programme for wetland surveillance is required.

#### 5.6 Long Term Acceptance

At the time of inspection the land treatment system had not come into operation, the works nearing completion.

There is currently great enthusiasm for the project, but it is difficult to accept that it will receive the long term community support necessary to maintain the higher level of funding necessary for proper performance of the system over its 40 year life span.

## 6. Conclusions

### 6.1 Overview of Schemes Inspected

Observations can be summarised as:

- . Land treatment or disposal schemes involving overland flow are not managed acceptably.
- . Spray irrigation is the only system of effluent application to the land worth considering for large scale operation.
- . Forest irrigation has limits as to nitrogen application.
- . Pinus radiata trees are a poor crop for nitrogen uptake.
- . Wetlands, with anoxic denitrification, are an essential component of land treatment for the reduction of nutrient discharge to receiving waters.
- . Forest spray irrigation is a costly method of treatment.

### 6.2 Matakana Island

The salient points are:

- . Ground water level is close to surface but probably there would be no substantial rise with spray irrigation limited to 60 mm per week.
- . Bacterial levels would be dramatically reduced during passage of effluent through the soil. Shellfishing standards would probably be achieved at the shoreline of harbour and sea. Disinfection would be required if public access is permitted to spray irrigated areas.
- . Nutrients would flow through the subsoil relatively unimpeded and discharge into marine waters.
- . The groundwater profile is such that excess flow and nutrients would discharge equally to harbour and ocean.
- . The level land profile and lack of natural waterways on the island make capture of seepage and reduction of nitrogen in wetlands impracticable.

- . The nutrient loadings from the Tauranga Chapel Street plant reach 950kg per day at ultimate design. Applied to 300 hectares, this is 1160 kg per hectare per year compared with 262 kg per hectare applied at Rotorua where limitations on nitrogen application dictated the use of advanced nutrient removal treatment. Without the benefit of denitrification, an area in excess of 8000 hectares would be required to restrict nitrogen levels to the desirable 40 kg per hectare per year.
- . While substantial denitrification would occur in the ground, the nitrogen loadings applied would result in nutrient discharge to harbour and coastal waters.
- . Even restricting the treatment and disposal area to 300 hectares as proposed, the cost of an integrated scheme involving land disposal on Matakana Island is very considerable and attracts particularly high operating costs.

#### 6.3 Welcome Bay

- . The catchment configuration and degree of development make appropriate siting of a land treatment and disposal scheme, even sized only for Welcome Bay, very difficult.
- . Considerable time is required for establishment of a forest prior to use for disposal.
- . This option is not cost effective compared with treatment of these local wastes at Mount Maunganui.

#### 6.4 Papamoa

- . The land is generally low lying, flat and poorly draining.
- . No suitable site for large scale land treatment and disposal system was identified.

#### 6.5 Purpose of Land Treatment

- . The essential difference between the Rotorua and Levin (or Matakana) schemes is that the Rotorua scheme is a land treatment system, meeting a requirement to minimise or eliminate nutrient discharge to Lake Rotorua. The land area is sized to lock up phosphorus in the clay fraction of the soils for 100 years and to prevent nitrogen escaping from the catchment by the use of denitrifying wetlands.

- . The Levin scheme is an effluent land disposal scheme. It disposes of effluent in as great volumes as is practicable in an area where transmission to waters sensitive to eutrophication is minimised because of distance; although, at the same time it does this in a way beneficial to soil stability and tree crop production.
- . The Matakana Island scheme also would provide for disposal rather than treatment, and would not meet any aspirations to prevent nutrient discharge to Tauranga Harbour.

#### 6.6 General

- . While Matakana Island offers the best opportunity for land disposal of treated effluent from the Tauranga area, it must be recognised that land treatment offers little or no benefit in terms of crop improvement or nutrient reduction to the harbour.
- . Land disposal has a very serious cost disadvantage compared to other options. The total cost of the strategy involving land disposal was not brought out in the earlier edition of this report, so excessive was it. The cheapest combination of this form of treatment and disposal is \$61.5m. This scheme involved forest irrigation of approximately one-third of the region's waste on Matakana Island, with two-thirds discharged by outfall off Mount Maunganui.
- . The cost of land disposal for all wastewater from the study area is \$100m-\$120m. This can be compared with \$45.3m for the scheme discharging all wastes by outfall off Mount Maunganui.