VALUING THE BENEFITS OF A SMALL COMMUNITY SEWERAGE SYSTEM IN THE COASTAL ENVIRONMENT

A Thesis submitted in partial fulfilment of the requirements
for the Degree of Masters of Applied Economics
at Massey University
New Zealand

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1999

Abstract

A community sewerage system is a public good which society derives a wide range of benefits from. Because a community sewerage system is a public good, it is normally provided under the direction and control of a local authority. A local authority contemplating providing a community sewerage system in a small coastal community, must consider whether the welfare of the community will increase as a result. To do this it needs to consider the total economic costs and benefits that the community might incur or gain from building a small community sewerage system. In the coastal environment the value of many of the benefits a community sewerage system would provide can not be observed in commercial markets.

This research aimed to provide local authority decision-makers with a way to value the benefits of a small community sewerage system in the coastal environment. To achieve this the contingent valuation method was used in the form of a mail questionnaire with specific reference to the circumstances of small coastal communities. Application of the questionnaire was illustrated using three small New Zealand coastal communities, Russell, Tapeka and Horeke. The questionnaire was mailed to households and businesses in these communities to solicit their willingness to pay for the benefits of a proposed community sewerage system. An average return rate of 50% was obtained.

The information and results obtained from the questionnaires showed that they can provide valuable information. In particular, information for a decision-maker wishing to determine if community sewerage is economically efficient in a small coastal community. The average value per fortnight that respondents from Russell, Tapeka, and Horeke placed on the benefits of a community sewerage system was $16.60, $15.97 and $9.75 respectively. For each community, the average value was not sufficient to cover the cost of the proposed community sewerage system. Nevertheless, the authority managing the sewerage issues in Russell, Tapeka, and Horeke gained beneficial insights to adopt the best plan of action for sewerage in each community.

Acknowledgements

May I acknowledge the following people for helping to make this thesis a reality:

Professor A.D.Meister and Dr. R.R.Alexander at the Department of Applied and International Economics, Massey University, for their supervision and guidance.

The New Zealand Counties Trust for their financial assistance.

The Far North District Council for their financial assistance and practical support.

My friends and colleagues for their support and assistance in the research.

My family, especially my mother and father for their assistance, tolerance and understanding during the duration of this research.

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1 The New Zealand Scene

1.0 Introduction

One of the most significant risks to New Zealand's coastal environment is inadequate sewage disposal. New Zealand has hundreds of communities scattered along a coastline spanning some 5,650 kilometres. Many of these communities are relatively small, and exist with very little of the public infrastructure found in larger centres. Sewage disposal has traditionally been provided for through on-site systems such as septic tanks.

Until recent decades this was acceptable because these communities usually had a very low impact on the coastal environment. In addition, few people perceived the risk of detrimental sewage effects in the coastal environment to be high. However, as the assimilative capacity of some coastal environments was exceeded due to the cumulative impact of bigger populations, people began to both see and perceive the risk of significant environmental deterioration.

Along with this, New Zealanders, because of greater discretionary income and increased environmental consciousness started to place a high value on both the tangible and intangible aspects of a clean natural environment. This is now expressed in New Zealand's environmental legislation, principally the Resource Management Act (1991). The Act has effectively placed an environmental bottom line on the use of natural resources. It has done this by requiring that they be managed in a sustainable way.

Recent New Zealand governments have adopted the principles of efficiency and user pays into a broad range of legislation. These principals underlie the major alterations made to New Zealand's welfare system and the services central government provides. The government considerably reduced its involvement in the economy, particularly through reducing its provision of 'private sector' services. In the case of sewage disposal, central government no longer subsidises the building of treatment plants. The user or community is now faced with fully financing the plant whenever such a system is required.

The increased preference by the New Zealand society for a quality coastal environment, and the reduced involvement by government in the provision of infrastructure services, have

resulted in some small coastal communities facing a large financial burden to obtain adequate sewage disposal[1]. In these communities often the only adequate way to dispose of sewage is by using community or reticulated infrastructure[2].

The purpose of this research is to provide decision-makers with a methodology that gains information to help them determine whether community sewerage is worthwhile for a small coastal community. The objectives of the research in providing this methodology are:

1. to obtain an accurate indication of a given community's value for a community sewerage system,
2. to provide information to determine the most significant factors influencing this value, and
3. to gain information on the perceived and current consequences of poor sewage disposal in the coastal community.

In meeting these objectives it is hoped that the research will fill a gap in knowledge at the local decision-making level. Application of the methodology will be demonstrated through two case studies. These are Russell (together with Tapeka) in the Bay of Islands, and Horeke in Hokianga Harbour. A brief outline of each community and the obstacles it faces to gain adequate sewerage, is provided below.

1.1 Case Studies

1.1.1 Russell

Once the capital of New Zealand and a thriving centre of whaling trade, Russell is now the hub of tourism activity in the Bay of Islands. A small community of approximately 450 ratepayers, and geographically isolated from main service and industrial centres, Russell is reliant on tourism for its economic support.

Situated on a hilly peninsula, Russell's elevated areas typically have impermeable soils that become easily saturated. They are therefore unsuitable for treating effluent from septic

[1] Adequate sewage disposal is the treatment and disposal of sewage to eliminate both the occurrence and potential for adverse ecological and health effects.
[2] Reticulated sewerage is the collection of sewage by a network of interconnected pipes for treatment and disposal at a single location. In this thesis reticulated sewerage and community sewerage will be treated as one in the same.

tanks. Its low lying areas have more permeable soils but also a high water table allowing the effluent to be quickly transmitted to the sea.

For over a decade it has been identified that Russell is in need of reticulated sewerage. This is because the conditions necessary for on-site systems to function well are not present in Russell. With the amalgamation of many of the former territorial authorities in Northland, the Far North District Council inherited the problem of providing such a system. The council's solution was a tertiary treatment system that would service both Russell and its neighbour, Tapeka Point.

In 1995 the council's discharge permit to discharge treated effluent into a natural wetland in Te Uruti Bay was appealed by Te Runanga O Taumarere. The appeal to the Planning Tribunal against the Northland Regional Council, who granted the discharge permit, was primarily based on the grounds that the discharge would be spiritually and culturally insensitive to the Ngaphui tribe. The appellants' case was that disposal of the treated effluent to deep bores was a feasible option that had not been properly investigated.

The Tribunal held that a lack of sufficient consideration of the alternative deep bore option, meant that the application for the discharge permit by the Far North District Council failed on a number of statutory instruments. On the evidence presented, the Tribunal did not grant the discharge permit. However, it conceded that if further investigations were made into the ground disposal option, and it was not found to be feasible, the Council would be allowed to complete the presentation of its case before the Tribunal. At the time of writing, the council is testing how physically feasible this option would be. A goal of this research is to help determine if it is economically efficient.

1.1.2 Horeke

Horeke is a very small community situated on the south side of Waihou estuary in the upper reaches of Hokianga harbour. The community is reasonably isolated with a large proportion of retirees and beneficiaries, and no dominant economic activity.

A large proportion of the community is located on low-lying ground adjacent to the coast. Here the soakage capacity of the natural soils is very limited, and the groundwater table is

normally very high. Due to the community's geographic location individual on-site sewerage systems can not provide quality sewage disposal and treatment.

Technical engineering studies have been conducted on the various options for providing the community with a fully reticulated tertiary sewerage system. This system would remove virtually all the adverse effects and possible risks associated with individual on-site systems. One of the goals of this research is to determine if a reticulated system would be economically efficient in Horeke.

1.2 New Zealand Legislation

New Zealand legislation that has an influence on the provision and extent of sewage disposal is contained in, and stems from, three different Acts. They include the Resource Management Act (1991), the Health Act (1956) and the Local Government Act (1989). These Acts and their supporting attachments reflect the broad nature of reducing the adverse effects of sewage, and providing for sewerage services.

The section begins by examining New Zealand's environmental law as it currently stands in respect to sewage disposal. This includes an investigation of the Resource Management Act and how it has been interpreted. The major reform of New Zealand legislation in the late 1980's and early 1990's, led to Maori cultural values, customs and attitudes being recognised and embraced much more than they had been in the past. An overview will be given on how these cultural values have been incorporated in New Zealand's environmental law. After this, the sewage disposal requirements of the Health Act will be considered. The section concludes with an examination of how the Local Government Act influences the provision of sewage disposal.

1.2.1 The Resource Management Act 1991

In New Zealand the primary legislation that controls the environmental effects of sewage disposal is the Resource Management Act (RMA) (Local Government NZ, 1997). Its purpose is to promote sustainable management in a way that treats all activities impartially. The RMA is based on controlling the "effects" of activities, not the actual activities themselves. "What the effects are, and their relative importance, is determined through

weighing up the collective values that society holds for the environment" (Local Government NZ, 1997: 13). Part II of the Act sets out its purpose and principles.

PART II
Purpose and Principles

5. Purpose – (1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while–

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonable forseeable needs of future generations; and
(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
(c) Avoiding, remedying, or mitigating any adverse effects on the environment.

(Resource Management Act, 1991: section 5)

Although the purpose of the RMA is the focus of New Zealand's environmental law, there has been some considerable debate over the interpretation of the word 'while' before sub-clauses (a), (b) and (c). The emphasis on natural and physical resources in section 5(1) suggests that the Act be primarily of ecological orientation. However, it is not clear whether the word 'while' was intended as a co-ordinating conjunction or a subordinating conjunction (Harris, 1995). In other words, must the matters in s5(2)(a), (b) and (c) be balanced against the use and development of natural and physical resources, or are the matters in s5(2)(a), (b) and (c) non-negotiable environmental bottom lines which act as constraints on the use and development of resources.

It was basically left up to the Courts to decide on which interpretation was correct. The most monumental case to date on this issue (Proposed New Zealand Coastal Policy Statement – Memorandum (1993) 3 NZPTD 109) has added significant weight to the latter interpretation.

> ". . . we believe that in its context, the word 'while' in Subsection (2) means "and at the same time", "and contemporaneously", "so long as management is". In other words, subsection (2) does not call for a balance to be struck between 2 objectives; it requires that management of natural and physical resources be carried out in a way which achieves the objectives (applies the constraint) specified in (a), (b) and (c).
>
> . . . section 5 indicates that the purpose of the Act is to ensure that 'natural and physical resources' are managed so that ' people and communities' may provide for their 'social, economic and cultural

> well-being' ... 'and for their health and safety'. This purpose however is not fulfilled in a way that makes unattainable the objectives specified in clauses (a), (b) and (c)..." (Proposed New Zealand Coastal Policy Statement Board of Inquiry, 1993)

In referring to the definition of "sustainable management" the Board of Inquiry concluded that:

> ". . . the true interpretation of section 5 does not allow the definition of the term to be broken up into a number of separate 'Principles'. The definition of that term must be taken as a whole" (Proposed New Zealand Coastal Policy Statement Board of Inquiry, 1993).

If this interpretation is accepted there still remain a number of subjective issues. To begin with, who should decide where an environmental bottom-line "lies" and what constitutes its make up? These decisions are often highly subjective. The RMA definition of the environment is not limited to the natural environment[3] (Williams, 1997). It includes "social, economic, aesthetic, and cultural conditions" and "amenity values". How much of an influence should these factors have on where the bottom line is set? Given these factors, what is a reasonable margin to allow for error?

Further, the term "sustainable" means neither priority for use and development nor priority for protection (Williams, 1997). Even if the decision maker is able to determine where the "environmental bottom line" should lie, the subjective decision on what level of protection to afford the resource, and therefore what level of use and development is desirable, still has to be made. In relation to s5(2)(b) the question is one of degree (Williams, 1997). With any activity there is always a reduction in life supporting capacity. A localised reduction in life supporting capacity may be on a small enough scale that there is no reduction in the ability of the wider environment to sustain life.

"The application of s5(2)(c) allows the decision maker a statutory discretion to choose between "avoiding" or "mitigating" an adverse effect on the environment" (Williams, 1997: 76). "The expression "avoid, remedy or mitigate" implies that an activity may be permitted even if it has an adverse effect on the environment" (Williams, 1997: 81). It is logical to interpret the Act as placing greater emphasis on avoiding adverse effects. Still the concept of "best practical option"[4] to prevent or minimise the adverse effects, requires consideration of cost and technical knowledge. Thus, the decision-maker may need to exercise some

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[3] The RMA definition is in appendix one.
[4] The definition of "Best Practical Option" is in appendix one.

judgement and discretion. This could involve comparing socio-economic effects against natural environmental effects.

An example of the need to exercise some discretion is provided in the case (Trio Holdings v Marlborough District Council (1996) 2 ELRNZ 353). The case refers to s6(a) of the Act – recognising and providing for the natural character of the coastal environment.

> "The natural character of the coastal environment is not to be protected at all costs – but to be protected in terms of sustainable management. ... "Recognise and provide for" is not an absolute imperative overriding other objectives of the Act" (Judge Kenderdine, 1996).

A proposal that would deliver fewer environmental effects is likely to have economic consequences. These have to be considered. This is seen in the water classifications standards case (Minister of Conservation v Gisborne District Council (1991) 1&2 NZPTD 198), where appeals for higher water classification standards were dismissed largely because of economic reasons.

> "It would be wrong to reject the Council's frank and compelling evidence, based on cost and financial hardship, and simply proceed to endorse a higher classification in the clear and certain knowledge that it would not, and could not, be met" (Judge Bollard, 1991).

Still, economic effects are only considered to the extent that they affect the community at large, not individuals[5].

In relation to sewage disposal in small coastal communities, it is clear that the purpose of the Act suggests that each problem must be assessed on a case by case basis. While in ideal situations the RMA indicates that adverse effects should be avoided altogether, it is obvious that some discretion is involved. This is especially in the cases where practicality and cost are significant issues. Support for this reasoning is also found in later sections of the Act, especially s32 (Duties to consider alternatives, assess benefits and costs).

The remaining sections of Part II, s6, s7 and s8, give further meaning to the clauses (a), (b) and (c) found in s5(2). The conjunctions between the opening paragraph and the matters that follow indicate the relative weight of each (Proposed New Zealand Coastal Policy

[5] This is seen in the case (Marlborough Ridge Limited v Marlborough District Council (1997) NZRMA 73).

Statement Board of Inquiry, 1993). That is, "recognise and provide for", "have particular regard to" and "take into account" imply a decreasing order of importance.

Two other sections of the RMA are of specific interest when considering sewage disposal in the coastal environment. These are sections 15 and 107. Each is presented in appendix one. Both relate to the discharge of contaminants. In regard to sewage wastewater, section 15 prevents the discharge of the wastewater into other water, and into or onto land where it could enter other water. The only exception to this is where the discharge is explicitly allowed by regulation, a rule in a regional plan, or a resource consent. Section 107(1) restricts the granting of discharge or coastal permits to situations where there is no:

(a) production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials
(b) conspicuous change in colour or visual clarity
(c) emission of objectionable odour
(d) rendering of fresh water unsuitable for drinking by farm animals
(e) significant adverse effects on aquatic life

Only under exceptional circumstances does section 107(2) permit a consent authority to grant a discharge permit that allows some of these effects, or contravenes section 15.

Another piece of relevant legislation that comes under the RMA's umbrella is the New Zealand Coastal Policy Statement (NZCPS). Stemming from section 56 of the RMA, it was prepared by the Minister of Conservation and issued in 1994. Chapter 5 of the statement – The Matters To Be Included In Any Or All Regional Coastal Plans ..., contains policies that specifically refer to sewage disposal[6]. Of particular relevance to this research, policy 5.1.2 requires that rules should favour the discharge of sewage to land, and make the discharge of sewage to water the exception.

Regional Councils carry out the formulation of these rules. It is mandatory for Regional Councils to prepare regional coastal plans under s64(1) of the RMA (Milne, 1993). This devolution of decision making to local authorities is an important feature of the RMA. Regional councils are responsible for managing the effects of contaminant discharges to water, land and air s30(f). Under the RMA, territorial authorities are responsible for

[6] These policies are presented in appendix two.

determining whether the use of an area of land for sewage disposal, is an appropriate use of that land, s31(b).

The two communities that are the case studies for this research come under the jurisdiction of the Northland Regional Council and the Far North District Council. In their Proposed Regional Coastal Plan for Northland, the Northland Regional Council states that one of the main threats to the maintenance and enhancement of coastal water quality is the discharge of contaminants into it. Amongst other things, the council specifically mentions discharges from sewage treatment plants and seepage from septic tanks (Northland Regional Council, 1994). The Council has made the discharge of treated effluent to coastal water from land-based wastewater treatment plants a discretionary activity[7]. A coastal permit must be obtained to carry out this activity. The discharge of human sewage into the coastal marine area, which has not passed through soil or a wetland, is a restricted coastal activity. This is consistent with the National Coastal Policy Statement[8]. The Council must process an application for a permit that would allow such an activity, but the consent granting authority is the Minister of Conservation.

1.2.2 The Influence of Maori Cultural Values

Before the legal initiatives of the previous decade, Maori cultural values, customs, and attitudes were given very little recognition in resource management and use. This was contrary to the principles of the Treaty of Waitangi, signed by over 500 Maori chiefs and Governor Hobson in 1835.

For the terms of the Treaty to be legally enforceable, they have to be incorporated in domestic law through statute. Until the previous decade no such statutes existed. Even though the Treaty promised Maori protection for their 'lands, estates, forests and fisheries', they were not able to assert their rights in New Zealand courts, whether under the Treaty or as customary rights. As the Treaty is a treaty of cession, these rights should have been legally enforceable. In the 1980's, observing the decisions made by the International Court of Justice, Canadian Courts, and the US Supreme Court, the New Zealand government started to prepare statutes to make Treaty rights enforceable.

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[7] See Proposed Regional Coastal Policy Statement for Northland in appendix three.
[8] See schedule 1.10 of the NZCPS in appendix two.

The State Owned Enterprises Act (1986) contains one of the most forceful enactments of the Treaty into statutory law (Milne, 1993). Section 9 of the Act states that "nothing in this Act shall permit the Crown to act in a manner that is inconsistent with the principles of the Treaty of Waitangi". The Court of Appeal has said that the phrase, "principles of the Treaty", implies a relationship of partnership between the Crown and Maori. This principle requires that the Crown and Maori act towards each other in good faith, and that they recognise the partnership may not always be equal.

Other significant principles of the Treaty of Waitangi have come from the Waitangi Tribunal (1975) as well as the Courts. They include the principle of "active protection" and the principle of "consultation". The former has been interpreted as the active protection of the authority of Maori people to use their lands, waters, homes, and things important to them, to the fullest extent possible. This relates to the principle of "rangatiratanga" (translated as "authority" or sometimes "sovereignty"). Unfortunately the Treaty obligations of the Crown and its conservation objectives can come into conflict (Milne, 1993). In cases such as this, the Waitangi Tribunal has taken the view that the Crown's "kawanatanga" (right to govern) under Article I of the Treaty, can override the principle of "rangatiratanga" present in Article II.

The principle of "consultation" implies just what it says; the Crown must consult Maori over issues that affect them. Although the Court of Appeal has refrained from specifying that the Crown must always consult with Maori, it is generally agreed that some consultation will be necessary, with the context determining how much.

The principles of the Treaty of Waitangi are an integral part of achieving the statutory purpose of the Resource Management Act (Williams, 1997). With the introduction of the RMA came new statutory requirements to take into account Maori interests in resource management. Decision-makers now have statutory obligations to develop consultative relationships with hapu or iwi[9] (Milne, 1993). A key result of Part II of the RMA is that all persons exercising functions and powers under the Act have a duty to:

[9] Hapu means a section of a large tribe, a clan, or secondary tribe.
Iwi means a Maori nation.

- as a matter of national importance, "recognise and provide" for the relationship of Maori to their ancestral lands, water, sites, waahi tapu and other taonga (treasures)[10] – section 6(e)
- have "particular regard" to kaitiakitanga (guardianship of resources) – section 7(a)
- "take into account" the principles of the Treaty of Waitangi – section 8

In addition to the above, when preparing or changing district plans or regional plans and policies, all local authorities have a duty to:

- "consult" with tangata whenua[11] (First Schedule, Part I, 3(d))
- "have regard" to any relevant planning document of an iwi authority (sections 61(2), 66(2) & 74(2))[12].

(Milne, 1993)

From these sections of the RMA it is no doubt evident that the obligation to take into account the principles of the Treaty of Waitangi extends to all levels of government. That is, to ministers of the Crown, regional and territorial authorities (Williams, 1997).

Another prominent feature of the RMA is the concern for Maori culture, traditions and values, quite apart form Treaty of Waitangi obligations. This is evidenced by the relationship between sections 8 and 6(e) of the Act. Section 6(e) is not confined to the interests of Maori and the Crown as Treaty partners (Williams, 1997). The relationship of Maori with their ancestral lands, water, sites, waahi tapu (land of special spiritual, cultural or historical significance) and other taonga (treasures) are matters of national importance regardless of the Treaty of Waitangi.

The culture and beliefs of Maori mean that they have an immense distaste for any association of human waste with water and food resources. This includes human waste treated to a high technical standard. By law, in particular through the RMA, these values must be taken into account in considering sewage disposal options. Thus, if Maori choose to do so, they can have a significant influence on the standard and type of sewage disposal in small coastal communities.

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[10] See Policy 1.1.3 in the NZCPS in appendix two.
[11] Tangata Whenua, in relation to a particular area, means the iwi or hapu that hold customary authority over that area.
[12] These sections are presented in appendix one.

1.2.3 Health Act 1956

Until the 1970's health issues were the primary reason for requiring good sewage treatment and disposal. In New Zealand, the Health Act 1956 makes local authorities responsible for managing the health aspects of sewerage systems (Local Government NZ, 1997).

Section 23 of the Act gives local authorities general powers and duties in respect to public health. These duties include inspecting for and mitigating nuisances or other problems likely to be detrimental to good health. Section 29 of the Act states that nuisances can include all parts of a private or community sanitary system.

These powers and duties are the motivating force to take action where individual sewerage systems and community infrastructure are failing to meet health requirements. However, there is a lack of forceful sanction in this area. In reality these powers and duties play a secondary role in any decision to upgrade the sewerage system(s) of a community (Local Government NZ, 1997).

While section 27A of the Health Act allows the Minister of Health to contribute to the cost of providing sewerage systems, at the present time the Ministry considers that its funds are best spent in other areas. Officials at the Ministry of Health consider that environmental concerns are now the main reason for the standard of treatment and disposal being sought (Local Government NZ, 1997). As the benefits of different treatment and disposal standards are hard to establish, and diseases associated with sewage can result from means other than by contact with sewage, central government subsidisation of sewerage schemes now seems to be a thing of the past.

1.2.4 The Local Government Act 1974

All households require some sort of sewage treatment and disposal service. Whether the resources used to provide these services are private or public, they are not free. There is a cost incurred to obtain them, and this cost must be financed. The Local Government Act (LGA), specifically Part VIIA, sets out funding policy processes that local authorities must follow when determining how to fund a community sewerage system.

Like the RMA, the LGA is based on the user/polluter pays principle.

> "The principle that the costs of any expenditure to control the negative effects that are contributed to by the actions or inaction of any persons or categories of persons should be allocated to those persons, or category of persons, in a way that matches the extent to which they contribute to that expenditure" (LGA, 1974: section 122F(d))

Technically, the council concerned must justify any departure from section 122F(d).

Under the Rating Powers Act 1988, the sewerage charging mechanism a local authority uses is limited to one of five. It could be:

- part of the general rates;
- part of a uniform annual general charge;
- a separate rate for sewerage;
- a separate uniform annual charge for sewerage; or
- a straight sewerage charge.

The incidence and nature of these charges are outlined in appendix four. Most councils have favoured either a uniform annual charge or a separate sewerage rate across all users connected to the community system (Local Government NZ, 1997).

None of these approaches are entirely consistent with the funding principles of the LGA. Uniform charges or rates can be varied according to the general user, for example charging households a different rate to commercial enterprises, but this is hardly a fair or practical method for meeting the requirements of section 122F. Furthermore, in small coastal communities where most users are households or small businesses, uniform charges or rates may not be very effective in distinguishing the burden different users place on the system.

Unfortunately no law currently exists enabling local authorities to charge according to effluent volume (Local Government NZ, 1997). Under the Rating Powers Act local authorities are unable to charge according to actual usage. If this Act truly restricts the options available for funding and providing sewerage services, it would seem to be contradictory to section 122F(d) of the LGA.

Anecdotal evidence suggests that some local authorities are trying to find ways around the Rating Powers Act, to more effectively fund the provision of services such as sewage disposal. Those that are considering alternative funding mechanisms seem to be looking at

more commercial based approaches. Local authorities considering these approaches need to be careful that they are not inconsistent with Part VIIA of the LGA.

Another aspect of local authority tasks that the LGA provides clear direction on, is the separation of service delivery and regulatory functions. As there is potential for a conflict of interest between the two, section 223(c) of the LGA requires, as far as practically possible, that local authorities have separate resources and personnel for the two functions. In respect to sewage disposal services, this is intended to ensure that the service quality and standards needed to meet environmental requirements, are not compromised by funding difficulties.

1.3 Summary

This chapter has outlined the context of sewage disposal in small New Zealand coastal communities. It has shown that New Zealand decision-makers have some discretion in deciding the standard of sewage disposal required in a given community. It has also indicated that the funding and provision of sewerage services now rests almost exclusively in the hands of local authorities. The next chapter will examine the issues that surround sewage disposal based on literature from New Zealand and overseas. It will provide an overview of why coastal community sewerage systems may need to be upgraded. The chapter will also examine some of the matters of contention over the provision and funding of community sewerage.

2 Sewerage Schemes: Physical and Financial Issues

2.0 Introduction

Sewage disposal is a matter that has plagued civilisation for centuries. The wide and varied range of issues that surround the topic have been embraced by disciplines ranging from the physical sciences to the political economy. There is a full and diverse literature on sewerage issues. To examine and critically assess this material in a constructive way that contributes to the purpose of the thesis, four main topic areas will be considered. These include physical infrastructure, environmental effects, the position of individual agents, and the role of the decision-maker. The first two topic areas consider the environmental impacts of sewage disposal activities, with the remaining two considering the financial arrangements.

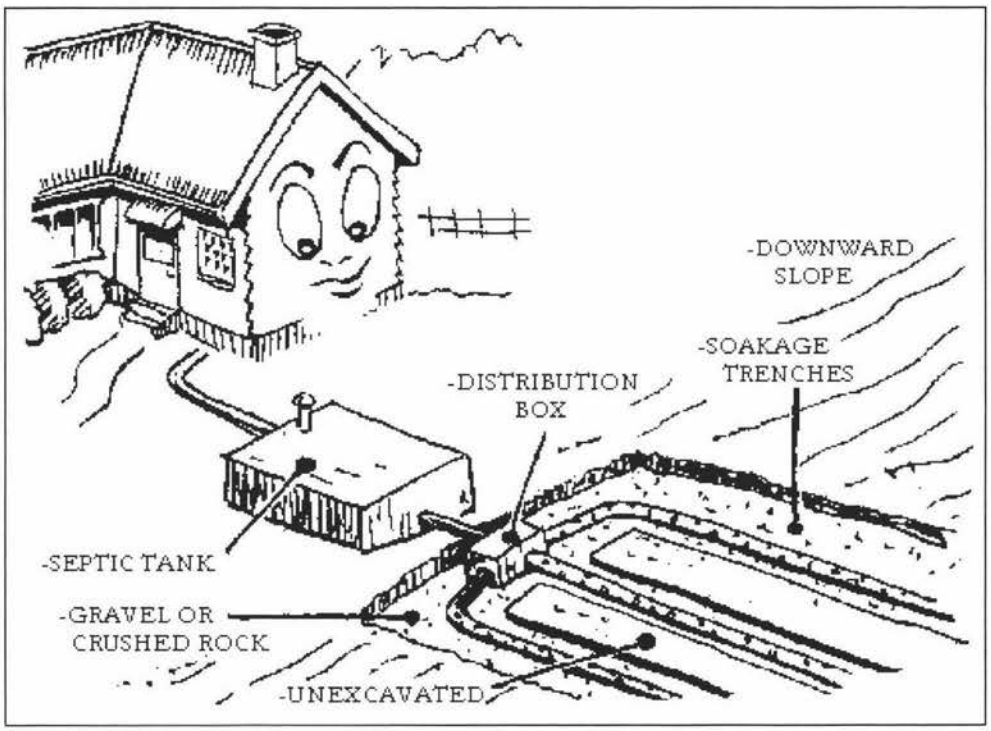
2.1 Physical Infrastructure

Typical sewage disposal infrastructure in New Zealand consists of either an on-site septic tank system or a reticulated system. The vast majority of small coastal communities in New Zealand rely on septic tanks for their sewage disposal. Hence, this portion of the literature review will concentrate on septic tank soil absorption systems, before briefly considering reticulated infrastructure.

2.1.1 Septic Tank Soil Absorption Systems

"Septic tank" is often used as the abbreviated term for septic tank soil absorption system (STSAS). As implied, the system has two components; the tank(s) and the drainfield. The actual septic tank has three functions: settling solids, storage of solids, and digestion of solids (Perkins, 1990). Once the septic tank has performed these functions, the drainfield or soil absorption area then renovates the applied wastewater through physical, chemical and biological processes. It is at this stage that many of the adverse properties of the wastewater are mitigated. STSASs, even with today's technology, are still the most cost efficient treatment available for human sewage (Bounds, 1994_b). Figure 2.1 illustrates the two stages of the sewage disposal.

Figure 2.1 A typical septic tank soil absorption system.



Source: (Environment B.O.P, 1996)

At either stage there are ample reasons why the STSAS may not provide high quality sewage disposal. These are basically because of neglect or ignorance on the part of the installer and user. This section of the review will first consider the role of the tank in the STSAS, after which the role of the drainfield will be considered. Likely problems encountered in small coastal communities will be highlighted.

2.1.1a The Septic Tank

The role of the actual tank in a STSAS is to conduct the primary treatment. Here, material that either floats or settles is separated from the waste stream and is partially decomposed anaerobically (Jantrania, Sack and Earp, 1994). It has been estimated that more than 45% of the total treatment can be accomplished in the tank, with its anaerobic organisms reducing solids by as much as 80% (Bounds, 1994_a). How well the tank performs however, is highly dependent on its initial design and the level of maintenance it receives (Perkins, 1990).

It is important that the design of the tank component of the STSAS is sufficiently robust. A robust tank will not be impeded by the adverse conditions in which it is required to function. If the tank is made out of concrete or corrosive material it should be coated with a

protectant, such as bitumen, so that it doesn't corrode through being in contact with the sewage, or groundwater that surrounds the tank (Perkins, 1990).

Without the most suitable type of soil and dedicated maintenance programme a tank with two compartments, instead of a single chamber, should be installed. In the majority of New Zealand circumstances, the risk of high levels of suspended solids overflowing from a single chamber tank and clogging the drainfield are considerable. "The New Zealand Standard (NZS 4610: 1982) single chamber septic tank does not reliably produce good quality septic tank effluent" (Environment B.O.P, 1996: 35).

A double chambered septic tank results in most of the solid settling and biological decomposition occurring in the first chamber. The second chamber captures the majority of the remaining solid material and acts as a backup to the first chamber. It also allows the remaining smaller and lighter particles to settle before the wastewater is discharged to the drainfield (Perkins, 1990).

Realising the limitations of septic tanks is very important. While relied upon extensively for many holiday homes, they do not always function particularly well under these circumstances. The shock loading they receive with sporadic use means that the quality of effluent leaving the tank can be much lower than that of a continuously loaded tank. It can take up to a month for the bacteria in the tank to adapt to the different loading and flow conditions (Environment B.O.P, 1996).

Similarly, septic tanks designed to serve a one or two occupant dwelling are unlikely to perform adequately when that dwelling is extended. The residence time, or time it takes a molecule of water to move from the inlet of the tank to the outlet, should be at least one and a half days (Perkins, 1990). Tanks with a greater volume can slow down the residence time, deal with a higher volume of wastewater acceptably, and therefore cater for greater use by more people. Table 2.1 recommends the appropriate septic tank capacity according to the number of bedrooms in a dwelling. When the actual tank is installed, possible increases in the volume of wastewater should be allowed for. At the very least, when changes to the property or dwelling are made, a review of the effluent disposal should be undertaken (Environment B.O.P, 1996).

Table 2.1 Recommended septic tank capacities.

Number of Bedrooms	Septic Tank Capacity (litres)
1 or 2	3400
3	4550
4	5450
5 or 6	6800

Source: (Perkins, 1990)

Even though septic tanks can function with a minimum of care, abuse of their capabilities by a household can lead to a significant deterioration in their performance. "Traditional systems are not idiot proof" (Environment B.O.P, 1996: 28). The discharge of paint thinners, pesticides, strong chemicals, disinfectants and other materials, can all cause a major upset to the biological processes present in the tank (Perkins, 1990). Likewise, solid materials that are not biodegradable hinder the performance and increase the necessary service frequency of a tank.

Easy access to the tank is also important. Evidence from septic tank cleaners suggests that a prominent reason for the failure of many STSASs is the lack of maintenance (Environment B.O.P, 1996). A poorly sited inaccessible tank hinders the maintenance of the system. To maintain the operating life of a STSAS it is important that the tank is easily accessed for the removal of accumulated sludge.

The required pumping interval of a tank will vary according to its use and size. There is no scientific evidence that suggests a tank must be pumped out once a specified interval elapses (Bounds, 1994_b). However, leaving the pumping of tanks to the discretion of homeowners has proven unsatisfactory. They tend to neglect the task until the tank malfunctions and damages the drainfield (Environment B.O.P, 1996). This suggests that some kind of regulatory approach and/or education of typical systems is needed.

The site position of the tank should take into account important aspects such as hydrology requirements and land area. The use of gravity to transport the wastewater into and out of the tank, while minimising the risk of flowbacks, is what makes the STSAS so cost effective and energy efficient. The required land area for a household drainfield can vary between $20m^2$ and $460m^2$ (Environment B.O.P, 1996). Tank placement should be such that

the required drainage area is sufficient, while still maintaining the required setback distances from buildings, wells, watercourses, bodies of water and other surface features.

2.1.1b The Drainfield

The drainfield is an important part of the STSAS because it provides the means to achieve high quality treatment. There are many "drainfield factors" which must be considered in assessing how appropriate a STSAS is for a given property. Like the tank, the drainfield should not be located in surface depressions, nor too close to bodies of water, buildings, property lines and other drainfields (Perkins, 1990). This is obviously a big limitation in small coastal communities.

Another big limitation to the effectiveness of STSASs is the soil type. Both impermeable or "tight" soils, and soils that allow very rapid drainage, do not adequately treat the wastewater (Environment B.O.P, 1996). While the perforated pipe that distributes the wastewater can be extended and surrounded by gravel or crushed rock to accommodate tight clay soils, if the soil percolation rate is slower than about 60 to 90 minutes per square inch, an alternative to the STSAS should be considered (Perkins, 1990). Similarly, if the percolation rate is faster than about 1 to 6 minutes per square inch, the contact time of the effluent with the soil is too short for effective treatment.

Both percolation and evapotranspiration can disperse the wastewater, and the drainfield should be sited to take advantage of both. Percolation, however, is the most important element in the treatment. The absorption trenches should be located parallel to the land contours, that is perpendicular to the slope of the land. This avoids overloading the downhill end of the trenches (Perkins, 1990). They should not be located on ground where the surface slope is greater than about 1.5 to 2.5 metres per 100 metres of horizontal distance. Nor should they be located where there is groundwater or impermeable rock and soil present within 1.2 to 2.2 metres of the surface soil.

Climate related factors such as rainfall, also influence the effectiveness of the in-ground treatment. These need to be considered in the system design requirements for it to be effective. The failure to properly account for these and other aforementioned drainfield factors, is the foremost reason for inadequate STSAS performance in New Zealand (Environment B.O.P, 1996).

To realise the potential or inadequacy of the STSAS in any community, there needs to be careful consideration of the factors influencing both the tank and drainfield performance. The only way to guarantee this is by regulation supported through effective compliance monitoring (Otis and Anderson, 1994). This would ensure that in areas not suitable for STSASs, alternatives are installed instead. It would also ensure that deliberate and accidental misunderstandings of STSAS capabilities do not occur (Environment B.O.P, 1996).

2.1.2 Reticulated Systems

If STSASs are not suitable to provide adequate sewage disposal for a community, then it is likely that a reticulated system is needed. A reticulated system is simply a system that links households into a distribution network which delivers the sewage to one central location, off-site. Obviously such as system will be of greater cost to a household than equivalent treatment by a STSAS.

The purpose of this review is not to develop an in-depth discussion about the various treatment methods at the end of the sewerage network. For those who are responsible for providing sewage disposal, information on treatment and disposal options is not a constraint (Local Government NZ, 1997). What follows is a general description to provide the reader with an idea of the progressive infrastructure needed to advance to tertiary treatment. It should be noted that at each stage, unless reasonably specific design is undertaken, it is difficult to quantify the costs of alternative systems (Green, 1989).

A wastewater treatment plant is a combination of operations or processes, generally assembled in a logical order to achieve progressively advanced treatment (Steven and Fitzmaurice, 1976). These operations can be categorised as primary, secondary, or tertiary, with less advanced plants having little or none of the later category of operations.

Primary processes and operations involve using screens to filter out debris and reduce the size of solids. The solids and floatable material are then removed in sedimentation tanks (Green, 1989). As the raw sewage enters the treatment system a bar screen (commonly a milliscreen) meets it, and breaks up any solids into smaller material (Steven and Fitzmaurice, 1976). After this, but sometimes preceding it, can be a grit chamber to remove grit and other inert matter. Next in line is the settling tank. It removes the lighter, organic

solids, with provision made for floatable material such as grease, fat and oil (Steven and Fitzmaurice, 1976). At the end of this process suspended solids and biochemical oxygen demand can be reduced by as much as 65% and 35% respectively (Green, 1989).

Secondary treatment involves utilising aerobic bacteria to oxidise, and therefore remove up to 90% of the biodegradable, oxygen demanding organic wastes (Miller, 1993). There are three main types of secondary treatment processes; activated sludge, filtration, and oxidation ponds.

The activated sludge process involves oxygen being injected into sewage retained in "aeration tanks." Often this is simply a mechanical "churning" of the waste. Microbial organisms metabolise the degradable material to leave a "liquor" and "woolly" type substance which is normally separated later in a settling tank (Steven and Fitzmaurice, 1976). Filtration is simply passing the wastewater over gravel or plastic media (trickling filters). The process provides a surface area for organisms to grow and oxidise the organic component of the wastewater (Green, 1989). Oxidation ponds are shallow basins with a large surface area that use wind to introduce oxygen into the liquid. They are both popular and common in New Zealand because given a sufficient land area, they can perform primary and secondary treatment as well as digestion of the sludge (Green, 1989).

Tertiary treatment is a series of chemical, physical and/or natural processes that lower the quantity of specific pollutants still left after primary and secondary treatment (Miller, 1993). These pollutants, discussed more in section 2.3, are typically expensive to remove through mechanical processes or chemical additives. In the past nitrogen and phosphorous, the two main contributors to the eutrophication of water bodies, have been removed through the application of lime and salts of aluminium or iron (Steven and Fitzmaurice, 1976). More often than not though, this creates a sludge removal problem.

Similarly, problems such as faecal coliform can be dealt with by chlorinating. In the coastal environment however, de-chlorinating would have to take place to avoid the detrimental effects chlorine has on the water environment (Green, 1989). In New Zealand spray irrigation has been a cost effective alternative to the use of salts and other chemicals for removing pollutants. Unfortunately the lack of suitable land in coastal environments often prevents the use of this method.

For those developing a sewerage system, providing tertiary treatment is seldom easy. Until very recently tertiary treatment was largely neglected because of cost and social attitudes. "Generally the effluent resulting from a sewage treatment process is discharged to a water course" (Green, 1989: 40). There are numerous reasons, to be discussed later, why this is no longer acceptable. It is up to those responsible for the well-being of their communities to ensure that the most appropriate treatment level and methods are chosen. As previously stated, information is not a constraint. Those responsible are obligated to think laterally about cost effective treatment. Two such alternatives that are gaining a growing amount of attention are briefly outlined below.

2.1.3 Alternative Systems

2.1.3a Effluent Drainage Servicing

Effluent drainage servicing (EDS), is the reticulated collection of sewage wastewater after on-site pre-treatment by a septic tank (Environment B.O.P, 1996). Its purpose is to provide off-site treatment more effectively than on-site disposal, and more cheaply than full reticulation. It is described in more detail by Ian Gunn[1] and the United States Environmental Protection Agency (US EPA)[2].

Effluent drainage servicing has great potential for households in coastal communities that have septic tanks, but poor or unsuitable drainfield conditions. While New Zealand comparisons with conventional reticulated systems have shown EDS to be approximately 5% cheaper, evidence from overseas indicates that New Zealand guidelines are excessively conservative (Environment B.O.P, 1996). Environment B.O.P cites the USEPA[2] as showing possible savings of between 30 and 65% over conventional systems (Environment B.O.P, 1996: 43).

2.1.3b Wetlands

A possibility for tertiary treatment that has been largely unexploited in New Zealand is the use of either natural or constructed wetlands. These work by funnelling wastewater through aquatic plant systems. Organic substances in the wastewater are absorbed and biodegraded by plants and micro-organisms (Gillette, 1996).

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[1] Gunn, I. 1989 . *Current Theory and Techniques on Alternative Sewage Engineer*ing.
[2] USEPA. 1991. *Alternative Waste Water Collection Systems.*

In New Zealand this option has generally been rejected because little information was available on design parameters, treatment efficiencies and optimal modes of operation. However, now there is ample information that can be obtained from a considerable number of sources operating wetland systems in America. The pioneer of these systems, Dr. Bill C. Wolverton, has designed numerous artificial marshland wastewater treatment systems for individual homes and communities, including the American National Aeronautics and Space Administration (Gillette, 1993). A number of American firms have also been very successful in using these systems to meet the standards of their State organisations, such as the Mississippi Health Department (Gillette, 1993).

For small coastal communities wetlands may well be one solution to many of the sewage disposal problems in the coastal environment. "The subsurface vegetated bed form of constructed wetlands is an ideal candidate for both economical and efficient additional treatment of septic tank effluent from individual homes prior to soil application ... " (Huang, Reneau and Hagedorn, 1994: 66). The plant/rock system finding favour with many American households without reticulated sewage, is another similar alternative.

These systems are equally adaptable to a reticulated scheme that uses one "wetland system" instead of individual household ones. When combined with oxidation ponds they can be an extremely effective means of tertiary treatment (Gillette, 1994). In New Zealand it is the macro version of the "wetland system" that has been utilised more.

The method of treatment selected will generally be determined by a balance of desired effluent quality and cost (Green, 1989). It is the acceptable level of sewage disposal effects on the coastal environment that will determine the desired effluent quality. These predominantly adverse effects are discussed in the next section.

2.2 Environmental Effects

An environment is made up of both metaphysical and physical elements. Sewage disposal is problem in the coastal environment because it has an impact on both. Whether environment is defined in a broad or narrow sense, the metaphysical and physical elements are linked together. What has an impact on one has an impact on the other.

Metaphysical elements can be interpreted as social, economic, cultural and spiritual conditions. Social and economic conditions will be considered separately in section 2.3 and 2.4. In New Zealand, cultural and spiritual conditions are largely determined by the values of local Maori. In general, these are not something that can be appropriately documented, nor should be. Section 1.2.2 of chapter 1 describes how New Zealand has chosen to take into account Maori values and culture.

Physical elements can be divided into three categories; ecological, aesthetic and health. As the vast majority of small coastal communities are serviced by on-site disposal systems, it is the effects that these can have on the coastal environment that will be examined.

2.2.1 Ecological

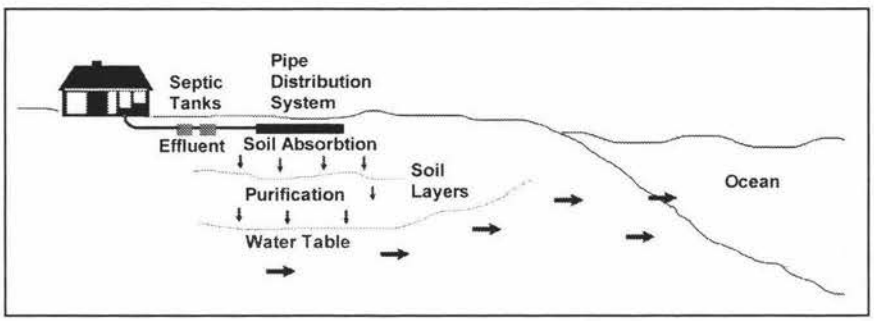
The ecological impact of sewage disposal in a given coastal environment is determined by the environment's assimilative capacity. "Assimilative capacity is defined as the amount of material that can be contained within a body without producing unacceptable biological impact" (Ludwig, 1991: 27). When sewage waste disposed of in the environment exceeds the environments assimilative capacity, it has an adverse impact on the environment.

There have been very few studies linking on-site disposal systems to a deterioration in the quality of the coastal environment. Of the handful of studies on septic tank groundwater related problems, only a few examine "contaminant" transportation between the groundwater/surface-water interface. "It is assumed that as a result of the hydrological cycle, contaminated groundwater will result in contaminated surface water" (Harris, 1995: 262). Figure 2.2 illustrates how this process may work.

When the sewage effluent enters the pipe distribution system it filters down into the soil strata. Under the right conditions this results in the effluent being purified by natural organisms and processes. However, if the water table is too high for the soil conditions, the unsaturated zone required for treatment will not be of sufficient depth. The effluent filters into the groundwater where it then seeps slowly into rivers or the sea (Daly, 1991).

The principle ecological effect that can result from inadequate on-site sewage disposal in the coastal environment is eutrophication. Eutrophication is the physical, chemical and biological changes that take place when aquatic ecosystems become over nourished with

Figure 2.2 Pollution of groundwater/surface-water by on-site sewage disposal.



Adapted from (Daly, 1991)

plant nutrients, mainly nitrates and phosphates (Miller, 1993). It is more severe in enclosed bays compared to areas where currents take much of the nutrient supply away. The composition of nitrogen, phosphorous, and potassium in sewage wastewater is close to the optimum ratio for plant growth (Jenssen and Skjelhaugen, 1994). Hence, where currents don't take much of the nutrient supply away, significant changes to the aquatic ecosystem will occur as a result of this artificial boost.

According to studies done in the United States, 55-85% of the nitrogen that enters a septic tank is available to the groundwater (Harris, 1995). The average STSAS removes 10% of the wastewater nitrogen in the tank, and 5–35% by infiltration. Nitrogen discharged from on-site systems is considered to be the biggest threat to water quality (Harris, 1995). "In coastal areas, a good percentage of the 4kg of nitrogen per person per year entering the average septic system can be estimated to reach surface water" (US EPA, 1990).

The relationship between nitrogen loading and eutrophication in coastal areas has not yet been quantified (Harris, 1995). Even so, a number of reports and observations suggest that the link between nitrogen and eutrophication is strong. According to one Australian study, septic systems were an important source of nutrients (mainly nitrogen) that contributed to a Blue Green Algae bloom 1000km in length (Geary, 1994).

Eutrophication is a problem because it results in the water body becoming more productive (Welch, 1992). With more nutrients plant growth accelerates and there is much more micro-organism activity. The increase in activity results in a decrease in light penetration. Clear waters become increasingly murky (Arceivala, 1981). But it can mean much more than just depriving tourists and swimmers of aesthetic appeal. The composition of marine-life changes. The principle pathway of energy in any marine environment is through the

predator–pray orientated food web (Welch, 1992). Predator–pray conversion efficiencies tend to decrease with eutrophication. This stems from the fact that phytoplankton (drifting plant organisms of relatively small size) tend to dominate their predators zooplankton (drifting single cell organisms performing the essential functions of life, and other micro-organisms such as crustacea), because of changing physical–chemical conditions (Welch, 1992). To a lot of people, this in and of itself may even be acceptable, but the likelihood of a decline in the catch of desirable fish species, indicates it is detrimental to human welfare.

Overloading the marine environment with nutrients also decreases the diversity of macroinvertebrates (invertebrates visible to the human eye). This reduces the purification of any organic mater that reaches the water, and therefore enhances the effects of eutrophication. The coastal area affected is more susceptible to events such as algae blooms, which in turn can result in other adverse effects, such as the decline in the stock of cod in the Baltic Sea (Gren, 1995).

With eutrophication comes an eventual depletion of dissolved oxygen. Biochemical oxygen demand (BOD) is defined as the amount of oxygen required by bacteria to oxidise the wastewater into carbon dioxide and water (Knapp, 1978). The higher the nutrient loading to a system, the greater the BOD and the lower the amount of dissolved oxygen. The result is the water becomes much more inhospitable to fish. Depending on the species and local coastal characteristics, they may die, migrate elsewhere, or even increase in number subject to food availability. It is normally the former effects that are prominent in the desirable species and the latter in the less desirable species. The analysis done on Waquoit Bay, Massachusetts, suggested that there was a direct link between oxygen depletion and nitrogen input from septic sources (Sham, Brawley and Moritz, 1995).

It should be obvious that the long term cumulative impact on a coastal environment of a small community's sewage disposal may well be detrimental. Even if the waste is sufficiently diluted, there may still be problems in the long run. A STSAS that doesn't achieve tertiary treatment could still cause eutrophication. The assimilative capacity of some coastal environments may simply be insufficient to cope with less than tertiary level treatment. Considering that the wastewater from a drain-field may take several decades to be transported to surface-water, the risk of being ignorant of today's true effects is very high (Sham, et al. 1995).

2.2.2 Aesthetic

Spillovers from septic systems right on the waterfront, perhaps because of intense rain, are aesthetically very displeasing. Odour, the presence of floating oil and solids, and water discoloration, all detract from recreational and navigational uses, riparian land values and scenery (Arceivala, 1978). In a small coastal community most of these effects are not likely to be significant or long lasting. Nevertheless at the wrong time of the year they may result in a loss of tourism or vacation revenue for the community.

2.2.3 Health

The health effects of poor sewage disposal result from disease producing bacteria and viruses entering water which humans come in contact with. These bacteria and viruses survive best under anaerobic conditions. They die off rapidly when competing with aerobic organisms. Thus, when the water table is high, anaerobic conditions exist and bacteria and viruses may travel long distances in the groundwater (Charlie et al., 1981).

Still, studies on the translocation and viability of viral organisms in groundwater have reached very different conclusions. A study done in Florida (Anderson et al., 1990), suggested that viruses present in septic tank wastewater are capable of reaching shallow groundwater, but only in low concentrations. The study also found that the viability of viruses is severely limited by being transported through groundwater aquifers.

Yet, other studies have reached the exact opposite conclusion. In Ireland several studies have suggested that STSASs are one of the major sources of groundwater pathogen pollution (Daly, 1991). According to Melnick and Gerba (1980) unsophisticated sampling procedures and inaccurate assumptions have consistently led to an underestimation of the presence of viral organisms in groundwater.

While bacterial counts, such as faecal coliform, do not accurately reflect the number of pathogens present in a sample, traditionally they have been the main indicator of the risk to public health resulting from sewage disposal (Green, 1989). At the present time Enterococci and Escherichia coli (bacteria similar to faecal coliform) are used as more reliable indicators.

Enterococcal numbers correlate well with the incidence of salmonella (gastro-enteritis), the most common form of sewage pollution illness (Consumer, 1989). It is generally caused by swimming or eating raw shellfish in polluted waters, and results in the infected person being sick for one or two days. Due to the short symptom period, the number of cases reported is probably only a small fraction of the actual number of infections (Consumer, 1989). In New Zealand other common ill health problems that result from swimming in sewage polluted water include boils and ear infections.

More serious diseases that can be contracted through eating sewage-contaminated shellfish include hepatitis A and typhoid. These generally result because raw sewage has been directly discharged into a Bay. In New Zealand cases of sewage induced hepatitis A and typhoid very rarely occur. It is conceivable however, that in a poor septic tank environment a bad combination of circumstances could result in one of these diseases.

According to the Environment Bay of Plenty (1992), in coastal marine areas without reticulated sewerage, the source of bacteria is almost certainly septic tanks. Environment Bay of Plenty found that pathogenic vibrio (certain species of disease producing bacteria) were more common at septic tank sites than similar sites with other disposal methods. This was especially so where septic tank soil absorption systems had failed. According to Green (1989) it is possible for the effects of malfunctioning STSASs to be worse than the effects of sewage out-fall.

Although there is always the possibility of adverse health effects eventuating as a result of STSASs, Environment Bay of Plenty (1992) found that bathing water quality was generally excellent. Only in sites with unsuitable year round conditions did they find evidence that health problems could eventuate from STSASs.

In cases where there is potential for adverse effects to occur (whether they be health, ecological or aesthetic), the solution to prevent these effects will be constrained by the funding resources available. If the only adequate solution is an expensive reticulated sewerage system, members of a small coastal community may be unwilling and/or unable to finance it. In such a situation, if the system is to be built, who should pay for it and how it should be financed, are questions that raise a number of equity issues. With respect to government policy and financing arrangements, these issues are considered in the next section.

2.3 The Equity of Government Policy and Financing Arrangements

People view the equity of a proposal according to how they perceive the distribution of its benefits and costs. The distribution of the benefits of a sewerage system is somewhat arbitrary. It will depend on who uses the system, and who gains from improvements in coastal quality as a result of the system. It is decision-makers that determine the distribution of costs. In a temporal sense, the distribution of costs is decided by government policy. Assuming this distribution remains unchanged, the inter-temporal distribution of costs is determined by the financing arrangement for the scheme. The equity of government policy is considered next, after which the following section will contemplate the equity issues raised when choosing a financing arrangement.

2.3.1 Government Policy

Under current New Zealand legislation the potential "users" of a proposed sewerage system are faced with funding all of it. This is a direct result of the polluter and user pays principles. The first states that those who cause pollution should have to pay to clean it up. The second states that those who benefit from the use of a service should have to pay for it.

If individuals in a community are generally content with the consequences of the pollution they cause, they may feel that the polluter pays principle is not justification for an "adequate" sewerage system. Territorial authorities are often faced with using this principle when they attempt to achieve more sustainable sewage disposal practise. They do this according to the national purpose of the RMA, but individual community members may not feel this purpose best meets their needs.

In a similar sense, if the potential users of the system believe that they will not receive all of its benefits, they may hold that the user pays principle is unfair. If other people will use and receive the benefits from the sewerage system, then some people may consider that the user pays principle is not taken far enough. An alternative principle is the 'benefit principle of taxation'. This states that those benefiting from a project should pay for it in proportion to the benefits they receive (Black et al., 1990). A community that perceives some benefits to fall outside its members may call for government grants to help meet the costs of their sewerage system (Local Government NZ, 1997). The benefits often cited as reasons for

justifying grants include, improved public health, a better international reputation for tourism, trade and standing on environmental issues.

The equity of the 'benefit principle of taxation', compared to the 'user or polluter pays principles', depends on the context. In New Zealand, most communities (that make up the national community) are paying the full cost of their sewage disposal (Local Government NZ, 1997). For this reason, giving a minority of communities grants based on the benefit principle is unlikely to be perceived as fair by others. Those individuals with high quality sewage disposal that are compelled to subsidise small communities without it, may argue that the extra cost per individual to provide adequate sewage disposal is simply part of their chosen lifestyle (Local Government NZ, 1997). Some may consider that the "costs" associated with a big city lifestyle, such as high housing prices and long commuting times, are no different.

The ratio of user charges to government grants, used to finance a sewerage system, will depend on the administrative and political feasibility of each (OECD, 1987). In the majority of OECD countries a high percentage of costs are covered by some type of user charge (OECD, 1991). The New Zealand view is that if the income and expenditure patterns of individuals are such that they can afford to pay, the reluctance of these individuals to face up to the costs of adequate sewage disposal should be resisted (Local Government NZ, 1997).

Where ability to pay is a concern, the equity of placing the standards of relatively more wealthy cohorts on to those less wealthy cohorts, becomes notoriously difficult to analyse (Levine, 1994). In New Zealand, a council ensuring the adequate provision of the service must justify any departure from the user pays principle. Local government funding mechanisms are not designed to solve the ability to pay constraint through transfers or income redistribution (Local Government NZ, 1997). A council that chooses to address the issue through making contributions from general funds, is breaching its legislative functions.

Ability to pay can be remedied through the actions of the national government. Formally this would occur through its redistribution policies. Grants for infrastructure in low socio-economic communities are one form of redistribution policy. Be that as it may, New Zealand governments have restricted their redistribution policies to income support benefits.

At the present time however, the extra 'Accommodation Supplement' for low-income families is not available for meeting the costs of sewerage services. Still, New Zealand circumstances dictate that the equity of the ability to pay question is best addressed by the national government. Their role will be considered more in section 2.4.

2.3.2 Financing Arrangements

The equity of the financing arrangement for a sewerage system is likely to be of considerable concern to its users. Where the system is on-site, such as a STSAS, it is up to the owner to determine the most appropriate method of financing his or her infrastructure upgrades and maintenance. Policies that promote the inspection of these systems at the owner's expense (see Environment B.O.P, 1996), even if perceived as unfair, are desirable for the wider community. It is the financing of off-site, reticulated systems, which is often contested.

A frequent comment in regards to long term debt financing is why burden constituents with the interest? "...while loans are a sensible option to assist communities in meeting the high costs of this service, they do not subtract from, but add to, the fact that the total costs may be inordinately high when compared to other household costs, and the amount paid for a similar service in larger communities" (Local Government NZ, 1997: 9).

Baker (1992) argues that pre-payment does not align with "user pays" and is not equitable. Intergenerational equity requires that current and future users pay the same real cost for the services of the system (Hartstone, 1995). This does not happen if the loan used to finance it is paid off before the life of the system terminates. Contrary to the commonly held belief that loans mortgage future generations, many analysts now realise that traditional financing mechanisms result in the current generation subsidising future generations (Baker, 1992). The only way to avoid this is through debt financing that is structured in such a way that the term of the loan matches the life of the asset (Hartstone, 1995). The real cost to each user should remain constant.

Under traditional arrangements, newcomers who take the place of existing community members, do not necessarily pay a fair price for the use of the system. More often than not, existing users will have prepaid at least part of the capital costs. The equity of this situation

for existing users is contentious, especially if they can't recoup some of their cost through property values. Consider the following example.

Assume A has a house worth $50,000. A is presented with a $5000 charge to gain access to adequate sewage disposal for the 25 year life of the system. Alternatively he or she can opt for a system of taxes (to pay off a loan-financed plant) that will evenly spread the cost of the plant over its lifetime. Assume that these future annuity payments in present value terms are equivalent to the $5000 charge. If A is unsure about the length of his or her house occupation and sceptical about the value access to the plant will add to his or her house, he or she will opt for the system of taxes. The reason being is that it ensures that the costs of the sewage plant are borne by the actual user. If A were to pay the $5000 and in one year's time, sell the house to B for $53,000 (the best price that can be obtained), A loses substantially compared to the tax system with loan financing. The same situation can arise where the loan is prepaid before the life of the system terminates. Few people are likely to view placing the homeowner in this position as fair.

Another source of substantial inequity is the financing arrangement of infrastructure designed to meet future demands or needs (OECD, 1991). Few consider it fair if the cost of this infrastructure is imposed on current users (Baker, 1992). Prevention can occur through appropriately structured debt financing and through refinancing debt service on excess capacity (Blamey, 1978). Impact fees are often used under traditional financing to make development "pay its own way". While they go some way to reducing the inequity of the situation, to be non-distorting they must take into account factors such as the interaction between property taxation and property values (Levine, 1994).

Likewise, users will perceive charges for the service according to some arbitrary rule, for example property area, when it is completely unrelated to the use of the service, as unfair. Charging according to other criteria, such as the fixed costs of service delivery and the variable costs of use (in a given time frame), is much more equitable (Blamey, 1978). Further, charging that more closely relates to the use and benefits received from the service, is likely to send the users a better signal about the real resource "cost" of their actions.

2.4 The Role of the Decision Maker

In New Zealand there are three tiers of decision making. These are the national level, the regional level, and the territorial level. The later two can be collectively termed "local authorities" (Milne, 1993). The majority of provision and funding decisions are made at the national and territorial levels. The bulk of this part of the review centres on these levels.

2.4.1 The National Level

Central government decision-makers have taken a "hands-off" approach to the provision of sewerage services. Central government legislation, as outlined in section 1.2 of chapter one, provides local authorities with guidelines for determining whether better sewage disposal is needed. Specific central government funding for sewage services is now non-existent. Welfare payments to people on low incomes are considered to be a more appropriate way of helping people pay for the cost of these services.

Reforms at the national level over the past two decades have been met with considerable domestic controversy. A common opinion expressed by Mike Moore (opposition leader to previous governments), is that the tighter fiscal budget policies of recent governments, in an attempt to address the nations financial deficit, have lead to blow outs in other deficits in physical, intellectual and social infrastructure (Moore, 1993).

However, New Zealand is one of only many countries who have undergone similar reforms and experienced similar consequences. A common strand in the provision of infrastructure has been the decentralisation of responsibility. The following quote of the undertakings of central government in New Zealand, is explained nicely by the second quote from a commentator on similar reform in Sweden:

> "One of the outstanding features of central government's performance since 1984 has been the attempt to devolve decision-making processes to local communities" (Green, 1989: 35).
>
> "One of the main priorities of central government is to reduce public expenditure. And to do this it must reduce local government spending, since this is a large portion of the total. One of the ways of imposing any restrictive measures (and not only spending cuts) is by getting those on whom the measures are imposed to share in, and to share responsibility for, these measures" (Elander, 1989: 46).

While some of this may be viewed as "passing the buck", there are some very good reasons to suggest that the reforms are advantageous. These can be examined by looking at the functional and legislative theory surrounding the role of central government.

Functional theory divides the purpose of government between development and redistribution (Peterson, 1995). It says that the main responsibility of national government should be redistribution, while that of local government should be development. Social development, such as education, health, and property right evolution, may be part of redistribution and social policy of the national government, or to a lesser extent, in New Zealand terminology, regional authorities[3].

In the case of physical infrastructure such as sewerage plants, functional theory says that local government is best equipped to design and administer its provision. This is because local government is disciplined by both market and political forces (Peterson, 1995). Local government has the comparative advantage in this area, and as such, national government is the least efficient provider of these services.

Coupled with this, legislative theory suggests that politicians will seek to distribute governmental benefits in such a way as they can claim credit (Peterson, 1995). Incentives provided by the political system can mean that politicians will try to maximise the benefits for their constituents, to gain re-election.

Both of these theories strongly suggest that it is unwise to use national government in the infrastructure development role. They are the basis for the move away from national grants for sewerage plants and other infrastructure in New Zealand. Politicians have had big incentives to provide grants for local infrastructure from national funds. This was one of the least efficient means of financing the needs of communities. It was possible for the total costs of these projects, which were spread over the nation, to exceed the local benefits that the projects provided. There was no real market or political accountability.

Still, if the reforms have been an improvement they have not come without problems. New legislation in the form of environmental law, and health and safety standards, is perceived

[3] In the United States, individual states typically provide social infrastructure such as education and health, but the small population of New Zealand means that regionally, this is not cost efficient.

to improve national well-being, but involves a "cost" to achieve. Central government often obtains the credit for addressing environmental problems with new legislation, but local authorities are asked to bear the burden by imposing these "costs" on their communities (Peterson, 1995). Some would argue that at least part of the financial responsibility of achieving higher national standards should rest with the initiator, central government (Green, 1989). Functional theory actually asserts that the fraction of benefits enjoyed by non-local residents from a project, should be the fraction of the cost financed by national subsidies or grants (Peterson, 1995). As far as local infrastructure is concerned, the New Zealand government has not taken this approach. This may be due to the fact that this fraction is very difficult to identify.

As previously mentioned, functional theory suggests that central government is the most competent agent for redistribution (Peterson, 1995). It is with this reasoning that the New Zealand government has attempted to address the points of those opposing community financing. Some argue that community financing places the burden of financing infrastructure on those least able to afford it (Stinson, 1984). With respect to sewage disposal, recent New Zealand governments proposed to alleviate this burden through the 'Accommodation Supplement'.

Originally this 'transfer payment' was seen as a "stop gap" measure (Hurley, 1993). Nevertheless, during the subsidy debate of the 1990s Treasury favoured its use, and so it stayed. Treasury argued that 'transfer payments' create fewer distortions and perverse incentives in what should otherwise remain a locally provided and funded service (Local Government NZ, 1997). While to a large extent this may be true, anecdotal evidence suggests that 'Income Support' has not made the supplement available to pay for sewerage services.

Still, even if the accommodation supplement is made available to pay for sewerage services, it is judged by many as extremely conservative. The original intention was that home renters and owners would receive 65% of essential costs in excess of 25% of their net income. This is unlikely to be a significant help to low income earners. It is generally accepted that for the poorest sections of a population, the cost of water and sewerage services should not be more than 1 or 2 percent of their income (Lee and Jouravlev, 1992). In OECD countries this is the average cost of these services as a fraction of household

disposable income. Treasury's Accommodation Supplement is significantly more hard-lined than these guidelines suggest should be the case.

2.4.2 The Regional Level

Of the three tiers of government in New Zealand, it is probably fair to say that Regional Councils are in a fortunate position when it comes to the provision of sewerage infrastructure. Financially they are uninvolved. Their role with respect to sewage disposal is to control the pollution of land, air and water (RMA, 1991: sections 15 & 30(f)).

Regional Councils do this through the preparation of regional policy statements, coastal plans, and other optional regional plans. All three avenues may be used to address and limit the effects of sewage disposal on communities and the natural environment. Rules and other methods can be directed specifically at sewage disposal, its quality, discharge, and effects. Optional plans, such as a 'Sewage Treatment Plan', can also go as far as specifying the fees and charges for services, and the scale, timing and sequence of public works (Milne, 1993). An example of this is seen in the Bay of Plenty Regional Council 'On-Site Effluent Treatment Regional Plan'. "Where an on-site effluent treatment system fails, causing gross overload, the system shall be replaced with a new system that shall comply with Rule 6.2.4(a)(i)(b)" (Environment B.O.P, 1996: 64 – Rule 6.5.4(b)).

Since district plans must not be inconsistent with regional plans and policies (RMA, 1991: section 75(2)), Regional Councils are in a position to set high standards that their district councils have to adhere to. However, the formulation of regional plans and policies is a political process with public participation. It is up to Regional Councils to ensure participation, and District Councils to ensure they participate (Milne, 1993). Unachievable or unreasonable standards should therefore be avoided. All the same, the risk of possible difficulties is still borne by district authorities, which may have little come back.

2.4.3 Territorial Authorities

Territorial authorities[4] are responsible for deciding:

- whether a proposal to provide certain services is valued enough to proceed with;
- the best practical option to provide the services proposed;
- the priority of the proposal; and
- how the proposal should be managed and financed.

These practical "hands on" decisions could well be made in the sequence stated, or in some partially altered order. This section of the review will consider the decisions in the order given here.

2.4.3a The value of the Proposal

The method of arriving at a decision on how worthwhile a project is, has generally been somewhat limited in scope. There is very little evidence in the literature of local decision-makers attempting to quantify the benefits of projects. This is especially so for projects which have a mix of private and public good characteristics, such as sewage disposal schemes.

Many local authorities have inferred from legislation that the benefits of a sewerage system are largely predetermined in extent, and sufficient to make it worthwhile. Better effluent quality, lower health risks and smaller adverse environmental effects, are benefits which would be in a community's best interest to obtain. The only decision to be made is how to provide an adequate scheme at least cost.

In most cases, no formal methods have been used to determine the value of a sewerage system to the receiving community. As a result, because of the "apparent" financial constraints many communities face, thoughts of providing these communities with adequate sewage disposal have been suspended. This practise is not consistent with section 32 of the RMA. A formal documented assessment of the value of such a system should be undertaken.

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[4] City and District Councils

2.3.4b The Best Practical Option

To choose the best practical option to provide sewage disposal, many local councils rely solely on informal methods. A survey (Martin and Northcott, 1995) of local authority capital investment decision making in 1994, found that only 34% of local authorities claimed to use any kind of economic evaluation technique when assessing capital improvement projects.

Factors such as the difficulty of projecting future cash flows, the inability to incorporate qualitative aspects, and the weighting given to political factors, are important limitations. However, they do not justify the decision of local authorities to ignore economic analysis altogether (Martin and Northcott, 1995). Just as other criteria are valuable, so is the economic analysis in making a more informed decision.

At the very least, a cost-effectiveness analysis could be undertaken to determine the most cost-effective way of providing a given set of benefits[5]. Cost-effectiveness analysis is an essential part of any infrastructure investment planning, and therefore authorities should dedicate sufficient resources to the task (Ellison and Walski, 1990). It is encouraging to note that of those authorities using an economic evaluation technique, most are using the more sophisticated and theoretically correct techniques (Martin and Northcott, 1995).

Proper assessment of the physical capabilities of various infrastructure alternatives, for example reticulation versus STSASs, is also an important task for territorial authorities. The short term view that on-site systems are an inappropriate technology, to be replaced at the earliest opportunity, is easily adopted due to inadequacies in previous design guidelines and the poor performance of some systems (Geary, 1994). A thorough and documented assessment of all alternatives needs be undertaken.

Determining the best practical option, and how worthwhile a project is, could well be done in conjunction with each other, or in reverse order. This is because to some extent the benefits and costs might well depend on the best practical option, as too might the best practical option depend on the benefits and costs.

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[5] A cost-effectiveness analysis is one half of an economic analysis. The other half is the benefit analysis.

2.4.3c Project Priority

If a sewerage scheme is worthwhile enough to build, the local decision-maker must decide what priority to give it. This involves ranking it against other projects that need to be undertaken. In the survey conducted by Martin and Northcott (1995), the two factors that were most influential in deciding not to undertake a project were limited funding (65% of responses) and the ability of the project to be postponed (22%).

The first factor points to the need to be rigorous and thorough in selecting projects competing for limited funds. It also points to the need to identify the least-cost option for a project (for the preferred set of benefits), and the potential of economic analysis to help determine this option and the priority of projects (Martin and Northcott, 1995).

The second factor points to the need for a coherent strategic plan. In the survey cited above, 68% of authorities did not have a current strategic plan, although at the time, 28% were developing one. It is easy to see that without strategic objectives, decision making can lack direction, cohesion, and organisational goals (Martin and Northcott, 1995).

Further, without a strategic plan a local authority is less accountable. It can more easily "pass the buck" for its indecision or rate revolt fear. In the past many local authorities have conceded to constituent pressure to keep rates low, and passed on an infrastructure deficit to future generations by delaying projects (Moore, 1993). Postponing capital expenditure and maintenance is one of the few budget-cut options for an authority that doesn't have immediate consequences (Peterson, 1983). A strategic plan would help to prevent this.

Although problems should be considered one project at a time (Davis, 1984), in the case of sewage disposal infrastructure, the use of planning over multiple sites can reap considerable benefits in the form of cost savings. It may be more beneficial to have one treatment system serving a number of communities, than to have a number of communities each with a treatment system. Projects can be prioritised, but within a long-term plan that achieves greater gain for the communities under the local decision-maker. Applying a system approach with optimisation techniques is one way of doing this (Ostojic-Skomrlj, 1995).

2.4.3d Project Management and Financing

Management and financing decisions are normally made "hand in glove", that is, together. Often one is made because of the other. In many instances an authority will have a policy on how it manages and finances its provision of sewerage services.

Historically, it has been territorial authorities that have owned and operated sewage disposal plants. In New Zealand, with the termination of subsidies, these plants are now largely financed through the rating base of each authority. However, at the present time many authorities are considering alternative, more "council independent" methods of managing and financing sewerage systems. This is because of the inefficiencies and other difficulties now being experienced with using rates as a source of funds.

In the United States whole and partial privatisation of utilities emerged because of events such as local tax reform, and devolution of policy and programs from state to local government[6] (Heilman and Johnson, 1992). The very similar turn of events in New Zealand has meant that some territorial authorities are considering, at least to some extent, doing the same.

One of the most attractive benefits of privatisation, is the divorce of the council from any financing responsibility. When this happens the council is no longer subject to a political review of rates and other means by which it finances the services provided (Ellison and Walski, 1990). Sound planning that was difficult under the old political regime, now becomes much more congenial for the authority (Ellison and Walski, 1990). The utility managers can charge the necessary fee to provide a quality service like any other private business.

Obviously any "privatisation" that takes place will not involve a pure market structure (Heilman and Johnson, 1992). The aim is to capitalise on the positive aspects of the public and private sector by meshing the two together. The qualities of the public sector that need to be retained include representativeness and accountability (Heilman and Johnson, 1992). The advantages of the private sector that are desirable to harness include faster and more economical construction, and more efficient operation and maintenance procedures. The

[6] State governments in the United States perform many of the roles that New Zealand's central government does. In the United States the Federal Government is the national or central governing body.

nature of the service and the extent to which it is affected by, and potentially affects, legislation, will determine the extent of the "privatisation" driving forces (Heilman and Johnson, 1992).

A serious concern with privatising public utilities is the compatibility of private and public interests. Depending on the context and details of the particular case, there could well be a trade-off of accountability for efficiency (Heilman and Johnson, 1992). Experience with privatisation in the United States has shown that territorial authorities have found the process difficult because of this trade-off. An authority has to ensure they meet their legal obligations, and exercise political and administrative discretion (Heilman and Johnson, 1992).

Accountability can be introduced through a contract. Yet this itself is a risk because it means the authority is committed for a long time to whatever accountability mechanisms it specifies (Heilman and Johnson, 1992). A contract often involves complicated performance provisions and remedies, such as repurchase agreements, that may pose significant problems for authorities facing unforeseen events.

Most of the American authorities that considered privatising their utilities had growing populations with a mean family income above the state average (Heilman and Johnson, 1992). These authorities tended to need extra capacity to meet growth rather than national environmental requirements. An above average mean family income and high growth are not normally characteristics of a small New Zealand coastal community.

An alternative to partial or full privatisation is simply to make the utility completely independent from council management and finance. The council can still retain control over its sewerage works, but professional managers can carry out the financing and management of its daily operations and capital expenditure. These managers can be given performance incentives to capture many of the benefits privatisation would provide.

Independent utilities have better maintenance practices, and infrastructure that is in superior condition to that of many publicly managed utilities (Peterson, 1983). Yet, one of the major concerns with independent utilities is that expenditure becomes a function of independent-revenue sources. It is no longer a part of general-expenditure decisions (Peterson, 1983).

This limits the flexibility of territorial authorities, and renders it far more difficult to establish priorities.

If a New Zealand territorial authority intends to manage and operate a sewerage scheme itself, this doesn't mean that it has to finance it through general revenue or rates. Rather it could set up an individual utility bill that would provide the sewage plant with some certainty in its revenue collection[7]. This may well capture a number of the advantages discussed above for private and independent utilities.

Finally, territorial authorities need to have good personal relation, education and consultation strategies. This is so they can inform their constituents of the purpose, benefits and need for sewage disposal systems (Local Government NZ, 1997). Good communication will make the chosen financing arrangement much more acceptable to the community. Providing the community with reasons for why it needs to alter or upgrade its sewage disposal, along with emphasising the longer term benefits, such as lower health risks, an enhanced environment and increased property values, will assist the community in accepting where the costs should fall (Local Government NZ, 1997). If worldwide trends are any indication, they suggest that the majority of the costs should rest with the receiving community.

2.5 Summary

This chapter has presented the reader with a thorough overview of the issues surrounding sewage disposal in small coastal communities. From the research presented, it is appropriate to conclude that septic tank soil absorption systems are a very efficient means of treatment, but only under the right circumstances. These systems are inadequate if they have been poorly installed or maintained, or the appropriate soil and topographical conditions are not present. In such cases they can pose significant risks to the environment and the health of those who inhabit it. The adverse effects they cause are often cumulative and can have a delayed impact. The most likely solution for removing such effects is a reticulated system that involves off-site treatment.

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[7] At the time of publishing the change would have to be consistent with Part VIIA of the Local Government Act, and the five charging mechanisms under the Rating Powers Act, given in appendix one.

New Zealand legislation leaves the provision and management of sewerage services in the hands of local authorities. In terms of political theory, the legislation is well founded. From an economic point of view, the lack of any funding contribution from central government is questionable. However this does not imply that central government should return to the use of subsidies and grants. This research suggests that the main problem with current government policy is in addressing the ability of some people to pay for their share of a community system. Outside of this, how individuals in a community view a proposed system depends on their knowledge of the need for it, how much they have to pay for it, and their perception of how equitable its financing arrangements are.

For territorial authorities to make informed decisions, they need to obtain information on the knowledge and perception of sewage disposal in the communities where a system is proposed. This may reveal a need for better information and education programmes. The research found that territorial authorities often lack good information. It also found that many fail to use appropriate methods to evaluate the sewage disposal problems of a community. The aim of this research is to provide a methodology to rectify this lack of information and knowledge of appropriate methods.

3 Theoretical Foundations for Estimating the Benefits of Sewerage Systems

3.0 Introduction

Sewage disposal in any community is a necessity. This necessity can be met by practices that range from very primitive to highly technical. In any community the extent to which an individual treats his or her sewage, determines the extent of the impact it will have on others. If the sewage is not treated and disposed of adequately, significant spillover effects are borne by others. In many instances these effects can only be overcome by public intervention. To avoid the creation of spillover effects from sewage disposal in a small coastal community, the most likely solution is investment in public sewerage infrastructure.

Investment implies a reallocation of resources (land, labour and capital) from existing use to a new use (in this case public sewerage infrastructure). In making this reallocation the products produced by the resources in the existing use will be lost (and hence the benefits derived from their consumption) but other benefits will be created by the new allocation of resources. In a society that seeks to maximise its welfare, it is important that such a resource allocation result in net benefits. The ranking of different resource allocations requires the making of value judgements, i.e. is the allocation better or worse. Welfare economics, a subdiscipline of economics, helps in formulating principles and tools to make such comparisons and to achieve maximum welfare. One crucial element in the process is an estimation of the benefits associated with different resource allocations. In what follows these principals and tools are explained and the theoretical foundations for benefit estimation techniques will be discussed.

3.1 Economic Efficiency and Optimal Welfare

If resources were not scarce there would be no need to determine how to allocate them among competing uses. But, since scarcity is all pervasive, choices have to be made and criteria are needed to evaluate these choices to determine if welfare will increase or not. Welfare economics present these criteria.

Historians of economic thought view Vilfredo Pareto (1848–1923) as the founder of contemporary welfare economics (Oser and Brue, 1988). "Welfare economics attempts to identify circumstances under which one can claim that one allocation of resources is better than another" (Perman, Ma and McGilvray, 1996: 8). Pareto defined optimal welfare as a situation where there is no resource allocation that will make someone better off while making no one worse off. If welfare is maximised there is no redistribution of goods and services that can increase someone's well-being without decreasing the well-being of someone else. The Pareto optimum implies (a) an optimal distribution of goods among consumers, (b) an optimal technical allocation of resources, and (c) optimal quantities of outputs[1]. It is an efficiency concept because it refers to society getting the maximum amount of goods and services from its limited resources.

A strong value judgement itself, Pareto optimality is also based on two other strong value judgements (Cullis and Jones, 1998). The first is that individuals are taken to be the best judge of their own welfare or utility. This has been criticised because in some cases individuals may believe that 'expert' knowledge is more desirable than their own judgement. The second value judgement is that individuals alone comprise society. Society is simply the sum of the individuals that make it up. In accepting this value judgement it is assumed that there are no superior interests to those of the individual.

Paretian value judgements in economics, as with any other discipline, impose a restrictive framework on the world to give it order and meaning. This restrictive framework means the Pareto criterion is not without limitations (Oser and Brue, 1988). It fails to address the equity of the distribution of resources in society. Instead it simply provides a set of efficiency conditions for the existing distribution. The criterion purposely excludes moral judgements that are often legitimate and dominant factors in policy formation. A moral obligation to provide future generations with a quality coastal environment is not considered in the Pareto criterion. Further, the criterion is also based on a static view of efficiency. It is conceivable that short run movements away from Pareto optimality could result in a more efficient situation in the long run.

The biggest limitation of the criterion is that **no-one** can be made worse off. This is what makes its strict application unsuitable for evaluating public policies. There are very few

[1] Perman, Ma and McGilvray, 1996: 81–84, provide a rigorous account of the conditions needed for a Pareto optimum.

policies and projects that make no individual worse off. The Pareto criterion seeks to avoid the welfare effects of utility changes between individuals. This is because economists have long recognised that interpersonal utility comparisons can not be made[2].

It was Kaldor (1939) and Hicks (1940) who proposed a broader Pareto criterion for evaluating public policies and projects. This is the potential Pareto improvement, otherwise known as the Kaldor–Hicks compensation principle. If those who would gain from a proposed change could compensate those who would lose, to the full extent of their perceived losses, the change would be acceptable. As long as the gainers can compensate losers and still benefit from the change, a policy or project satisfies the criterion. Actual compensation is not required. If it were, then the proposal would satisfy the strict Pareto criterion.

Although the "potential Pareto improvement" is the criterion used to judge public proposals, it is not spared from the limitations of the strict Pareto criterion. Further, since a proposal passes the criterion if its benefits are greater than its costs, it is only welfare enhancing from a utilitarian perspective[3]. The potential compensation criterion separates efficiency and equity (Hanley and Spash, 1993). The criterion can not therefore address the equity issues raised when determining how to finance a sewerage scheme. A decision still has to made on who should pay for the scheme. This was discussed in chapter 2, and will be considered further in the conclusions drawn from the research.

The basic premise of welfare economics is that a perfectly competitive market system will achieve Pareto optimality – an efficient social outcome. In such a system the market demand curve for a good reflects social benefits and the market supply curve reflects social opportunity costs. The difference between benefits and costs, that is, net economic benefits,

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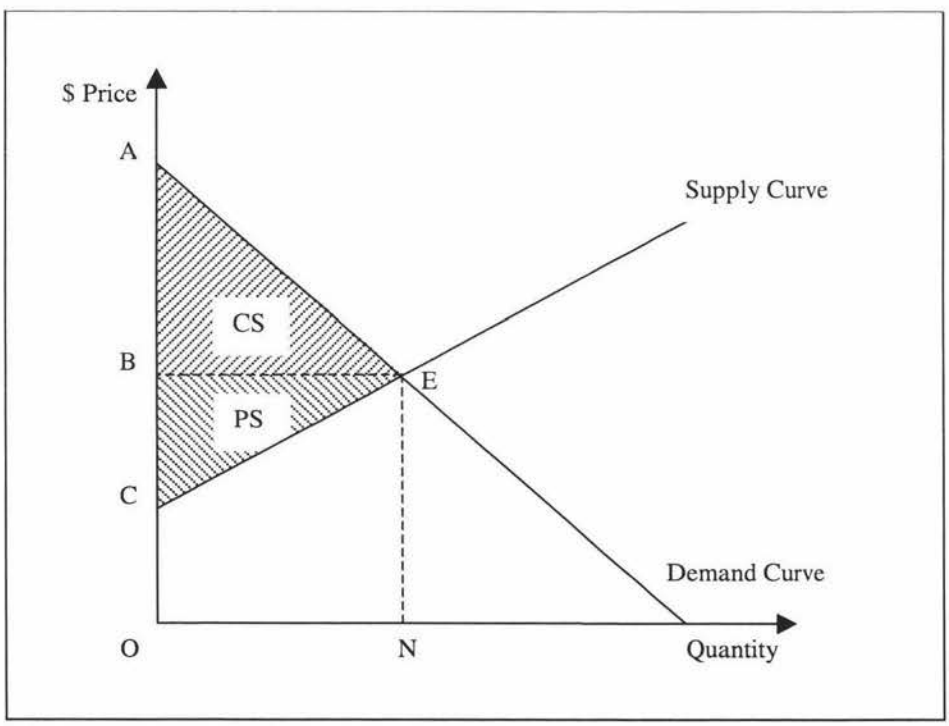
[2] Pareto optimality is expressed in terms of utility. Utility is the satisfaction an individual obtains from something. Therefore to make the concept of Pareto optimality suitable for policy evaluation, it is necessary to find a measuring rod of utility. The most notable measuring rod that has been suggested is money. If there is a unique relationship between money and utility, then changes in monetary amounts will reflect changes in utility. However, this unique relationship does not exist. The utility of one unit of money will vary from individual to individual. An extra dollar will provide a poor person greater utility than it will a rich person. The monetary measure therefore can not be used (without making qualifying assumptions) to make statements about utility or welfare changes between individuals (This is discussed further in section 3.3).

[3] In a narrow sense, the utilitarian perspective regards the welfare of society as the weighted sum of the utilities of individual members of society. It concerns itself with the end result of an action, that is, the consequence. If the consequence is okay (benefits > costs), then the action is fine irrespective of whether some people are worse off (Perman et al, 1996).

is maximised at the level of output where the marginal benefit is equal to the marginal cost. In figure 3.1, this occurs at point E, where the demand and supply curves intersect. (The demand curve is also known as the marginal social benefit curve, and similarly the supply curve the marginal social cost curve). The market demand curve records the maximum amount consumers are willing to pay for the last unit purchased. The area underneath the demand curve up to the last unit purchased, represents the total social benefit from all the units purchased (or the total willingness to pay). Likewise the market supply curve records the minimum price producers require to supply one more unit. The area underneath the supply curve up to the last unit supplied, represents the total social cost of supplying those units.

Figure 3.1 Pareto optimality in a perfectly competitive market.



The shaded areas in figure 3.1 show the maximum net economic benefit obtained from perfectly competitive trade. It is made up of consumers surplus (CS) and producers surplus (PS). Consumers surplus is the difference between total social benefits (OAEN) and the amount consumers have to pay for the quantity purchased (OBEN). Producers surplus is the difference between the amount producers actually receive (OBEN) and the total social cost of the quantity produced (OCEN). Measuring the consumers' and producers' surpluses, following alterations in the conditions of demand and supply, is useful for assessing changes in social economic benefits. However, if the market for the good in question is

absent then measurement of these surpluses is not possible since there is no market behaviour in the buying and selling of this good and hence no supply and demand curve can be calculated. In a similar sense, if the market is imperfect then measurement of these surpluses will not truly reflect social economic benefits. The reasons for such failures of the market system are presented below.

3.2 Failures of the market system

For the market system to achieve Pareto optimality it needs to work perfectly. This will occur when some basic conditions are fulfilled, one of which is that the property rights to all resources are well defined. If this is not so there will be incomplete or missing markets. It is especially with regard to environmental goods and services that the assumption of well defined property rights is crucial.

3.2.1 Property Rights

In many cases, the main source of inefficiency in resource allocation is the absence of well-defined property rights (Baland and Platteau, 1996). Property rights are a bundle of entitlements that spell out what the owner of a resource can do with it. They are like a social contract. Property rights specify how society will protect the owner of the resource, and how the resource owner has obligations to society.

Where property rights are non-attenuated or completely specified, they provide incentives for resource owners to use their resources in such a way as to achieve economic efficiency. Hence, non-attenuated property rights lead to a Pareto optimal allocation of resources. Essentially, there are four characteristics that must be present in a property right structure for these rights to be non-attenuated.

Firstly, property rights must be completely specified (Randall, 1987). There must be clear universal information about the entitlements or rights that accompany ownership, including restrictions and penalties for violation. Ideally all resources, except those that are so plentiful that everyone can consume as much as they want, should be owned (Prosner, 1977 in Baland and Platteau, 1996).

Secondly, property rights must be exclusive. All the benefits and costs of a resource must accrue only to the resource owner(s). There should be no uncompensated externalities.

Thirdly, property rights must be transferable from one owner to another. This is so a resource can be used where it is valued the most. One of the fundamental characteristics necessary to achieve an efficient allocation of resources, is the trade of rights to a resource (Randall, 1987).

Fourthly, property rights must be completely enforceable and secure from involuntary seizure (Randall, 1987).

In essence there are also four distinct types of property rights, each of which has various degrees of attenuation. These include open access property, common property, private property, and state owned property.

The rights associated with open access property are non-existent. Nobody owns the resource, and everybody has the privilege of using it. The key characteristic of open access property is non-excludability. Underground aquifers and coastal environments are classic examples of resources where these types of rights have existed, and still exist. It is only when a resource is plentiful enough to meet everyone's use and demands, that there is no conflict with this type of property right.

Common property rights exist whenever a group of resource users establish customary procedures or conventions governing the use of the resource. The group of owners normally set specific duties and rights to the resource. Further, they can usually prevent non-members of the group from gaining access to the resource. In New Zealand, there are very few customary procedures or conventions governing the use of sewage disposal resources in small coastal communities.

Private property rights are fully specified and non-attenuated. The owners of the resource have exclusive rights to it, and others have a duty to refrain from encroaching on these rights. Many of the households in small coastal communities regard the resources they need to dispose of their sewage as private property. In actual fact, some of the sewage disposal resources that these households use, such as the soil and aquifers under it, have very few of the characteristics of fully specified private property. In all likelihood, the septic wastewater

from a STSAS will filter through to neighbouring properties, underground aquifers and the sea. These natural resources are not owned by the household, nor limited to its property.

State property rights exist where a resource is fully owned by the crown, and others have a duty to observe the rules set by the crown (central government). State property rights govern the New Zealand coastal area. The Department of Conservation and Local Authorities are charged with managing coastal resources. As explained in chapter 1, their mandate is to ensure the sustainable use of these resources. For a small coastal community, this may not be the same thing as using them efficiently. The "values" of the community could be significantly different to those of the national community. A small coastal community may not even prefer to take into account environmental bottom lines.

The problem with sewage disposal in small coastal communities is the lack of well-specified property rights. The rights to the resources used for sewage disposal have essentially changed over time. While the crown may have been the owner of the coastal environment and the aquifers under the land next to the coast, to a large extent these resources took the form of open access property. However, with changes to how people perceive the coastal environment, and an increase in the number of people gaining enjoyment from it, the crown found it necessary to challenge the use of coastal resources for sewage disposal. The crown had to consider whether the use of aquifers and coastal waters for sewage disposal would best provide for the well-being of the community and country. In essence it removed the presumptive "rights" to dispose of sewage, both untreated and partially treated, into the coastal environment.

The state did this because of the wider environmental problems sewage disposal creates. These environmental problems occurred because some people were unhappy with other peoples' use of the coastal environment which imposed harm on them, to which they had not given consent (Wills, 1997). It also did this because of the free rider problem. In short, this is where an individual hopes everyone else will stop polluting, and continues to pollute himself or herself. The individual would then enjoy the benefits of a large reduction in pollution, without incurring any of the costs necessary to obtain the benefits. He or she does not contribute by upgrading his or her own sewage disposal.

Whether or not the actual rights to a resource exist with the polluter, or the person benefiting from a more pollution free resource, is a matter of community ethics and justice

(Wills, 1997). It is not an efficiency issue unless transaction costs prevent the transfer of the resource rights to where they are valued most. In the past decade New Zealand governments, as evidenced by the polluter pays principle, have suggested that the rights lie with those supporting the pollution free resource. However, recognising that there is always some degree of pollution, they gave decision-makers the task of determining what an acceptable level of effects is[4]. Taking into account the RMA's goal of sustainable management, the level of mitigation required by polluters is determined by the values that society holds for the environment. The economic theory of externalities provides some insights into this. In particular, what the appropriate level of effects or "pollution" should be to achieve a Pareto optimal situation. The theory also highlights the difficulties encountered in finding this level of pollution.

3.2.2 Externalities

An activity is said to generate a beneficial or detrimental externality if that activity causes uninvited benefits or damages to others and no corresponding compensation is provided to or paid by those who generate the externality (Baumol and Blinder, 1991). When people dispose of their sewage in such a way that it causes negative environmental effects, for example eutrophication, they do not take into account the loss of satisfaction that results for other people.

Septic tank soil absorption systems (STSASs) that create environmental problems are an example of an infra-marginal externality. To illustrate this concept, imagine two groups of households in a small coastal community, group A and group B. The activity of households in group A is disposing of sewage using inadequate STSASs. Households in group B engage in a number of leisure activities which provide greater satisfaction in a more pollution free coastal environment[5]. Imagine also a household, C, that belongs to group A. An infra-marginal externality is said to exist when an alteration to C's activity does not change the level of satisfaction of group B, but an alteration to every households activity in group A either harms or benefits group B. With significantly fewer inadequate STSASs the quality of the coastal environment increases to the benefit of B. Likewise with more inadequate systems the quality decreases to the detriment of B.

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[4] Refer to section 1.2.1 of Chapter 1.

[5] A individual household in the community could belong to both groups, or neither of the groups.

Whether this externality is potentially relevant depends on whether it generates any desire on the part of the externally effected party, B, to modify the behaviour of the acting party, A, (Buchanan and Stubblebine, 1962). The simple desire of party B to modify the behaviour of party A does not necessarily imply B has the ability to implement this desire. The externality has to be Pareto-relevant, and there have to be few barriers preventing an agreement between A and B. These barriers typically include transaction costs, uncertainty and ignorance.

A Pareto-relevant externality exists when the activity of A can be modified to make B better off, without making A worse off. If B values their activity enough, a reticulated sewerage system could be introduced in a way that makes households in A indifferent between this system and their existing systems. It is because of the barriers preventing an agreement between A and B, that there is a role for an independent entity (the government) to determine if the externality is Pareto-relevant.

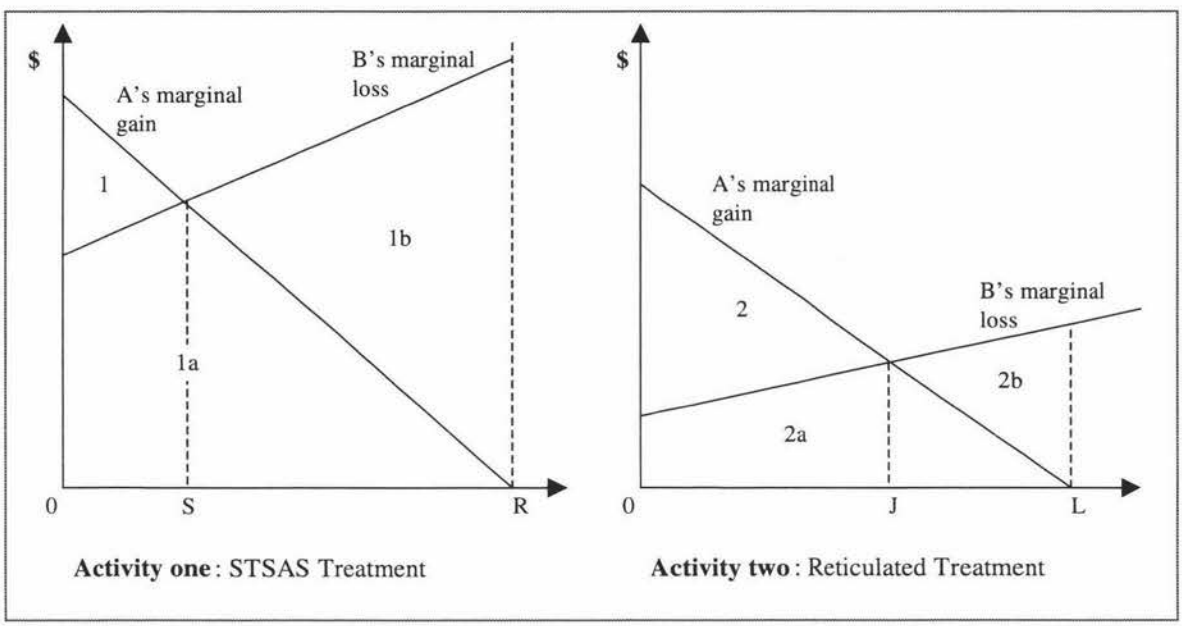
A graphical depiction of the problem faced by the decision-maker is presented in figure 3.2. Here A has two alternative activities, disposing of sewage via an "inadequate" STSAS, and disposing of sewage via an "adequate" reticulated system. In the graphs the scale of each activity increases along the horizontal axis. The graphs clearly indicate that as the scale of each activity becomes larger, the marginal gain to A falls and the marginal loss to B rises. The areas beneath the marginal curves represent total gains or losses.

If A and B do not negotiate, A will choose activity one at scale OR. This results either because of the absence of well-defined property rights, or because A has the property rights. In both cases there is nothing to prevent A from choosing the unconstrainted activity that results in a larger personal gain. The unconstrained personal gain of activity one (1+1a) is larger than that of activity two (2+2a). Often it is the difficulties in co-ordinating the members of parties A and B, the incentive for members of each party to "free ride" on the efforts of others, and the insignificant effect a single individual has, that result in no negotiation. Without intervention, activity one at scale OR is the more than likely outcome.

Limiting activity one of A to a scale of OS, say by limiting the population of the community, would give a larger social product. However, in the case of figure 3.2, the optimum is clearly activity two at a scale of OJ, since this yields the larger net social product (area 2 > area 1).

Where there are barriers to the free trade of rights, the initial arrangement of rights by the legal system directly affects the efficiency of the outcome (Coase, 1960). The role of the decision-maker in these situations is to determine whether area 2 is greater than area 1. Clearly in figure 3.2, if the rights initially rested with party A, an inefficient outcome (OR) would result without government intervention.

Figure 3.2 A Pareto-relevant externality.



Source: (Turvey, 1963)

The New Zealand government has implicitly said that area 2 in figure 3.2, is generally greater than area 1. It has evoked ethical principles of justice and fairness to direct the property rights to resources in the direction of those benefiting from "cleaner" activities. Evidence for this is provided by legislation in the form of the Resource Management Act (1991). In this Act it is the mandate of local authorities to consider each specific case, and determine the appropriate level of effects. From an economic perspective the reason why local authorities need to do this, is because markets for goods and services such as environmental quality are incomplete or absent. The reason why they are incomplete or absent is because of the 'public good' characteristics these goods and services possess.

3.2.3 Public Goods

A good or service is termed a 'public good' if the benefits it provides are not depleted by an additional user, and if it is difficult or impossible to exclude people from these benefits

(Baumol and Blinder, 1991). A public good is therefore characterised as non-rival and non-excludable. In contrast a private good such as an ice-cream, is both rival and excludable. A person can not consume it unless he or she buys it. Once the ice-cream is consumed, it is not available for consumption by another person. For these reasons an individual will supply a private good but not a public good. People can not be excluded from the benefits of a public good, so the person providing the public good has no way of making other people pay for it. The free-market system fails to provide public goods.

In the case of a community sewerage system, the benefits it provides in the form of improved environmental quality, removal of odours etc. are available to everyone. No-one can be excluded from enjoying them and, enjoyment by one person does not prevent enjoyment by another. In a similar sense the negative externalities generated by inadequate STSASs are also a public good. A lower environmental quality for one person does not prevent another person experiencing that same lower quality, and people in the community can not avoid that quality. Public goods and externalities are two sides of the same coin. The appropriate level of the public good determines the appropriate level of effects, and vice versa.

While a public good may not be provided by the free-market, if it is to be provided, it should still be supplied in an efficient way. The provision of public goods and services by central and local authorities should lead to a Pareto improvement. To achieve this improvement authorities need to have information on the benefits and costs of public goods and services. As we saw earlier, for private goods traded in the market, the area under the demand and supply curves provides that information. However, for goods not traded in the market no such information is available. Other ways need to be found to measure the benefits of such non-market goods. The techniques developed to do so are called non-market valuation techniques. They are designed to measure the consumers' surplus associated with the consumption of non-market goods. Consumers' surplus and benefit estimation are considered next.

3.3 Consumer Surplus and Benefit Estimation

As was shown earlier, the area under the demand curve above the equilibrium price paid is called consumers surplus. It reflects the net benefits to the individual (when dealing with an

individual demand curve) or society (an aggregate demand curve) of being able to consume the given quantity of a good or service. However, since utility is not measurable in absolute terms, information about utility must be obtained from "revealed preferences", that is, empirical data describing an individual's consumption behaviour or preferences under different economic circumstances. Market demand functions reflect these revealed preferences and the area under the demand curve can be measured in monetary terms, hence providing a monetary estimate of the benefits (utility) of a quantity of goods and services to an individual consumer.

Demand curves derived from market observations are called Marshallian demand curves. The consumers surplus measure from these demand curves is known as the Marshallian consumers surplus (i.e. the difference between the maximum willingness to pay for a good and the amount actually paid). An increase or decrease in the surplus indicates the consumer (when dealing with an individual demand curve) or society (an aggregate demand curve) is better or worse off, that is, utility has increased or decreased. To be able to draw this conclusion however, certain conditions need to hold, since the Marshallian demand curve is derived under the assumption that income is held constant and not utility.

A unique relationship will exist between changes in the monetary measure of consumers surplus and utility if a) the income effect (or income elasticity) is zero, and b) the marginal utility of money is constant (Hanley and Spash, 1993). The first assumption is necessary for there to be a unique relationship between changes in price and consumers surplus. The second assumption is necessary for there to be a unique relationship between changes in consumers surplus and utility. The second assumption (constant marginal utility of money) requires that the price elasticity of demand is unity (one). It also requires that the marginal utilities of other commodities should remain unaffected by the change in consumption of the investigated good (Perman et al, 1996). In reality, these assumptions turn out to be very restrictive because they only apply to commodities on which expenditure is a small fraction of total income.

John Hicks (1941) redefined Marshall's concept of consumer surplus. He did this using an ordinal system of indifference curves. An ordinal analysis concentrates on relative changes, and therefore allows money measures of consumer welfare that are independent of Marshall's restrictive assumptions (Hanley and Spash, 1993). All that an ordinal system of utility requires for money to be a measure of a welfare change, is that the individual is able

to preferentially rank alternative bundles of goods in a manner consistent with certain axioms of rational behaviour[6] (Perman et al, 1996).

Hicks expressed the changes in welfare that result from a price change, by variations in income that would leave the consumer's total utility unchanged. Whether this level of utility is taken to be that before the price change, or that which would result after a potential price change, depends on the property rights of the consumer. This is shown in the four income variations that Hicks defined to measure welfare changes.

Compensating Variation – this is the change in income at the new level of prices, that returns the individual to his or her old level of utility. The individual therefore has a property right to the existing situation, not the new one. For a price increase, the compensating variation is the amount of income received so the individual is indifferent between this compensated situation, and the old situation with the lower price. For a price decrease, it is the amount paid by the individual for the opportunity to pay the lower price.

Compensating Surplus – this is the change in income that leaves the consumer at their initial utility level following a price change, if the consumer is constrained to purchase at the new price the quantity he/she would have in the absence of the income change.

Equivalent Variation – this is the change in income that is equivalent to the effect of a price change, but when all prices are at their initial levels. In this case the individual has a property right to the new situation, but not the old one. For a price increase, equivalent variation is the maximum the individual would pay to face the old, lower price. This 'amount' would make the individual indifferent between the two situations. For a price decrease, it is the amount the individual would need to receive to continue paying the old price.

Equivalent Surplus – this is the change in income that leaves the consumer at his or her subsequent utility level without the price change, if he/she is constrained to purchase at the old price the quantity he/she would have in the absence of the income change.

The compensating and equivalent variation measures generally apply to goods and services where the quantity consumed can be chosen. The supply of these goods and services is

[6] For a brief outline on these axioms see Varian, 1996: 35.

normally continuous in nature. Hicks developed the compensating and equivalent surplus measures for public goods and services. Since public goods and services are indivisible in production and non-rival in consumption, there is a discrete as opposed to a continuous quantity of the good or service. For this reason an individual can not choose to adjust the level of the good he or she consumes (Perman et al, 1996). These four measures have replaced Marshall's concept of consumer surplus as the theoretically correct measure of welfare changes.

Which of the measures are used depends on the type of good in question and the property rights to that good. Whether the consumer is faced with paying for, or accepting compensation for, a change in the quantity of the good, also depends on property rights. Even so, Willig (1976) showed that for price changes the difference between what a consumer is willing to pay (WTP) and willing to accept (WTA) is a function of income elasticity, and within reasonable bounds of the elasticity, the difference between WTP and WTA is small.

Willig (1976) also resurrected the use of Marshallian consumer surplus. He did this by showing that for a small price change and an income elasticity near unity, the Marshallian consumer surplus lies between the compensating and equivalent measures of WTP and WTA. This result has been confirmed and extended by many other papers (see Mitchell and Carson, 1989: 31), and provides the theoretical justification for using techniques that elicit the value of a non-market good from market demand curves.

In New Zealand, the theoretically accurate measure for valuing the benefits of small coastal sewerage plants is compensating surplus. The main service a reticulated system would provide – a better quality or non-deteriorating coastal environment, is indivisible in production and non-rival in consumption. With or without the sewerage system, the quality of the local coastal environment is fixed, albeit at different levels. At any given time the "consumer" does not have any options to choose from (Hanley and Spash, 1993).

Further, since the introduction of a community sewerage system would effectively increase utility by preventing a decline in, or improving, the quality of the coastal environment, a WTP measure of compensating surplus is a more theoretically correct measure than WTA.

> "Where a given quality level of a public good is not currently available, a CS_{WTP} [consumer surplus / compensating surplus

> willingness to pay] measure is indicated to determine the value of increased provision, just as it is for determining the consumer surplus of a private good which an individual neither owns nor currently uses".
> "In the public good case... a CS_{WTP} measure is also indicated for a proposed decrease when a given quality level is currently available" (Mitchell and Carson, 1989: 40–41).

The next section considers the total economic value of a resource. It is necessary to identify the types of value that constitute compensating surplus, before the techniques used to estimate it can be considered.

3.4 Total Economic Value

"Value" means a variety of different things. In economics it is assumed that value resides in people. It arises when the wants or preferences of a person are satisfied. Values are in and of people, for things. They are instrumental (OECD, 1992).

The emphasis in this research is on economic efficiency. In this light, "value" is associated with an attempt to maximise the satisfaction of an individual or a collective group of people. It is based on preferential choice.

The total economic value of a resource can be divided between use and non-use value. In the case of a sewage disposal system the "resource" is the services or benefits it provides, for example, a non-deteriorating or improved natural environment.

Use value is the value given to both current and expected future use of a resource for commercial, sport, scenic and other activities (Kerr, 1986). It includes both direct use and indirect use values. Direct use occurs when the outputs of the resource, for example the environment, are consumed directly. Indirect use occurs when the functional benefits of the environment are indirectly consumed, for example, assimilative capacity. Expected future use is a subjective value that an individual is likely to implicitly calculate by finding his or her expected consumer surplus. The individual will anticipate what his or her consumer surplus will be in each future state. He or she will also have a subjective probability of these states occurring. A consumer might implicitly multiply the two to find his or her consumer surplus (Perman et al, 1996).

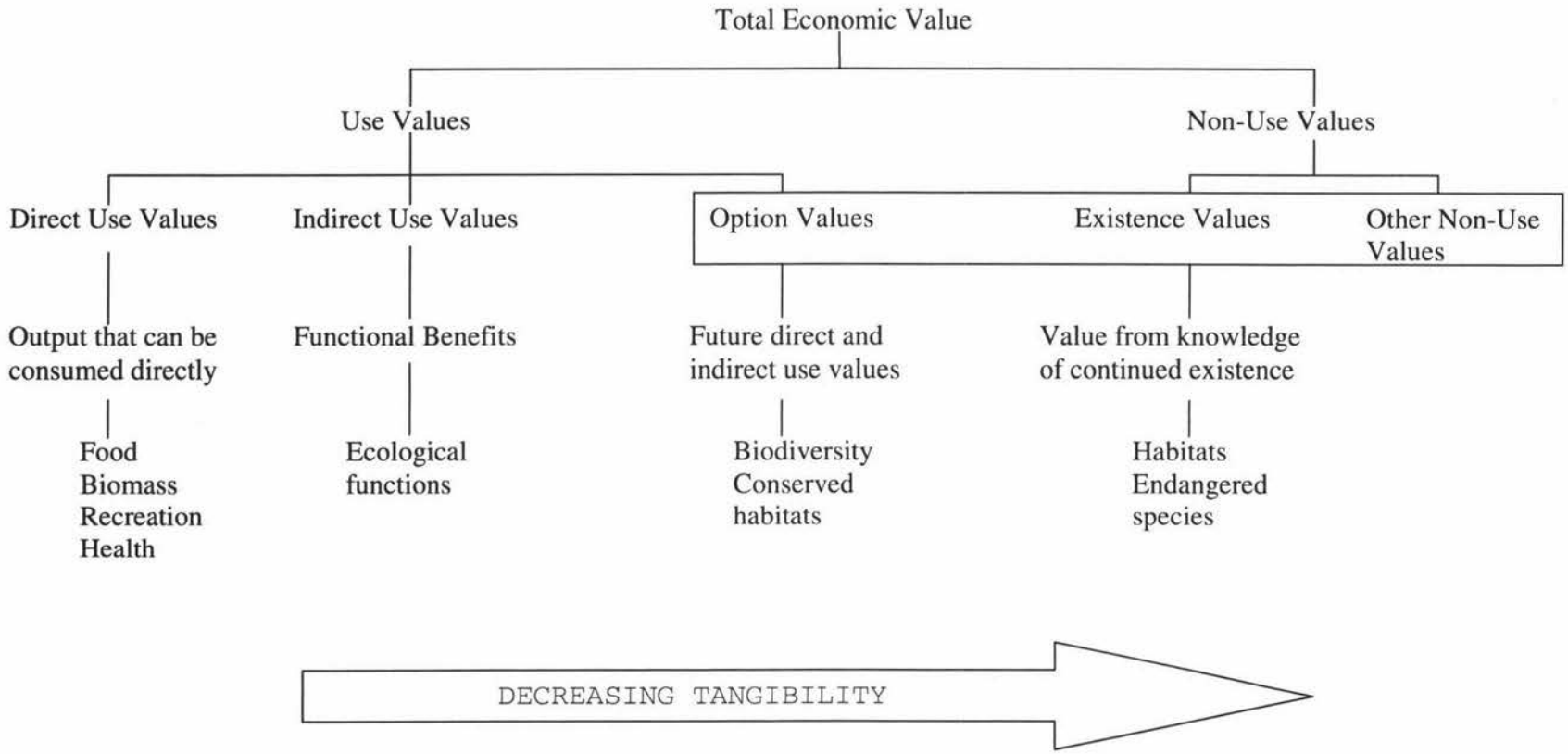
Non-use value is exactly what it implies. It is value gained from a resource, but not from its direct or indirect use. A special form of non-use value is option value. Option value is the value given to the option of future use where there is a risk associated with the demand or supply of the resource. People may rationally pay a premium that leads to more certain demand or supply in the future (Randall, 1987). It is likely to be a considerable portion of the value found in the benefit estimation for this research. Option value must be distinguished from option price which, as the sum of option value and expected consumer surplus, includes both use and non use values.

Two similar types of non-use value are bequest value and existence value. Both are unrelated to whether the individual concerned will ever be able to benefit directly or indirectly from the resource (OECD, 1995). Bequest value is derived from the pleasure of being able to pass something on to one's descendants. Existence value is derived from the mere knowledge that a resource continues to exist. The approach taken in this research is that existent value includes the value given to inherent values. Brookshire, Eubanks and Sorg (1986) argue that inherent values should be excluded from benefit measurements because they are not consistent with the "efficiency ethic". These researchers feel that inherent values are derived from an individuals ethical notion of right and wrong, and do not increase utility.

On the contrary, many other researchers consider that ethical beliefs do not involve self-sacrifice. "... those who make choices of this kind obtain utility from satisfying internalised social norms" (Mitchell and Carson 1989: 66). Something has an inherent value to the extent that humans derive utility from giving it a right to exist. If this right means enough to the individual they will be willing to pay to ensure that it continues to exist. Ethical motivations are not unique to inherent values.

Figure 3.3 summarises the types of economic value that constitute the total economic value of a resource. The examples used at the bottom of each type of value could apply to a coastal resource.

Figure 3.3 The types of value that constitute the total economic value of a resource.



Source: (Munasinghe, 1992)

3.5 Techniques to Value the Benefits

The techniques used to estimate the compensating surplus for a public good seek to elicit a person's value for the benefits the good provides. As determined in section 3.3, this value can be elicited from a person's willingness to pay for the good. There are two types of evaluation techniques that can be used to elicit a person's willingness to pay for a good or service; those that are based on revealed preferences, and those that are based on expressed preferences. Revealed preference approaches elicit use values. Expressed preference approaches elicit both use values and non-use values.

Clearly, for a decision-maker providing adequate sewage disposal in a small coastal community, both types of value need to be estimated. To ascertain the use value there are a number of revealed preference techniques that could be used, but the most common are the travel cost method and the hedonic price or property value method.

The travel cost method is the most widely used technique to estimate site recreational benefits such as scenery, swimming, boating and fishing. The travel costs of getting to a site are used to infer "willingness to pay" for its benefits. By applying the technique it is assumed that the benefits obtained from a site are at least equal to the travel costs of getting there. It is also assumed that the number of trips to the site are inversely related to travel cost (Kerr, 1986).

Considering that many people in a small coastal community live on-site, rather than just visit or holiday at the site, the travel cost method is unsuitable. For most people travel costs would be no reflection of the benefits they obtain from the site. Further, the technique can not capture the private benefits of adequate sewerage, such as convenience and reliability. Nor does it allow consideration to be given to the uncertainty of resource quality and quantity.

The hedonic price method is usually applied to situations where the value of an environmental amenity is capitalised in the value of property. The market price for the property is decomposed into separate values for each of its attributes, including the environmental amenity. A value for more quality and quantity of the environmental amenity

is gained by determining how property values change, as a result of changes in the environmental amenity (Kerr, 1986).

The method relies on data that are statistically sensitive enough to determine property value differences that result from "setting" variations. For this reason it is unsuitable for the benefit estimation required. Within small coastal communities all properties are subject to the same ecological effects of poor sewage disposal. The micro differences from property to property that result from sewage disposal, are unlikely to be big enough to significantly influence property value. Even if reliable property value data were available, with approximately fifty properties in a small coastal community there would not be enough data for the technique to be applied.

In the special case of health benefits, sometimes the value of improvements is evaluated using the human capital approach. In this approach dose–response relationships are often used to determine the extent of health improvements. The value of these improvements is taken as the sum of the value of reductions in lost labour market earnings and the outlays for health care. The approach is deficient because for retirees, homemakers and others who do not work in the market, there is still a loss of utility despite there being no loss of earnings (Berger, Blomquist, Kenkel and Tolley, 1987). Some individuals also have little control over their health or healthcare expenditures. "There is little basis in economic theory for the use of cost of illness values in benefit cost analysis" (Berger et al, 1987). The approach reflects cost, not choice value.

Valuations using expressed preferences are normally conducted with the contingent valuation method. The method is based on various survey forms. It elicits what people are willing to pay for changes in the demand or supply of goods or services (Kerr, 1986). Its capacity to evaluate both use and non-use values gives it a distinct advantage over other valuation techniques (Hanley and Spash, 1993). In particular, the method facilitates the collection of option value data for uncertain levels of future demand and supply of an environmental resource (Edwards, 1988). Uncertainty is a prominent characteristic of inadequate sewage disposal in small coastal communities.

For the purpose of this research, the contingent valuation method is the best valuation technique. It has been the technique used for benefit valuations comparable to the one

required in this research. In the next section the technique is discussed in more detail using two case studies.

3.6 Two Valuation Studies

Contingent valuation surveys are conducted in three forms; through personal interviews, by the telephone, and through mail questionnaires. The first study that will be investigated in this section conducts the survey through personal interviews. It is a willingness to pay survey on a public sewerage project in the Caribbean. The second study uses a mail questionnaire to determine the willingness to pay for groundwater protection in Dover, New Hampshire. Both studies investigate resources with characteristics analogous to those of this research.

3.6.1 Public Sewerage in the Caribbean

The public sewerage project for an island in the Caribbean was analysed by Darling, Gomez and Niklitschek (1993). At the time the island's citizens provided for their own sewage disposal. The problem with this was that the majority of individual sewerage systems allowed the excreta to filter through to the limestone and out to sea. The extent of the adverse effects this could potentially have on the coastal ecosystem, beach erosion, fishing, tourism, and people's health, was uncertain.

Since people on the island understood the sewerage issue because of their direct experience with sewage disposal, they were asked about their willingness to pay for a public sewerage system. The personal interviews conducted to do this were made up of three parts. The first was a detailed description of the good being valued and the hypothetical circumstance under which it would be made available to the respondent. The second part contained questions that elicited the respondent's willingness to pay for the good. A third part consisted of questions about the respondent's characteristics, preferences, and use of the goods being valued.

Two hundred and seventy seven interviews were conducted with households that would be connected to the sewerage system, and four hundred and thirty three with households that lived outside the connection area. In both cases households were told of the potential impact

of disposing wastewater into the ground, and the potential for avoiding such impacts with the construction of a public sewerage system.

A sewerage charge was proposed as the realistic mode of payment for all households, those who would be connected to the system, and those who wouldn't, but would potentially benefit from better quality beaches and coastal water. In each case dichotomous (yes/no) valuation questions were asked. Respondents were asked whether they were willing to pay $x more on their water bill each quarter to have public sewerage, or continue paying what they currently did and go without public sewerage. The amount respondents were asked if they were willing to pay, $x, was varied across the sample. From the results of the survey the probability of a "yes" response to a given $x was calculated. An econometric model was then used to relate the probability of a "yes" response to the amount asked and household characteristics. With the model formed, average willingness to pay was calculated.

In comparison to the current research the Caribbean study enjoyed a large population of respondents to sample from (3,268 and 53,041 in each group). This made the study congenial to the use of the dichotomous choice format for the willingness to pay questions. With a much smaller population dichotomous choice can not be used to estimate average willingness to pay.

The researchers for the Caribbean study also split their survey between users and non-users of the sewerage system. Their reason for doing this was that users of the system would gain both private and public benefits, while non-users would only gain from improvements in coastal quality. In the current research, because impacts are very localised, non-users of a proposed sewerage system could easily find substitute coastal sites. The "use value" benefits they would receive are likely to be negligible.

A risk analysis was also conducted as part of the Caribbean study. Of relevance to the present research, are the estimations used of the likely benefit loss prevented from avoiding declines in tourism due to health impacts. The amount of the tourism benefits depended on (a) the probability that the water reached a critical level of contamination, (b) the probability that enough swimmers get sick to make the contamination a perceived problem, (c) the number of tourists that stay away once the problem is perceived, and (d) the economic value of each tourist lost. The study found no basis to make a rigorous statistical estimate of these factors, so a range of estimates was used that appeared reasonable. This,

along with the other benefit range estimates, was used in a benefit cost analysis to determine the likelihood of the project having a positive net present value.

The study did not therefore use respondent valuations of the expected tourism benefits from the sewerage project. The contingent valuation survey focussed on households and not businesses. In a small coastal community, given the complicated nature of estimating expected benefits from preventing a loss in tourism, it may be better to rely on the subjective valuations of business managers and owners. The low number of these people in a small coastal community makes it easy to include them in a survey. Range estimations about their willingness to pay amounts can still be made.

3.6.2 Groundwater Protection in Dover

A study in Dover, New Hampshire (Shultz and Lindsay, 1990) determined the amount that property owners were willing to pay for groundwater protection by using a mail questionnaire. Like the current research the study also wished to identify what socio-economic factors influence willingness to pay. The study employed the same contingent valuation methodology as that used for the Caribbean sewerage project, but is distinguished by obtaining willingness to pay amounts that explicitly include both use and non-use values. It is also distinguished by the use of a mail questionnaire rather than personal interviews.

The survey was mailed to 600 property owners using Dillman's (1978) total design method. The response rate to the survey was 58%, good by mail questionnaire standards. A single willingness to pay question in the dichotomous choice format was asked after an "information framing" section. The section introduced the respondent to groundwater use and potential problems. The aim of the willingness to pay question was to elicit the total value a household gives to groundwater protection, including non-use values such as option value and bequest value. There was no other methodology besides the survey to estimate the value of the groundwater protection plan. The use of a single methodology is a distinct advantage for researchers and decision-makers faced with budget, time and labour expertise constraints.

A multivariate logit model was used to estimate the average willingness to pay of Dover property owners. The model was also used to discover the principle socio-economic characteristics that influence willingness to pay for groundwater protection. While this type

of model is not feasible for use on the small populations that the current research works with, the analysis of socio-economic characteristics could easily be done using a similar regression technique.

Both of these valuation studies have provided valuable insights on how to proceed with the valuation required in this research. Each has had elements that are similar to the sewage disposal problem in many of New Zealand's small coastal communities. Chapter 4 will build on these studies, justifying the reasons for the specific formats chosen. It will also explain any departure from the guidance provided by them. The next section will provide a synopsis of the contingent valuation method. The synopsis will include an overview of how the method works, and the potential difficulties that can occur in using it.

3.7 An Overview of the Contingent Valuation Method

Since the early 1970s the contingent valuation method has been used to value the benefits of a wide range of non-market goods. These goods range from recreational experiences to lower mortality risks from nuclear power plant accidents and toxic waste dumps (Mitchell and Carson, 1989). The way the technique gains a value for these non-market goods, is considered next.

3.7.1 Contingent Valuations

To value the benefits that people gain from a non-market good, the contingent valuation method relies on the four Hicksian measures of consumers surplus discussed in section 3.3. It seeks to estimate either the willingness to pay or the willingness to accept compensation for some change in the supply or quality of a non-market good, according to the property rights associated with that good. The change in the supply or quality of the non-market good is created using the scenario of a hypothetical market. There are a number of ways of presenting this scenario, including trade-off games, costless choice, priority evaluation, delphi techniques and contingent valuation/bidding games (Mitchell and Carson, 1989). In addition, the hypothetical market can be modelled on either a private goods market or a political market. Mitchell and Carson (1989) suggest that respondents should be presented with material that consists of three parts:

1. a description of the goods being valued and the hypothetical circumstances under which they are made available to respondents,
2. questions which elicit each respondent's willingness to pay for the goods being valued, and
3. questions about respondent characteristics (for example, age, income), their preferences relevant to the goods being valued, and their use of the goods.

Each part complements the others, and there may not be a sharp distinction between them. It is important that the market is designed to be as realistic as possible, and that the questions are designed to facilitate the valuation process. Questions on respondent characteristics may be used in regression equations to estimate a valuation function for the good, and/or as partial evidence for the valuation's reliability and validity. The actual questions on willingness to pay or willingness to accept compensation can take a number of forms. Two examples which are often cited are the open-ended form and the dichotomous choice form.

Open-ended questions are very simple. They ask the respondent to put a value on the goods in question. In respect to this research an example would be:

> "What is the maximum amount per fortnight your household or business is willing to pay for a community sewerage system? $___/fortnight"

Respondents do not usually find it easy to determine this value. They are not normally faced with situations in which they have to consider "value" in the way the question asks. For this reason other methods are frequently used. One of the most common is dichotomous choice.

The dichotomous choice question is normally presented as:

> "Is your household willing to pay $X per fortnight for a community sewerage system?"
>
> 1 Yes
>
> 2 No

where X is an actual dollar amount that is varied among respondents.

The dichotomous choice question aims to emulate the circumstances a respondent faces when purchasing a market good or service. From the answers given by respondents, average and total willingness to pay is determined using a logit or probit regression model. For the regression model to produce results that are statistically reliable, a large number of respondent answers are required. Interestingly, in a comparison of the reliability of open ended and dichotomous choice questions, Loomis (1990) found that both provided similar predictions of the long run value people placed on resources.

A contingent valuation survey is normally conducted by face to face interviews, telephone interviews, or mail questionnaires.

3.7.2 Limitations of the Contingent Valuation Method

The contingent valuation method is limited by the assumptions it is based on, and the biases that can occur in eliciting willingness to pay amounts. It is important that these limitations and biases are recognised. This is to ensure they have a minimal impact on a survey's design and application of its results.

Cummings, Brookshire and Schulze (1986) consider that contingent valuation is principally based on two assumptions. Firstly, that potential respondents have an incentive to determine their order of preference between the good being examined and other relevant goods and services. This assumption is equivalent to assuming that respondents behave as they would in real market situations. Secondly, that potential respondents will not behave strategically.

The contingent valuation method is limited by the extent to which these assumptions are satisfied. The first assumption may not be very well satisfied, for example, when open-ended willingness to pay questions are used. This is because respondents have difficulty answering such questions, so they may not devote enough time and effort to quoting a value that truly represents their valuation. The second assumption is violated when respondents try to influence the level of provision of a good. They can do this by over or understating their true willingness to pay for it. This is known as strategic bias, and is one of the less subtle forms of measurement biases that if present, can mean the results of a contingent valuation are unreliable. Measurement biases take a variety of forms. They often manifest themselves as the practical difficulties a researcher must overcome to obtain true and

representative answers. A complete list of potential measurement biases is presented in table 3.1.

Table 3.1 Potential measurement biases that can be present in contingent valuation studies.

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1. *Incentives to Misrepresent Responses*
   Biases in this class occur when a respondent misrepresents his or her true willingness to pay (WTP).
   A. *Strategic Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount (conditional on the perceived information) in an attempt to influence the provision of the good and/or the respondents level of payment for the good.
   B. *Compliance Bias*
      1. *Sponsor Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to comply with the presumed expectations of the sponsor (or assumed sponsor).
      2. *Interviewer Bias*: where are respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to either please or gain status in the eyes of a particular interviewer.
2. *Implied Value Cues*
   These biases occur when elements of the contingent market are treated by respondents as providing information about the "correct" value for the good.
   A. *Starting Point Bias*: where the elicitation method or payment vehicle directly or indirectly introduces a potential WTP amount that influences the WTP amount given by a respondent. This bias may be accentuated by the tendency of some respondents to agree with an interviewer's request regardless of their true views.
   B. *Range Bias*: where the elicitation method presents a range of potential WTP amounts that influence a respondent's WTP amount.
   C. *Relational Bias*: where the description of the good presents information about its relationship to other public or private commodities that influences a respondent's WTP amount.
   D. *Importance Bias*: where the act of being interviewed or some feature of the instrument suggests to the respondent that one or more levels of the amenity have value.
   E. *Position Bias*: where the position or order in which valuation questions for different levels of a good (or different goods) suggest to the respondents how those levels should be valued.
3. *Scenario Misspecification*
   Biases in this category occur when a respondent does not respond to the correct contingent scenario. Except in A, in the outline that follows it is presumed that the *intended* scenario is correct and that the errors occur because the respondent does not understand the scenario as the researcher intends it to be understood.
   A. *Theoretical Misspecification Bias*: where the scenario specified by the researcher is incorrect in terms of economic theory or the major policy elements.
   B. *Amenity Misspecification Bias*: where the perceived good being valued differs from the intended good.
      1. *Symbolic*: where a respondent values a symbolic entity instead of the researchers intended good.
      2. *Part-Whole*: where the respondent values a larger or smaller entity than the researcher's intended good.

   a. *Geographical Part-Whole*: where a respondent values a good whose spatial attributes are larger or smaller than the spatial attributes of the researcher's intended good.
   b. *Benefit Part-Whole*: where a respondent includes a broader or a narrower range of benefits in valuing a good than intended by the researcher.
   c. *Policy-package Part-Whole*: where a respondent values a broader or a narrower policy package than the one intended by the researcher.
3. *Metric*: where the respondent values the amenity on a different (and usually less precise) metric or scale than the one intended by the researcher.
4. *Probability of Provision*: where a respondent values a good whose probability of provision differs from that intended by the researcher.

C. *Context Misspecification Bias*: where the perceived context of the market differs from the intended context.
1. *Payment Vehicle*: where the payment vehicle is either misperceived or is itself valued in a way not intended by the researcher.
2. *Property Right*: where the property right perceived for the good differs from that intended by the researcher.
3. *Method of Provision*: where the intended method of provision is either misperceived or is itself valued in a way not intended by the researcher.
4. *Budget Constraint*: where the perceived budget constraint differs from the budget constraint the researcher intended to invoke.
5. *Elicitation Question*: where the perceived elicitation question fails to convey a request for a firm commitment to pay the highest amount the respondent will realistically pay before preferring to do without the amenity. (In the discrete-choice framework, the commitment is to pay the specified amount).
6. *Instrument Context*: where the intended context or reference frame conveyed by the preliminary nonscenario material differs from that perceived by the respondent.
7. *Question Order*: where a sequence of questions, which should not have an effect, does have an effect on a respondent's WTP amount.

Source: (Mitchell and Carson, 1989: Table 11-1)

The contingent valuation method is also limited by the difficulties encountered in determining an appropriate sample of respondents to survey, and the inferences that can be drawn from the survey results. If these difficulties are not given sufficient thought and consideration, the contingent valuation can still be biased, even in the absence of measurement errors. Table 3.2 identifies the biases that can result from these difficulties.

Table 3.2 Potential sampling and inference biases.

1. *Sample Design and Execution Biases*
   A. *Population Choice Bias*: where the population chosen does not adequately correspond to the population to whom the benefits and/or costs of the provision of the public good will accrue.
   B. *Sampling Frame Bias*: where the sampling frame used does not give every member of the population chosen a known and positive probability of being included in the sample.

C. *Sample Nonresponse Bias*[7]: where the sample statistics calculated by using those elements from which a valid WTP response was obtained differ significantly from the population parameters on any observed characteristic related to willingness to pay; this may be due some respondents failing to respond to the survey, or even just some of the questions in it.
D. *Sample Selection Bias*: where the probability of obtaining a valid WTP response among sample elements having a particular set of observed characteristics is related to their value for the good.

2. *Inference Bias*
   E. *Temporal Selection Bias*: where preferences elicited in a survey taken at an earlier time do not accurately represent preferences for the current time.
   F. *Sequence Aggregation Bias*
      1. *Geographical Sequence Aggregation Bias*: where the WTP amounts for geographically separate amenities that are substitutes or complements are added together to value a policy package containing those amenities, despite the fact that the amenities are valued in an order (for example, independently) different from the appropriate sequence.
      2. *Multiple Public Goods Sequence Aggregation Bias*: where the WTP amounts for public goods that are substitutes or complements are added together to value a policy package containing those amenities, despite the fact that the amenities were valued in an order (for example, independently) different from the appropriate sequence.

Source: (Mitchell and Carson, 1989: Table 12-1)

Unless avoided, measurement, sampling, and inference biases can make the results of a contingent valuation unreliable. A researcher will very rarely encounter all of these biases in a valuation. The ones that must be avoided will depend on the resource being valued and the form of the survey developed. The biases that this research needs to avoid will be considered in chapter 4.

3.8 Summary

The criterion used to evaluate investment in public infrastructure is the potential Pareto improvement. The potential Pareto improvement forms the core of welfare economics. A principle part of the potential Pareto improvement involves comparing a project's benefits and costs. This chapter set out the theoretical rationale for valuing the benefits of a small coastal sewerage system. It showed that a lack of well-specified property rights is the key reason for why sewage disposal has become a problem in small coastal communities. Until recently, many of the resources used to dispose of sewage were not owned in a way that allowed conflict between competing interests to be avoided. Externality theory provided

[7] Mitchell and Carson (1989) consider it virtually impossible to carry out a survey without some non-response bias.

insights into what decision-makers must determine, along with the difficulties they face in gaining the real system costs and payoffs for each household. The theory of value revealed the link between what people are willing to pay and changes in their welfare.

This chapter also identified the contingent valuation method as being the most suitable to value the benefits of adequate sewerage. It is the only technique that can be used to determine both use and non-use values. The next chapter will develop the technique to meet the purpose of the research.

4 Methodology

4.0 Introduction

As discussed in chapter 3, the method chosen for this research is contingent valuation. The contingent valuation method takes the form of a survey. It relies on individual responses to changes in circumstances described in an artificially constructed market (Stoll, 1983). In this chapter the development of the survey instrument, the relevant population, and the implementation strategy for the survey will be discussed.

4.1 Identification of Benefits

On-site septic tank soil absorption systems are the prevalent form of sewage treatment in small coastal communities. Benefits are forgone when the appropriate conditions necessary for these systems to function adequately are absent. An adequate sewage disposal system will provide benefits by eliminating the adverse effects of current inadequate sewage disposal. A sewerage system can either eliminate these effects or it can not. For different types of sewerage systems that do eliminate the adverse effects, the benefits they provide (eliminated effects) are essentially the same.

Table 4.1 identifies the benefits of an adequate sewage disposal system. It does this according to the type of economic value gained from them, as discussed in chapter 3. The benefits in table 4.1 were comprised by consulting several sources of information. This included general literature on the subject, the Far North District Council, and some residents in the communities where reticulated sewerage is proposed. These benefits are likely to be similar across all small coastal communities. Still, consultation is important to become familiar with any benefits not identified here, and with the terminology local residents use to describe any effects.

Table 4.1 The benefits of a community sewerage system.

	Benefits			
	Ecological	Aesthetic	Health	Dwelling
Direct and Indirect Use Value	Improvements in the general quality of recreational experiences. A possible improvement in recreational fishing catches. A more natural balance of marine life to allow improved on-site observation of fish, wildlife, plants etc. Support for indirect off-site uses. Greater tourism advantages with a reputation for being clean and green.	Clearer water for boating, swimming and other recreations. No odour problems.	Smaller pathogen numbers, so lower skin and ear infection rates. Fewer sick days. Smaller cost and need for preventative measures.	Less contaminated groundwater and soil. More convenient sewage disposal with less stress and disruption. Higher property value. A more aesthetically pleasing back yard. Lower cost of maintaining public and private property through better soil support, preventing surface water run-off and erosion etc.
Option Value	Prevention of marine life deterioration. Less risk of marine disasters such as Algae Blooms. Bequest motivation due to possible vicarious consumption.	No risk of sewage spillovers & therefore - water dis-colouration - floating oil - bobbing solids. A certain supply of aesthetically pleasing qualities for the future.	Less risk of a serious disease such as hepatitis A or typhoid.	
Non-use Value	Knowledge of a more certain and stable composition of marine life. Bequeathing children and relatives with a more stable ecological environment.	Knowledge of a "cleaner" more aesthetically pleasing environment. Endow children and relatives with a more aesthetically pleasing environment.	Leaving descendants with an environment where there is less risk of ill health.	Desire to bequeath a property of higher value than would be the case in the absence of community sewerage.

Some benefits, such as possible reductions in public health expenditure, and a better international reputation for tourism and standing on environmental issues, are not mentioned in table 4.1. There are two reasons for this. The first is that a lot of these benefits are negligible. The second is that the population asked to pay for the sewerage system will not perceive these as benefits to themselves. The relevant population is considered in the next section.

4.1 The Relevant Population

An important step in developing a contingent valuation survey, is to identify the population that is likely to be affected by the proposed project (Mitchell and Carson, 1989). Since the majority of the benefits of community sewerage rest with the receiving community, this makes them the relevant population. In New Zealand the community potentially benefiting from the proposed system is also required to pay for it. This requirement goes well with the pre-condition that a contingent valuation survey is conducted on the population receiving the benefits of a good.

In the case of community sewerage, even if some of the benefits fall outside the community, it is more practical for them to be considered separately. On a case by case basis, it is very difficult to get potential respondents from outside the community to express a value for an improved coastal environment next to the community. The respondents are more likely to give a value that corresponds to all coastal communities, not just the relevant one. This problem is known as the "embedding effect" (Kahneman and Knetsch, 1992). The very localised impact of inadequate sewage disposal in a small coastal community, also means that there are normally plenty of substitute sites for non-community members.

The amount people are willing to pay for the benefits and use of community sewerage reflects their value for it. This is because the value of a good stems from the benefits it yields. The contingent valuation method works by getting people to think about these benefits before they determine their value (or maximum willingness to pay) for the good. However, historically sewerage systems have been at least partially financed through rates. The person who pays the rates for a premise, may not be an occupant of that premise. The rate payer in such a case would not be the principal beneficiary of the services of the system, rather the tenants would. Since the tenants would experience the majority of the

benefits of the system, it is them and not the absent rate payer that need to be surveyed. It becomes apparent that surveying the users of a proposed sewerage system is potentially at odds with a council's intended financing mechanism. Still, it may not be unrealistic to think that in the case of rates, an increase would be passed on to the actual users of the system (tenants). The difficulty here is in finding a realistic payment vehicle for users. This will be considered in section 4.4

To form the list of potential respondents the potential users of the proposed sewerage system had to be identified. For the case study communities this required soliciting information from the Far North District Council. The Council had a list of ratepayers and property addresses, but little knowledge of what properties were rented and the identity of those who occupied them. For Horeke, because it is a small coastal community with 50 or so premises, the problem was easily overcome by consulting knowledgeable community members.

In the case of Russell, the process was much more difficult. With over 450 premises the only feasible method that could be used, was to subjectively determine from the list of ratepayers and property addresses what properties were likely to be rented. Where a ratepayer owned more than one property, he/she was considered as a potential respondent, along with the property occupants (even if they couldn't be identified, their location was). The introduction of holiday homes made the process more complicated, so most ratepayers, even if they never occupied a premise in Russell, were part of the potential respondent list. The difficulty in constructing a potential user list in Russell meant that some tenants would not have been surveyed.

4.3 The Survey Form

Contingent valuation surveys are conducted using personal interviews, telephone interviews and mail questionnaires. What form or method is chosen to conduct the survey will depend on the population to be surveyed, the objectives of the survey, and the constraints to undertaking the survey.

The households and businesses in a small coastal community that will use a proposed sewerage system, have been established as the survey population. Because this population is

very small, a full census rather than a sample will give a much more reliable indication of community's total willingness to pay.

The objectives of the survey provide the primary direction to determine what form of it is best. In this research the survey has three objectives:

1. to obtain an accurate indication of a given community's willingness and ability to pay for a community sewerage system,
2. to provide information to determine the most significant factors influencing the amount an average household is willing to pay, and
3. to gain information on the perceived and current consequences of poor sewage disposal in the coastal community.

Obviously the first objective is of primary importance, but the second and third objectives are also necessary to provide decision-makers with information that will help them to better meet the needs of their communities. This may be information on respondents opinions, knowledge, or experiences. It might also be on the level of the respondents understanding. Both types of information give decision-makers a better indication of the need to educate their communities.

The main purpose of this research, is to provide a methodology that allows decision-makers to determine if a community financed sewerage system would be a potential Pareto improvement. Specifically, if it would be a potential Pareto improvement in a small coastal community. Since the resources of decision-makers are not unlimited, the chosen form of the contingent valuation method needs to conform to constraints in the form of time, budgets and labour expertise.

Given the survey population, the three objectives of the survey and the constraints the survey must satisfy to meet the purpose of the research, a mail questionnaire is the best form of the contingent valuation method. There are many advantages and disadvantages to each of the three survey approaches. In general, the mail questionnaire is considered less favourable than personal interviews or telephone interviews. However, it was selected because it best meets certain key requirements of the study.

The most significant advantage that the mail survey provides, is a lower cost. Mail questionnaires are the most economical of all methods (Gardner, 1978). No training of

interviewers is required and no expensive travel costs are incurred. The absence of travel costs is very significant given the likely diverse geographical locations of holiday home owners. The low cost is important because if obtaining the desired information involves high transaction costs, it may not be perceived as worthwhile enough to obtain.

The advantage personal interviews have over mail questionnaires, is that the interviewer can tailor the questions to a respondent's circumstances (Mitchell and Carson, 1989). The interviewer can skip irrelevant questions and repeat questions the respondent is uncertain about. Compared to an equivalent mail questionnaire an interviewer is likely to obtain more responses to each individual question. However a mail questionnaire is not subject to interviewer bias. This is important given that a Council decision-maker conducting an interview, intentionally or unintentionally, is likely to bias the true results. Further, a mail questionnaire does not take up as much personnel time to conduct as personal or telephone interviews. Given the likely work environment of the decision-maker wishing to conduct such a survey, this is another important advantage.

The two most significant disadvantages of mail questionnaires, compared to interviews, are low response rates, and sample selection bias (Mitchell and Carson, 1989). Sample selection bias results, for example, from a small proportion of low income earners returning the questionnaire because they have difficulty understanding or reading it. However, all other shortcomings of mail surveys may be overcome if respondents are familiar with the amenity (Mitchell and Carson, 1989). Further, the significance of these two disadvantages is reduced when the questionnaire is well designed. It is also reduced when the respondents take an active interest in the service and benefits being valued. Studies have found that nonresponse is often associated with a lack of interest in the topic of the survey (Mitchell and Carson, 1989). It is unlikely that respondents in the surveyed community would lack interest in an adequate sewage disposal system, given the benefits they would receive and the financial costs they could incur.

In general, mail questionnaires are used when taking a population census (Gardner, 1978). This is consistent with the aim to survey all households and premise occupants in a given coastal community. It is also fair to say that the type of questions being asked, so the survey elicits the required information, are not of a complex nature. Thus the questions needed for the sewage disposal scenario in a small coastal community, are more congenial to the use of a mail questionnaire than the questions needed for other surveys.

4.4 Questionnaire Design

Just as there is no clearly superior survey method that yields better results for all types of questions, there is no single correct version of a questionnaire (Mitchell and Carson, 1989). The survey questionnaire developed for this research can be viewed in appendix 5[1]. To a large extent its design and construction followed the Total Design Method developed by Don Dillman (1978). While it is tedious to go through all the intricacies of the design and question wording, significant characteristics of the survey will be highlighted, and reasons for chosen features given. This is to justify the questionnaire's design so possible future users do not inadvertently adjust key features.

4.4.1 Respondent Impressions

The professional image of the survey is highly influential in enhancing the importance of it to the respondent (Dillman, 1978). The booklet format, carefully designed cover pages, a quality printing job, good quality paper etc. are all important to inspire confidence and authenticity in the survey and its sponsors (Gardner, 1978). The end result must be aesthetically pleasing while maintaining question and page structure to keep respondents from skipping individual items or whole sections of the questionnaire (Dillman, 1978).

A covering letter is included with the survey (see appendix 5). Its basic aim is to communicate the appeal of the survey. An explanation of the study topic, the benefit to the community which the respondent is part of, and the importance of the respondent to the survey's success, are all emphasised (Dillman, 1978). The letter is reproduced on Massey University letterhead to emphasise the non-commercial nature of the survey, its professional image, and the reputable stature of the institution from which the survey is conducted.

The front cover of the questionnaire is very important because it contributes to a respondent's first impressions of the survey and receives the most attention. It includes the

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[1] The questionnaires for Russell, Tapeka and Horeke are identical apart from small alterations to the willingness to pay section. These alterations occurred because of the different charges required in each community, and because Russell and Tapeka know they are definitely getting a system, whereas for Horeke the decision has yet to be made. Russell and Tapeka, while sharing the same system will be sent distinguished questionnaires. This is because some members of each community regard them as having a very separate identity.
These questionnaires have been developed to use in small coastal communities where no decision has been made to build a reticulated sewerage system. For this reason Horeke was chosen as the community the appendix questionnaire refers too.

study title, a graphic illustration, any needed directions, and the name and address of the institution conducting the survey (Dillman, 1978). It is an offsetting colour to the white pages used for the rest of the questionnaire.

On the first two inside pages of the questionnaire, the background of the survey topic is given. This is informative and sets the scene for the rest of the survey. It provides respondents with a neutral description of the sewage disposal problem, so they can start thinking about their own experiences, their values, and their subjective risk of adverse effects from "inadequate" sewage disposal.

4.4.2 Questions

Writing the questions of a questionnaire requires some considerable thought. They must be written for a particular population, a particular purpose, and placement in a sequence that retains the respondent's attention (Dillman, 1978). The questions in the questionnaire found in appendix 5 were written for a small coastal community where a decision to provide adequate sewerage has not been made. The questions were formulated in a style and sequence with the specific aim of gaining information that allows a more informed decision to be made. In doing this the following questions were asked about each question in the survey:

> Will it obtain the desired kind of information?
> Is the question structured in an appropriate way?
> Is the precise wording satisfactory?
> (Dillman, 1978: 118)

When these three questions are answered in the affirmative the questionnaire is constructed in a manner that allows it to be its own advocate. This is important because without an interviewer, the questionnaire comes under the respondents complete control (Dillman, 1978).

There are four parts to the survey questionnaire developed for this report. These are: respondent sewage disposal practises; benefits the respondent(s) might derive from a community sewerage system; elicitation of respondent willingness to pay; and respondent details. All four, while not explicitly identified, are self-evident. What is important to note is the ordering of the sections and the preamble that links one section to the next. The order has been chosen to get respondents to think about the benefits they might obtain from a

community sewerage system, before the questions on willingness to pay are asked. The preamble or written transitions help to establish a vertical flow and continuity to the questionnaire (Dillman, 1978).

Since the first question, and the question on willingness to pay, are the most important in the questionnaire it is beneficial to identify the reasons for the form they have taken. The first question is the most crucial because it has a big influence on whether the questionnaire is destined for the mailbox or the rubbish bin (Dillman, 1978). The first question has been chosen to be applicable and interesting to everyone. Even though it does not contribute to the objectives of the survey, its purpose is to bridge the gap between the background and the rest of the questions. It also aims to try and make respondents feel as though their views are important. Since the questionnaire takes a full page, it has been designed to give the questionnaire the appearance of being fast and easy.

The form of the willingness to pay section and question structure has been partially determined by the selection of the mail survey method. Bidding games and other similar methods to elicit the willingness to pay amount, cannot be considered once a mail questionnaire is chosen. Due to the very small population in the communities of interest, dichotomous choice or the binary YES/NO format can not be used either. This is because there would in insufficient data to derive estimates of average and total willingness to pay. Therefore, to determine the maximum that a respondent is willing to pay for adequate sewage disposal services, a variation of the open ended question format has been used.

Open-ended questions have been subject to substantial criticism. In a report to the National Oceanic and Atmospheric Administration Panel on contingent valuation, Arrow, Solow, Leamer, Portney, Radner and Schuman (1993) did not recommend the open-ended format to elicit a respondents willingness to pay. Common reasons for this, as cited by many experts in the field (see Mitchell and Carson (1989); Ready et al. (1996)) include that it is more susceptible to strategic and non-response bias than other methods. Further, if respondents are in some sense unfamiliar with the good, they may have difficulty determining a value for it. Nonetheless in some cases, as acknowledged by Mitchell and Carson (1989) the format has worked well. When working with a mail questionnaire and a very small population, it is the only available option.

"Unfortunately respondents often find it difficult to pick a value out of the air, as it were, without some form of assistance, just as they tend to be hard pressed to determine the highest price they are willing to pay for items at a garage sale in the absence of price tags" (Mitchell and Carson, 1989: 97). To help alleviate this, a question stating the likely cost per fortnight (although the respondent is given no indication of this) and asking for a YES/NO answer is presented before the open ended question on the maximum willingness to pay. This approach is also consistent with evidence that suggests respondents faced with an open-ended solicitation of their willingness to pay, will give specific consideration to the likely cost of producing the good (Hanemann, (1996); Knopp, Pommerehne and Schwarz (1997)). Implicitly stating the value saves the respondent from the mental fatigue of doing this. Respondents often assume the numeric value provided as part of a question is an expert cost estimate of providing the good (Knopp et al, 1997). The down side of this is that people do not like paying more for a commodity than it costs (Hanemann, 1996).

For Russell, Tapeka and Horeke the cost per fortnight has been calculated by the Far North District Council. The Council calculated this fortnightly amount by apportioning the total cost of the system across each user over the system's life. A significant advantage of the open-ended format is the simple analysis that results from soliciting a respondent's maximum willingness to pay. In the case of this research the fortnightly cost calculated by the Council can be compared to average respondent willingness to pay. If the average willingness to pay is greater than this fortnightly cost, then the project is a potential Pareto improvement for the community. If not, then the likelihood that it is a potential Pareto improvement for the wider community, must be considered independently.

As payments for services such as sewage disposal are made at the household or business level, this is the level the respondent is directed to answer the willingness to pay questions at. According to Mitchell and Carson (1989), the willingness to pay question is answered as a holistic assessment rather than conscious summing of each of the different benefits gained, to reach a total value. For this reason the question is framed in aggregate terms.

The willingness to pay section is framed in a way that is consistent with the payment vehicle described in the preamble above the questions. The payment vehicle is a charge made by a stand-alone sewerage utility. The questions are based on a fortnightly amount. The reason why they are not expressed in monthly terms, and therefore consistent with

charges for other services such as power and phone, is because the fortnightly charge is more consistent with most household income and expenditure patterns.

The payment vehicle used to ask the willingness to pay questions has been chosen because it is the way the communities in this research will most likely be asked to pay for adequate sewage disposal services. Respondents don't just value services and amenities in abstract, but also the conditions under which they will be provided, including the way they will be asked to pay for them (Mitchell and Carson, 1989). The other beneficial thing about this payment vehicle is that it is independent of council financing mechanisms. The use of this neutral payment vehicle may mean that potential respondents which are hostile to the council are more willing to reveal their true value for community sewerage.

4.4.3 Biases of Particular Relevance to the Questionnaire Methodology

A bias is a one sided inclination that causes the actual answers to deviate from the true answers. One of the most significant forms of bias is strategic bias. If a respondent behaves strategically, he or she will either overstate their true willingness to pay amount in an effort to ensure the service is provided, or "free ride" and understate their true willingness to pay amount, in anticipation that others will pay enough for the service to be provided anyway. The possibility of strategic behaviour in the research surveys may be a very valid concern. Nevertheless, a significant number of studies have found that there are important factors which mitigate against strategic behaviour including, information costs, and the adherence to social norms of altruism, fairness and honesty (Mitchell and Carson, 1989). In this sense, a well-constructed survey deters strategic behaviour.

A form of strategic behaviour that may be of particular concern in the case study surveys is effort minimisation. This occurs when the respondent believes that the provision of the service is inevitable and that there will be no relationship between what is offered and what will have to be paid (Mitchell and Carson, 1989). It may mean that the respondent does not make much of an effort to think about his or her answers. It may also mean he or she doesn't bother to respond. This could well be evident in the results from Russell, given its turbulent history of proposals for adequate treatment. Whether "active interest", mentioned in section 4.3, is sufficient to counterbalance effort minimisation, can only be considered once the methodology has been applied.

Other forms of bias, besides strategic bias, that may have particular relevance to the mail questionnaire developed include, starting point bias, instrument bias and sample selection bias. Starting point bias is where the respondent's willingness to pay amount is influenced by the amount first introduced (Mitchell and Carson, 1989). This is one of the side effects of eliminating the need for the respondent to "pick a value out of the air". Only careful consideration of the amounts obtained will indicate whether starting point bias influences the results of the questionnaire used in this research.

Instrument bias is where the method for collecting or paying the amount offered may influence its magnitude (Kerr, 1986). This is most significant where nothing is offered for the service, even though the respondent's true willingness to pay is above zero. The question asking respondents why they were not willing to pay anything (if they offered a zero amount), was to distinguish between respondents protesting against the payment vehicle (instrument) and those who truly weren't willing to pay anything.

Sample selection bias is bias that occurs because people have the opportunity to select for themselves whether they will participate in filling out the questionnaire (Mitchell and Carson, 1989). It has already been briefly considered in section 4.3, but generally results because some respondents find the questionnaire difficult to understand or irrelevant. Pre-testing usually results in changes to the questionnaire that reduce sample selection bias.

4.2.4 Pre-testing

One of the principal means of reducing bias is pre-testing. Pre-testing can help avoid bias by making the questionnaire clearer and providing people with the information they need to make their decisions (Mitchell and Carson, 1989). Areas in the questionnaire that are not understood by potential respondents can be revised. This reduces the chances of a respondent selecting not to return or complete the questionnaire because it was difficult to understand. Further, pre-tests can help identify any background or payment vehicle misspecification that may influence respondent answers, or provide them with the wrong information.

Pre-testing is probably the single most effective way of enhancing a survey's reliability (Mitchell and Carson, 1989). It can consist of trying the questionnaire on experts, colleagues, friends and acquaintances (Gardner, 1978). Small focus groups may also be

used to discuss the questionnaire and each individual question. At the end of the pre-testing the following questions should be asked:

> Are each of the questions measuring what they intend to measure?
> Are all the words understood?
> Are questions interpreted similarly by all respondents?
> Does each close-ended question have an answer that applies to each respondent?
> Does the questionnaire create a positive impression, one that motivates people to answer it?
> Are the questions answered correctly? (Are some missed, and do some elicit uninterpretable answers?)
> Does any aspect of the questionnaire suggest bias on the part of the researcher?
> (Dillman, 1978: 156).

With the exception of the last, unless these questions are answered in the affirmative, adjustments need to be made to the questionnaire. For the purposes of this research, the questionnaire has been developed and revised according to the recommendations of experts in survey and question construction – the thesis supervisors. It has also been tested on friends and acquaintances, staff members at the Far North District Council, and a limited number of people from each community. These tests resulted in a number of suggestions with revisions made accordingly.

Since variations in the survey itself could induce small changes in the answers of some respondents, and since the answers of respondents will vary according to their state of mind at the time they complete the questionnaire, lower and upper bounds of the average willingness to pay are often estimated. These bounds can be used to determine the likelihood of the benefits of a given system being greater than the costs. Evidence for justifying this approach and realising the limitations of any survey, including a questionnaire, comes from a paper on follow-up questionnaires by Cameron and Quiggin:

> "The implication of the empirical findings in this paper is that respondents seem not to hold in their heads a single immutable "true" point valuation of an environmental resource. At best, they may hold a distribution of values – amounts they would be willing to pay with some associated probability density. This might be interpreted as "uncertainty". Whenever they are asked to draw value for the resource, they make a draw from this distribution...."
> (Cameron and Quiggin, 1994: 233).

4.2.5 Follow-up Mailings

In any questionnaire, follow-up mailings after the original posting must be prepared in order to obtain a good response rate. "Without follow-up mailings, response rates would be less than half those normally obtained using the Total Design Method,..." (Dillman, 1978: 180).

The first follow-up used is a postcard sent as a reminder to those who haven't returned their questionnaire, and a thank you to those who have. It is normally sent one week after the questionnaire is mailed out. The postcard is convenient to both the researcher and respondent, and introduces variety to the survey process (Dillman, 1978). Its contents can be considered in appendix 5.

A second follow-up three weeks after the original mail-out can be sent to non-respondents. It consists of a shorter cover letter that informs non-respondents that their questionnaire has not yet been received, and a replacement questionnaire with another return envelope is included (Dillman, 1978). The covering letter appeals for the questionnaire's return. A third follow up, which is generally sent seven weeks after the original mailing, is very similar.

For the purposes of this research, it is not expected that the second and third follow-ups will warrant the expense and time necessary to undertake them. The decision-maker conducting a survey in a small coastal community must assess the likelihood that these follow-ups will be required. In a small coastal community with 50 or less premises, expense and time will not generally be prohibiting factors. The large number of potential respondents in this research make follow-ups a much more arduous task given the resources available.

4.5 Summary

The construction of a questionnaire to determine what people are willing to pay for the benefits of a community sewerage system, is by no means easy. For decision makers facing similar tasks in the future, the questionnaire developed in this thesis is a good starting point. With a little bit of tinkering it could easily be adapted to the individual circumstances of some of the many small coastal communities up and down the country. The important point to note is that this tinkering is not the same as significant alteration. As considered in this

chapter, there are very good reasons for the layout, design and construction of the questionnaire. The results it yields and possible suggestions for altering its design and delivery will be discussed in chapters 5 and 6.

5 Data Analysis and Results

5.0 Introduction

A vital part of providing decision-makers with an improved information base is the analysis of basic data. Data analysis transforms answers obtained from surveys in to clear and succinct information, useful for decision making purposes.

The data obtained in the three surveys for this research, concern the willingness to pay of households and businesses for a proposed community sewerage system. Specifically their willingness to pay for the benefits of community sewerage, such as improvements in coastal water quality. The surveys also elicited information on the type and age of the sewerage systems in place, the problems experienced with these systems, peoples use of the local coastal environment, and their perception of sewage pollution problems in it.

In this chapter the process of aggregating and analysing the raw data from survey questionnaires is described, and the results so obtained are discussed. In the first section the preparation of the data set, which is to be used for the analyses, will be outlined after which the particular analyses undertaken and the results obtained will be discussed.

5.1 Preparation of the Data Set

All the data obtained from the surveys were entered on a spreadsheet as soon as the questionnaires were returned. This had the advantage that when the final cut-off date for questionnaire returns was reached, little additional inputting of data was required. The final cut-off date was approximately eight weeks after the questionnaires were first sent out.

The total response rate at the end of this eight week period was just over 50% for the whole survey. For the three communities Russell has a 50%, Tapeka a 60% and Horeke a 37% return rate. However, while these are the response rates for the questionnaires returned, the number of individual questions answered varied. In part this was due to respondents not knowing the answer (e.g. some people didn't know the age of their sewerage system so left

the question blank) or to an unwillingness to answer the question. This latter situation was the case with the willingness to pay question.

The answers to the willingness to pay question (question 19) needed to be carefully scrutinised. For the given answer to be valid, the respondents must not be biased against revealing their true willingness to pay because of the vehicle used, or because of past council management of the sewerage issue. It was expected that some bias may creep into the survey and for that reason question 20, eliciting information from the respondent that may indicate bias, was strategically placed after the willingness to pay question. The results show that this strategy worked since many respondents stated they were not willing to pay any amount for a new sewerage scheme because the council had mismanaged community sewerage in the past. Their answers therefore (mostly zero) cannot be used in the results since they do not reflect the respondents true willingness to pay for the benefits a new sewerage system would provide, rather they are protest votes. These willingness to pay answers were therefore removed from the data set. Of course it is possible that some people who responded with a positive amount to the willingness to pay question biased their answers downwards for the reason mentioned above. It was unlikely however that these people would not have indicated their opinion in question 20 or at the back of the questionnaire (where another opportunity to comment was provided). Again if any bias was detected in any of these answers the willingness to pay answer was removed from the data set. As it turned out, only two respondents fell into this category.

A final question that needed to be dealt with, before completing the data set, was how to deal with missing values. Missing values become a problem when statistical techniques, such as regression analysis, are applied to the data. Rather than delete from the data set all respondents with missing answers, it is preferable to impute some of the missing values so as to obtain a larger data set. This is of course a very subjective process and open to criticism. The reason for taking this path was to be able to use as much information as possible from the questionnaires in light of the return rate being 50%.

The most common approach to imputing missing data is to use ad hoc methods based on the answers of other respondents (Mitchell and Carson, 1989). This was the approach used in this research. Missing values for variables such as expenditure by respondents on their current sewerage system, and age and income, were simply replaced with the averages obtained for the community. For variables such as the number of occupants per dwelling

and education level, the community median was used. This was because these variables are either qualitative or can only take the from of a whole number. Where respondents did not know whether or not they had suffered ill health as a result of inadequate sewage disposal in their community, the decision was made to indicate that they hadn't unless they had stated what activity the ill health problem resulted from. The cultural significance variable was more difficult. For the few respondents who had not answered the question, the imputed answers were varied between Yes (1) and No (0), according to the respective percentage of yes and no answers in each of the communities. The full data set is presented in appendix 7.

5.2 Analyses and Results

The data obtained from the survey can be analysed in four parts. These parts are: the state of current sewage treatment, use and value of the coastal environment, willingness to pay for a new sewerage system, and general background information on the communities. The summary statistics obtained from the questionnaires are presented according to these four parts in appendix 6.

5.2.1 The State of Current Sewage Treatment

The question on washing wastewater shows that in Horeke and Russell a high proportion of the washing wastewater goes to septic tanks (65% and 86% respectively). This may be of some concern considering that detergent and other substances in washing wastewater may impair the biological processes present in a tank. In Tapeka the percentage of respondents who said their washing wastewater went to a public drain and the percentage of those indicating the 'other' destination, can probably be aggregated to indicate the percentage of wastewater going to the community treatment system.

The destination of respondent sewage is fairly predictable. In Russell 94% of respondents indicated their sewage went to a septic tank. In Russell and Tapeka, from the explanations volunteered in the returned questionnaires, it is probable that the majority of 'other' destinations are more sophisticated on-site treatment systems. In Horeke however, a high proportion of the 'other' destination and the sewage well/pit destination are probably long drops.

The low percentage of respondents who indicated their washing wastewater goes to a different location than their septic wastewater is disturbing, particularly in Russell (12%) and Horeke (40%) where the dominant destination of sewage is septic tanks. The percentages given here were found by recording the number of respondents who indicated different destinations in question 3 and question 4.

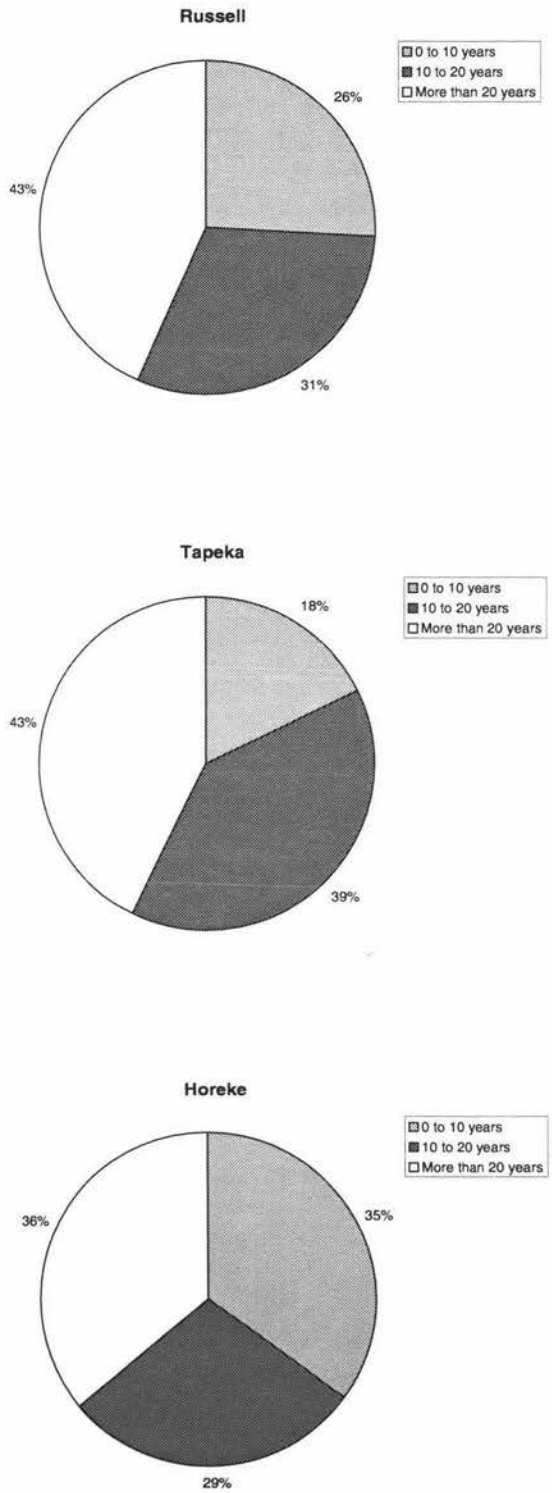
The age distribution of respondent sewerage systems obtained from question 5, indicates that in all three communities the largest proportion of respondents thought their system was more than 20 years old. In Tapeka the majority of respondents are connected to a community system, but the system age distribution suggests that many respondents have no idea of how old their system is. A comparison of each community by the proportion of systems in each age group is given in figure 5.1.

The percentage of respondents who think their system needs major restoration is similar in Horeke and Russell (35% and 34% respectively) but much higher in Tapeka (75%). These percentages probably reflect a combination of the deteriorated state of some existing systems, and the attitude of some respondents faced with paying for a community system.

Interestingly, the percentage of respondents who indicated that they have had some sort of problem with their system is very similar in all three communities; 45% in Horeke, 44% in Russell and 48% in Tapeka. The high percentage (36%) in Tapeka who said they have had an overflow and/or a blocked system, may stem from problems at the actual treatment site, or it may stem from problems with the reticulated piping from each premises.

With the removal of outliers the average amount spent by Russell respondents ($85) on their current sewerage systems is very similar to that of Horeke respondents ($90). The dominant sewerage system in both communities is septic tanks, so these figures most likely reflect pumping out costs. In Tapeka the figure of $298 reflects the rates Tapeka respondents pay for sewerage services. As the actual amount of rates paid for sewerage services is $509, the figure of $298 is probably lower because some respondents are not on the system or own a section and do not pay the full amount. It may also be due to the fact that only a portion of the $509 goes to servicing the existing system.

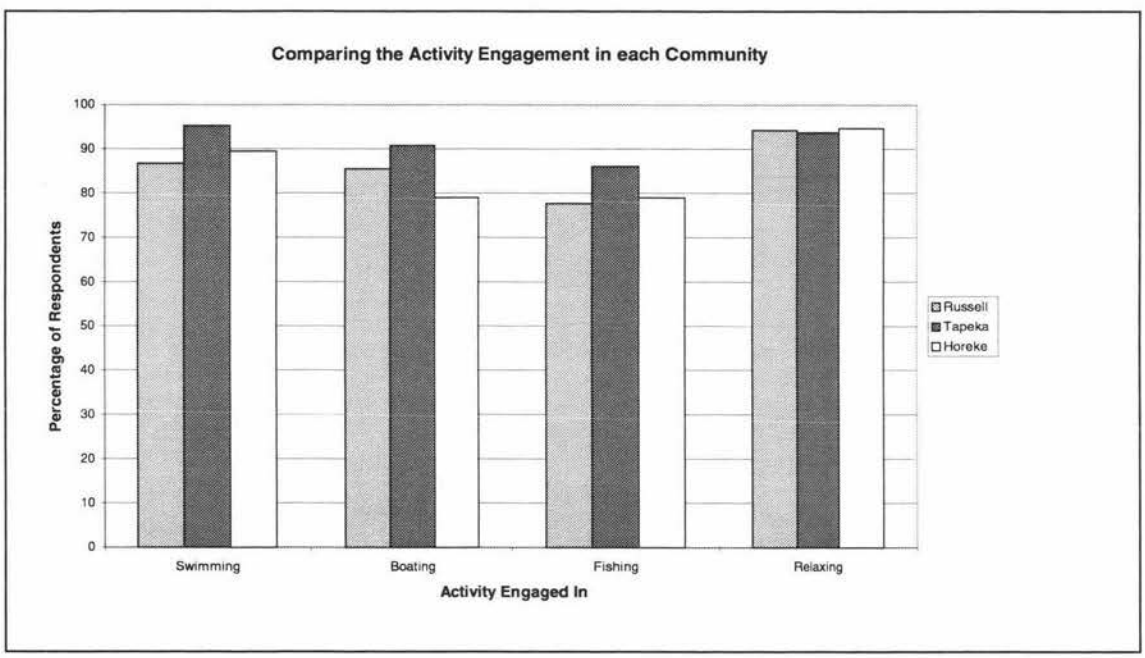
Figure 5.1 Age distribution of respondent sewerage systems in Russell, Tapeka and Horeke.



5.2.2 Use of the Coastal Environment

The answers to questions 9, 10, 11 and 12 of the questionnaire, show that a high proportion of the respondents from each of the coastal communities engage in the activities identified. This was of course expected, but it confirms that people who live, work and holiday in small coastal communities gain enjoyment from engaging in activities that are made possible by being in the coastal environment. Passive use, represented by "Relaxing" (viewing the wildlife and scenery etc.) is the activity that the highest proportion of respondents engage in. Figure 5.2 shows the percentage of respondents from each community who engage in swimming, boating, fishing and relaxing.

Figure 5.2 Respondent engagement in coastal activities.



For each of the three communities surveyed, the percentage of respondents who thought they have had a health problem that stemmed from the sewage disposal in their community, is low. The Russell percentage (11.2%) is over twice that found in Horeke and Tapeka (approximately 5% for both). Even so, the fact that the majority of problems are skin or ear infections suggests that ill health resulting directly from inadequate sewage disposal is not significant. Predictably the majority of problems resulted from swimming, but it is really only a respondent's opinion as to whether or not the problem came from sewage disposal. The relatively high percentages in the 'did not know' category provide a good indication of respondent uncertainty in this regard.

Since 85% of respondents from Horeke consider the coastal water to be of cultural and/or spiritual significance, this percentage indicates that the composition of values for the coastal environment in this community is different to that of Russell or Tapeka. In Russell and Tapeka the percentages are only 44% and 31% respectively.

People who rely on the quality of the coastal environment for their work and income make up a good proportion of each of the three communities. The Russell percentage is by far the highest at 35%, while for Horeke it's 25% and for Tapeka it's 18%. The high percentage for Russell is probably a reflection of its tourist trade.

5.2.3 Willingness to Pay for a New System

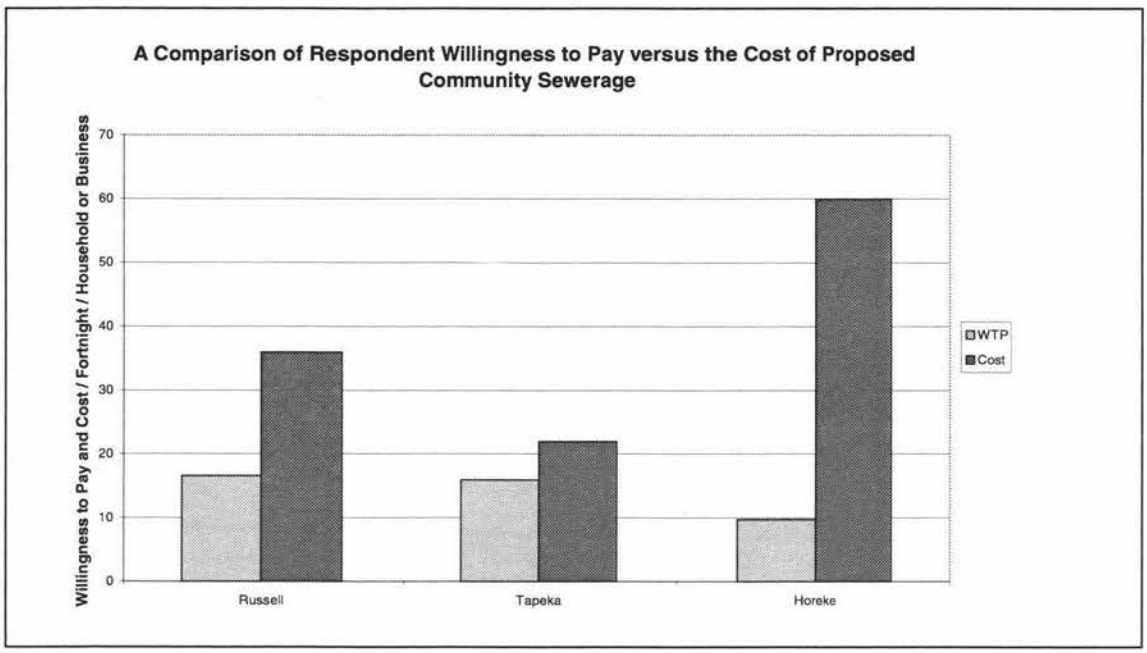
The willingness to pay of respondents for a new system is to a large extent dependent on the benefits they think they will obtain from it. Some of the likely 'premise' benefits of a community system over an on-site system include better reliability, more convenience and absence of odour. 84% of Tapeka respondents and 78% of Russell respondents thought that a new system would provide them with such benefits. The percentage for Horeke is much lower – 50%. This may be part of the reason for the significantly lower willingness to pay of Horeke respondents, as determined in section 5.3.5.

When it comes to the actual willingness to pay of those who gave valid answers, without exception the average amount is less than that required to finance the proposed community sewerage system. The average amount respondents are willing to pay per fortnight in Horeke ($9.75) falls well short of the $60 required to finance the system. Likewise, the $16.60 in Russell falls short of the $36 required. In Tapeka the average willingness to pay of $15.97 is not significantly different to the figure of Russell respondents, but with $22 per user required to finance their share of the two communities joint system, their shortfall is not as large. This is depicted in figure 5.3.

A confidence interval for the point estimate of average willingness to pay can be calculated to account for possible errors in the estimate. In a census these errors could include biases not accounted for and lack of representation. Variations in the estimate may also result because of the chosen survey instrument and respondent uncertainty[1].

[1] Refer to chapter 4.

Figure 5.3 Comparing willingness to pay to the cost of community sewerage.



Following the approach taken by Darling, Gomez and Niklitschek (1993) a confidence interval that is within plus or minus 40% of the estimate for Tapeka ranges from $9.58 to $22.36. The $22 required to finance their share of the joint system falls within this interval. The interval is wide because of the many potential influences on the average estimate which are hard to account for. The interval for Russell ranges from $9.96 to $23.16. For Horeke the confidence interval ranges from $5.85 to $13.65. It is evident that neither of these intervals encompasses the amounts required to finance their systems. The implications of these findings will be examined in the concluding chapter.

What is interesting to note from the results of question 21 is that swimming & boating, and fishing & shellfish collecting, are consistently the top two reasons in each community for preventing sewage wastewater pollution. This may well be due to respondents interpreting these activities as being those that are most directly affected by sewage wastewater pollution. 'Benefits to others' is the next most common reason. It can be interpreted as respondents wanting to live and act for the good of others. Cultural and/or spiritual values, as would be expected given previous results, are also an important reason for preventing sewage pollution in Horeke.

5.2.4 General Background Information

In considering the respondent groupings obtained from question 2 of the questionnaire, it seems that the majority of respondents are homeowners. Given the difficulty of identifying home renters for the Russell and Tapeka mailing lists the low percentage of respondents who are renting homes in these communities is unlikely to be representative. Holiday homeowners form the other major proportion of respondents in Russell and Tapeka.

Many of the circumstances of respondents are self-evident. Just by looking at the average age of respondents in Russell and Tapeka (57 and 58 respectively), it is clear that there is a large retired population in these communities. The average respondent age in Horeke is only 48. It is interesting to see that the number of male and female respondents from Horeke are equal, whereas in Russell and Tapeka the number of male respondents is much higher.

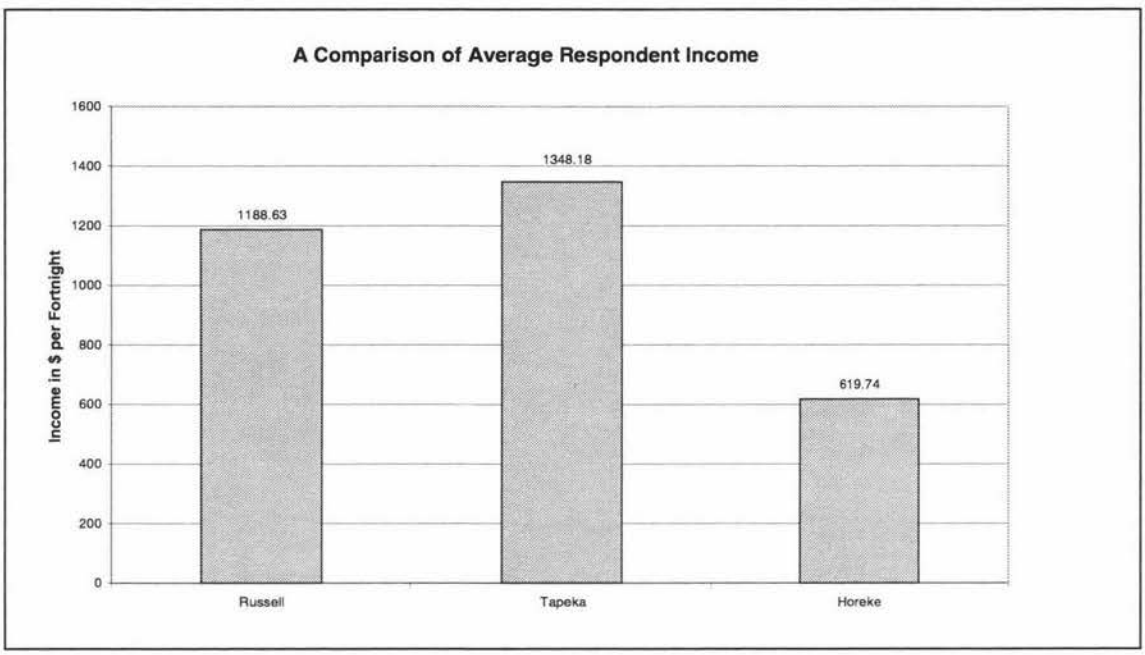
Predictably, questions 24 and 25 reveal that the child dependency ratio (the ratio of occupants under 18 to those over 18) is much higher in Horeke than in Russell or Tapeka. In Horeke it is approximately two thirds, whereas in Russell it is about one eighth and in Tapeka about one third.

The average education in Horeke is much lower than that of Russell or Tapeka. In Horeke it is equivalent to 'higher school certificate', while in Russell and Tapeka the average education is equivalent to a trade or technical certificate. This could be a significant reason for why Horeke respondents have an average per fortnight income that is approximately half that of Russell and Tapeka respondents. Figure 5.4 compares the average income of respondents from each community.

The higher average number of contributors to 'income/turnover' in Russell is a direct reflection of the number of businesses in the community. Interestingly, there is also a higher percentage of respondents who belong to an environmental organisation in Russell (29%) compared to Horeke or Tapeka (15%).

In the next section, some of the summary statistics and background information on respondents will be used to determine what factors influence willingness to pay. The analysis presented will also consider whether there are unique community characteristics that influence willingness to pay.

Figure 5.4 Average respondent income in Russell, Tapeka and Horeke.



5.3 Analysis of Willingness to Pay Responses

It is of interest to examine why each community and the people in them offered various willingness to pay answers. Knowledge of the reasons why different answers were given, may help in the formulation of sewerage policies for small coastal communities. A regression analysis with willingness to pay as the dependent variable and a number of socio-economic parameters as the explanatory variables, can be used to investigate these reasons.

Regression analysis is concerned with the study of the dependence of one variable on one or more other variables (Gujarati, 1995). This regression analysis seeks to determine what explanatory variables have the most influence on "willingness to pay" for an adequate sewerage system. At the same time it is intended that the analysis will provide a validity test for the questionnaires, a simple model to predict "willingness to pay", and determine if there are any statistically significant differences between the three case study communities.

5.3.1 ANCOVA Models

Regression models containing a mixture of quantitative and qualitative variables are called analysis of covariance (ANCOVA) models. In this study the dependent variable, "willingness to pay", is quantitative. The potential explanatory variables are quantitative and qualitative. An example of a potential quantitative variable is income. Qualitative variables are typically represented by binary dummy or indicator variables. If the variable is gender, then 1 might represent male and 0 female.

Binary dummy variables can also be used to distinguish between different groups or categories. Explanatory variables with a 1 to indicate the observation is part of a given group, and 0 to indicate it is not, allow the observations in different groups to be "pooled". As a result, the valid responses from each community have been combined to form one "larger" data set for the regression analysis. The advantage of pooling the results from each community is that often there is an increase in the precision of the estimated parameters (Gujarati, 1995).

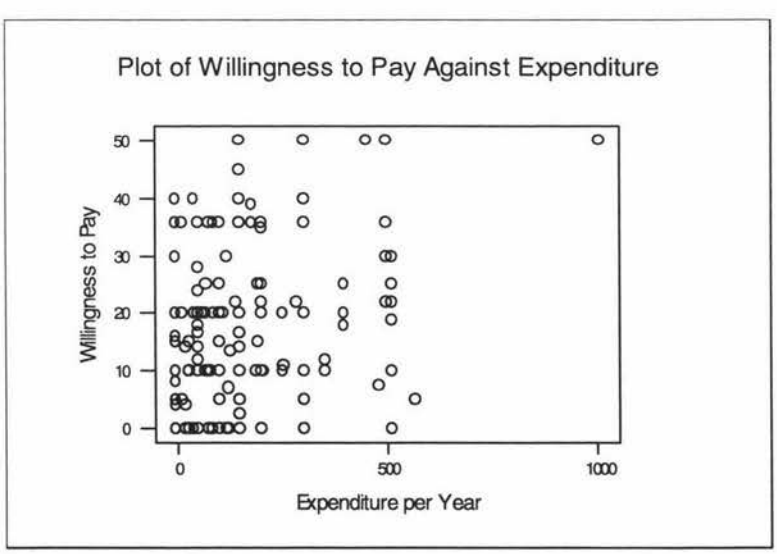
In forming a regression model of willingness to pay it is necessary to identify the variables that could potentially affect willingness to pay. In this study these variables were identified before the questionnaire was constructed. This was because of the need to ask questions which solicited information from the respondent on these variables. Theory, logic and the experience of other surveys suggested that the potential explanatory variables present in the data set found in appendix 7, are a good cross section.

With the exception of questions 1, 4, 5, 20 and 21, appendix 7 contains the answers given to all questions. Each 'Occupancy Type' explanatory has been gained from the information provided by question 2 in the questionnaire. Here, if the respondent circled the holiday homeowner category, then this was recorded with a 1 under the 'HHOwner' explanatory in the data set. At the same time, a 0 was placed under the other occupancy explanatory variables. There is no 'homeowners' explanatory because homeowners act as the "base" occupancy type. For the 'Use' explanatory, an arbitrary decision was made to combine questions 9, 10, 11 & 12 of the questionnaire. Here, if the respondent said "yes" to two or more of these four questions, they were assumed to actively use the coastal waters near the given community. As a qualitative variable, active use was indicated with a 1, and non-use with a 0.

One could hypothesise that in a simple regression analysis the variable that would have the most significant influence on willingness to pay would be income. With a higher income a household would in all likelihood be willing to pay more. What other variables may have a large influence however, is difficult to predict. Theory and logic offer no strong indication as to which ones would be more influential than others. Since the direction of influence of most of the explanatory variables is logically predictable, the next step in forming a regression model of willingness to pay is to narrow down the number of explanatory variables to those that have a significant influence on willingness to pay. This can be done using well developed statistical processes, acknowledging the direction and guidance provided by theory.

A preliminary step to running regressions on possible quantitative explanatory variables is a graphical analysis. This consists of plotting the dependent variable ("willingness to pay") against each explanatory to see if there are any discernible trends. These trends are most easily seen in a scatter diagram. Figure 5.5 of "willingness to pay" versus "respondent expenditure on current systems" provides an example of a graph with no trend.

Figure 5.5 Scatter plot of respondent willingness to pay versus expenditure on current systems.



If a trend exists this indicates that the explanatory may be significant in explaining some of the variation in "willingness to pay". An absence of any distinguishable trend indicates the potential explanatory may not have a significant influence on "willingness to pay". From the graphical analysis undertaken on the quantitative variables it seemed doubtful that 'Age', 'Education', 'Number of Contributors to Income', 'Number of Occupants', and 'Length of Residence in the Community' would be significant in explaining the willingness to pay of respondents.

Qualitative variables obtain their explanatory power by recognising a difference between the average of each group. For the purpose of identifying likely explanatory variables, there is therefore no need to graph them. Differences between the average willingness to pay for each group are considered important if they explain a significant amount of the total variation in willingness to pay. Likely explanatory variables that are identified by differences and trends are confirmed or rejected in the model selection process.

5.3.2 Selecting a Regression Model

In this research, because of the large number of potential explanatory variables, stepwise and best subset regressions will be used to identify those that explain the most significant amount of variation in the willingness to pay of respondents. Explanatory variables that are not statistically significant can be discarded. One or two of the "best" subset models are then chosen with the aim of trying to make improvements to them.

In the first attempt to identify the best regression model to account for the variation in respondent "willingness to pay", the expenditure explanatory was found to explain the most significant amount of variation. On closer examination this was a direct result of the very large amount spent on current systems by a very small number of respondents. These respondents were unusual and had a large influence on the parameter estimations in the regression model. It was decided as a result of this influence, that they and other similar influential respondents should be removed from the data set. Figure 5.5 indicates that with the 'influential' respondents removed, there is no identifiable trend in willingness to pay caused by the expense explanatory.

With the revised data set, stepwise and best subset regressions were undertaken again to identify the statistically significant explanatories. In table 5.1 the forward selection stepwise

method identifies the first seven most significant explanatory variables (in bold). The order of further explanatory variables is not given here because their statistical level of significance is considerably less than those present in table 5.1.

Table 5.1 Forward selection output.

	Steps						
	1	*2*	*3*	*4*	*5*	*6*	*7*
Constant	6.92	2.95	1.10	1.01	-0.06	0.11	0.75
Conven	10.8	8.9	7.9	6.0	6.0	6.4	6.5
T-Ratio	5.35	4.44	4.06	2.84	2.90	3.09	3.15
Y/Turn		0.0048	0.0052	0.0051	0.0049	0.0049	0.0053
T-Ratio		4.27	4.80	4.73	4.62	4.61	4.93
Livelih			7.2	6.9	6.5	6.5	5.5
T-Ratio			3.99	3.87	3.67	3.66	3.00
Restor				4.3	4.8	4.7	4.7
T-Ratio				2.38	2.68	2.63	2.67
EnvOrg					4.5	4.6	4.9
T-Ratio					2.42	2.48	2.65
Health						-4.1	-4.6
T-Ratio						-1.76	-1.98
HHOwner							-3.8
T-Ratio							-1.92
S	12.8	12.3	11.9	11.8	11.7	11.6	11.5
R-Sq	11.78	18.74	24.41	26.39	28.39	29.43	30.67

Looking down the column of a given step, each explanatory variable is added to the previous one. At step 1 the regression model has only a single explanatory variable (Conven – convenience). At step 7 there are seven explanatory variables in the model. Below the coefficient for each explanatory are the t-ratios. They give the statistical level of significance of the explanatory in the presence of the other explanatory variables. For a t-ratio of 1.96, under the null hypothesis that the true value of the coefficient is zero, the exact probability of obtaining a t ratio of 1.96 or greater is 0.05. The exact probability (in this case 0.05) is known as the p-value of the test. It is a measure of how likely it is to experience the observed data and t-ratio if the null hypothesis is indeed true[2] (Smith, 1994). The larger the t-ratio the smaller the p-value will be. Thus for all but two of the coefficients

[2] In the case of the coefficients associated with each explanatory variable, the null hypothesis is that the value of the coefficient is equal to zero (and therefore that the explanatory does not explain any of the variation in the dependent variable).

in table 5.1, since the absolute value of the t-ratios is greater than 1.96, the likelihood that the true value of coefficient is zero, is less than 5%.

The best subsets selection method is similar to the stepwise method but uses Mallows C_p as the key statistic for selecting the best model. Mallows C_p is a statistic that balances the variance of the fitted values from a model (which increases as unimportant variables are added to the model) and the bias of the fitted values (which decreases as important variables are added). For a cross section of explanatory variables, the model with the minimum value of C_p is normally taken as being the "best". Table 5.2 indicates that the model with the same seven variables identified in the last step of the forward selection method has the lowest C_p value.

Table 5.2 Best subsets regression and Mallows $C_{p.}$

Response is WTP

Vars	R-sq	Adj. R-sq	C-p	s	HHOwner	Bus M/O	Restor	Problem	Expense	Use	Health	Culture	Livelih	Conven	Gender	Age	Time	Educat	Y/Turn	Contrib	EnvOrg
1	11.7	11.3	45.9	12.800										X							
2	18.4	17.7	28.3	12.334										X					X		
3	23.7	22.6	14.8	11.956									X	X					X		
4	25.9	24.5	10.4	11.811			X						X	X					X		
5	28.0	26.3	6.1	11.668			X						X	X					X		X
6	29.0	27.0	5.1	11.613			X				X		X	X					X		X
7	30.2	27.9	3.7	11.543	X		X				X		X	X					X		X
8	30.7	28.0	4.3	11.533	X		X				X		X	X					X	X	X
9	31.1	28.1	5.1	11.525	X		X				X	X	X	X					X	X	X
10	31.5	28.1	6.0	11.523	X		X				X		X	X		X		X	X	X	X

The regression on these seven explanatory variables is given in table 5.3.

Table 5.3 Regression equation with the seven most significant explanatory variables.

The regression equation is

WTP = 0.92 + 6.44 **Conven** + 0.00512 **Y/Turn** + 5.18 **Livelih**
+ 4.98 **Restor** + 5.05 **EnvOrg** - 4.98 **Health** - 3.70 **HHOwner**

Explanatory	*Coef*	*Stdev*	*t-ratio*	*p-value*
Constant	0.916	1.955	0.47	0.640
Conven	6.438	2.071	3.11	0.002
Y/Turn	0.005124	0.001075	4.76	0.000
Livelih	5.182	1.849	2.80	0.006
Restor	4.978	1.775	2.81	0.006
EnvOrg	5.053	1.855	2.72	0.007
Health	-4.978	2.914	-1.71	0.089
HHOwner	-3.701	1.959	-1.89	0.060

s = 11.57 R-sq = 30.2% R-sq(adj) = 27.8%

In a regression analysis that is primarily concerned with determining what variables have the most significant influence on the dependent variable, it is sensible to adhere to the principle of parsimony. Ideally the regression equation should be simple and clear while also explaining a large amount of the variation in the data. For this type of research the equation presented in table 5.3 explains a standard (but low) amount of the variation (R–sq = 30.2%) (Mitchell and Carson, 1989). It is prudent however, to asses whether the sign of each explanatory coefficient is consistent with what theory suggests (Mitchell and Carson, 1989). At the end of the assessment a good basis will exist to determine if there are any deleted explanatory variables or unique community characteristics, which would significantly improve the amount of variation explained by the model.

The sign in front of the first five explanatory variable coefficients is consistent with theory. Convenience and other small private benefits, income or turnover, dependence on the coastal environment for income and livelihood, the need to undertake major restoration on an individual system, and environmental organisation membership, all suggest people would be willing to pay more for a proposed system.

The negative sign and size of the holiday homeowner coefficient also makes perfect sense. As holiday homeowners are not present year round to enjoy the benefits of a reticulated sewerage system, it may not be as worthwhile for them as permanent residents.

The negative sign of the health explanatory coefficient is difficult to reconcile with theory. It is logical to think that respondents would be willing to pay more if they believe their

health has suffered as a result of inadequate sewage disposal. The negative sign of the coefficient is contradictory to this logic.

The p-value for the health coefficient in table 5.3 is the highest amongst all the explanatory variables present in the equation. At 0.089 it suggests that if the null hypothesis is rejected, the chances of it being true are about 89 in 1000. At the commonly used significance level of 0.05 (50 in 1000 or 1 in 20) the health explanatory is not significant.

If some people are unsure of the health effects they may have suffered as a result of inadequate sewage disposal, or know they have alternative pollution free swimming sites, this may be reflected in the data. Some people may have answered the health question (question 13) in a positive manner, but know they can undertake preventative measures to avoid such ill health in the future. With the few people who indicated they have had health effects (see appendix 6), the size and sign of the explanatory may simply have been due to random chance.

Since the sign of the health explanatory coefficient is not consistent with theory, the health explanatory has been deleted. The resulting regression equation and output is presented in table 5.4. Using this regression equation as a starting point, various other potential explanatory variables were added to it to see if an equation could be obtained that explained a more significant amount of the variation in "willingness to pay". No such explanatory variables were found. Even with some of the existing explanatory variables removed, the new ones failed to improve the model.

Interaction terms to account for variation in "willingness to pay" due to the possible "interactive" effects of two explanatory variables, were also examined. An interactive term is usually gained by multiplying one explanatory by another. In the case of the interactive terms tried with the above variables, there were no significant increases in the R^2 value. The interactive terms were either insignificant or made other previously significant explanatory variables insignificant. Replacing two explanatory variables with an interactive term is an unnecessary complication, so no interactive terms have been used in the model.

Table 5.4 The regression with the health explanatory removed.

The regression equation is

WTP = 0.55 + 6.08 **Conven** + 0.00521 **Y/Turn** + 5.62 **Livelih**
+ 4.88 **Restor** + 4.77 **EnvOrg** - 3.27 **HHOwner**

Explanatory	*Coef*	*Stdev*	*t-ratio*	*p-value*
Constant	0.554	1.953	0.28	0.777
Conven	6.075	2.069	2.94	0.004
Y/Turn	0.005208	0.001079	4.83	0.000
Livelih	5.624	1.840	3.06	0.003
Restor	4.878	1.782	2.74	0.007
EnvOrg	4.772	1.856	2.57	0.011
HHOwner	-3.270	1.952	-1.67	0.095

s = 11.62 R-sq = 29.2% R-sq(adj) = 27.2%

A further way to account for additional variation is to see if there are unique community characteristics not captured by the existing explanatory variables. This is done with binary dummy variables. In this research, Russell has been made the "base" community to which Tapeka and Horeke are compared. Two additional explanatory variables (DTap and DHor) are used to indicate, say in Tapeka's case (with DTap), whether the respondent is from Tapeka. By regressing "willingness to pay" on these and existing explanatory variables evidence is provided on whether there should be a different constant term for each community. If a different constant is needed, this means that respondents in separate communities, on average, base their willingness to pay on a different starting point. Table 5.5 suggests this is not the case.

The p-values for both the dummy variables for Tapeka and Horeke, at 0.284 and 0.685 respectively, suggest these variables do not explain a significant additional amount of variation in "willingness to pay". This is confirmed by the fact that the R–sq and R–sq(adj) have not changed much since the last regression.

A community may also have unique characteristics that would suggest that the value of a given explanatory coefficient should change. To determine this the DTap and DHor variables are multiplied by the data values for each existing explanatory. Multiplying DTap by Y/Turn for example, creates an explanatory that has just the income values of Tapeka respondents. A regression that includes this new variable provides statistics to determine whether income has a significantly different effect on the willingness to pay of Tapeka respondents.

Table 5.5 Dummy variables for the constant term.

The regression equation is

WTP = 0.88 + 6.10 **Conven** + 0.00530 **Y/Turn** + 5.41 **Livelih**
+ 5.23 **Restor** + 4.52 **EnvOrg** - 3.22 **HHOwner** - 2.55 **DTap**
- 1.17 **DHor**

Explanatory	*Coef*	*Stdev*	*t-ratio*	*p-value*
Constant	0.877	2.107	0.42	0.678
Conven	6.103	2.101	2.91	0.004
Y/Turn	0.005302	0.001103	4.81	0.000
Livelih	5.413	1.853	2.92	0.004
Restor	5.233	1.813	2.89	0.004
EnvOrg	4.520	1.874	2.41	0.017
HHOwner	-3.221	1.972	-1.63	0.104
DTap	-2.549	2.372	-1.07	0.284
DHor	-1.166	2.871	-0.41	0.685

s = 11.64 R-sq = 29.6% R-sq(adj) = 26.9%

Regressions undertaken on the new and existing explanatory variables revealed that none of the new variables are statistically significant in the presence of the existing ones. This was in spite of the various combinations of the new and existing explanatory variables used. A similar exercise was undertaken using interaction terms but the result was no different.

Any differences between the willingness to pay of people in these three case study communities can be adequately explained by factors which are present in all small coastal communities. None of the differences in inter-community willingness to pay can be attributed to a community's unique characteristics. General factors such as, a households income, whether their livelihood depends on the quality of the coastal environment, or whether they only holiday in the community, all account for the differences in willingness to pay that might otherwise be explained by unique community characteristics. This result suggests that the best regression model is that identified in table 5.4, and reproduced in full in table 5.6.

The single quantitative and five qualitative variables identified in this regression analysis are likely to be the principle determinants of "willingness to pay" in many small coastal communities. From this study it would appear that unless ill health has been prominent and regular, it does not provide much of an explanation of why people would be willing to pay for a community sewerage system.

Table 5.6 Full output and statistics of the chosen model.

The regression equation is

WTP = 0.55 + 6.08 **Conven** + 0.00521 **Y/Turn** + 5.62 **Livelih**
+ 4.88 **Restor** + 4.77 **EnvOrg** - 3.27 **HHOwner**

Explanatory	*Coef*	*Stdev*	*t-ratio*	*p-value*	*VIF*
Constant	0.554	1.953	0.28	0.777	
Conven	6.075	2.069	2.94	0.004	1.3
Y/Turn	0.005208	0.001079	4.83	0.000	1.1
Livelih	5.624	1.840	3.06	0.003	1.1
Restor	4.878	1.782	2.74	0.007	1.2
EnvOrg	4.772	1.856	2.57	0.011	1.0
HHOwner	-3.270	1.952	-1.67	0.095	1.1

s = 11.62 R-sq = 29.2% R-sq(adj) = 27.2%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	6	11647.2	1941.2	14.37	0.000
Error	209	28231.9	135.1		
Total	215	39879.2			

SOURCE	DF	SEQ SS
Conven	1	4712.3
Y/Turn	1	2712.7
Livelih	1	2236.9
Restor	1	801.1
EnvOrg	1	805.2
HHOwner	1	379.0

Durbin-Watson statistic = 2.14

In the regression equation presented in table 5.6, the 'convenience' explanatory has the largest coefficient (+6.08). This is probably a result of the direct tangible benefits people think they will gain from an adequate reticulated system. Likewise the 'restoration' coefficient (+4.88) is likely to reflect the direct benefits some people gain from not having to overhaul their own system. It may also emanate from people acknowledging they have to do something about their inadequate sewage disposal.

The 'livelihood' coefficient (+5.62) may well be an indication of the risk averseness of people who are dependent on the local coastal environment for their income. These people may not have the flexibility to shift elsewhere that others have. 'Environmental organisation' is another qualitative explanatory with a positive coefficient (+4.77). In all likelihood it reflects the value some people place on a clean and largely natural

environment. The positive 'income/turnover' coefficient (+0.00521) arises because of ability to pay. With a higher income a larger amount is offered.

The negative coefficient (-3.27) for the 'holiday homeowner' explanatory shows that compared to other types of premise occupants, holiday homeowners are not willing to pay as much. This probably results from the fact that holiday homeowners are not continually present to obtain the year round benefits a community system would provide. They may not view the problem as a high priority because they have other expenditure they could undertake at a permanent place of residence, which is more beneficial for them.

The size and sign of each coefficient may be a guide for decision-makers who have some "knowledge" of the circumstances of a coastal community similar to Russell, Tapeka and Horeke, and wish to approximate the community's willingness to pay. Of course the equation can not be used to infer the average willingness to pay of another community, but it may be useful to provide some direction for decision-makers wishing to determine the value a community gives to the benefits of community sewerage. The coefficients in front of the qualitative variables are simply dollar amounts the average respondent is willing to pay if they say YES to the corresponding question. As the equation is linear, the YES answers can simply be added together. The very small and insignificant constant (0.55) means it can be treated as zero. Therefore the sum of the YES answers can be added to the willingness to pay amount that is a direct result of income, to find the total willingness to pay.

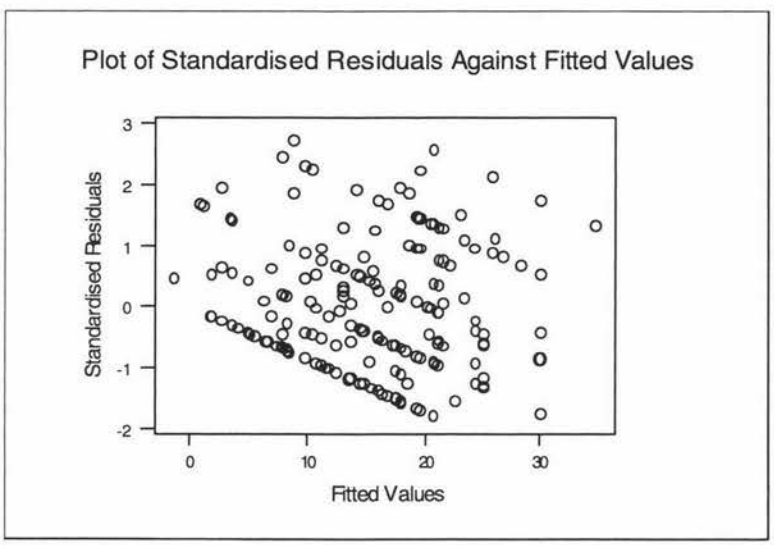
5.3.4 Regression Assumptions

The credibility of the model, presented in table 5.6, depends on the extent to which it satisfies the assumptions needed for linear regression. For this reason it is prudent to check that it satisfies these assumptions. The first of three critical assumptions is that the variance of the dependent variable is the same, whatever the value of the explanatory variables. This is also known as homoscedasticity. It can be checked by a plot of the standardised residuals against the fitted values. Figure 5.6 is the "constant variance" plot for the equation identified in table 5.6.

The plot in figure 5.6 shows no evidence of non-constant variance. The observations do not form a funnel shape, as is the case where there is non-constant variance. The standardised

residuals do however have a slight downward slope. While not ideal, for the purposes of this analysis, it is not of significant concern.

Figure 5.6 Constant variance plot of standardised residuals against fitted values.

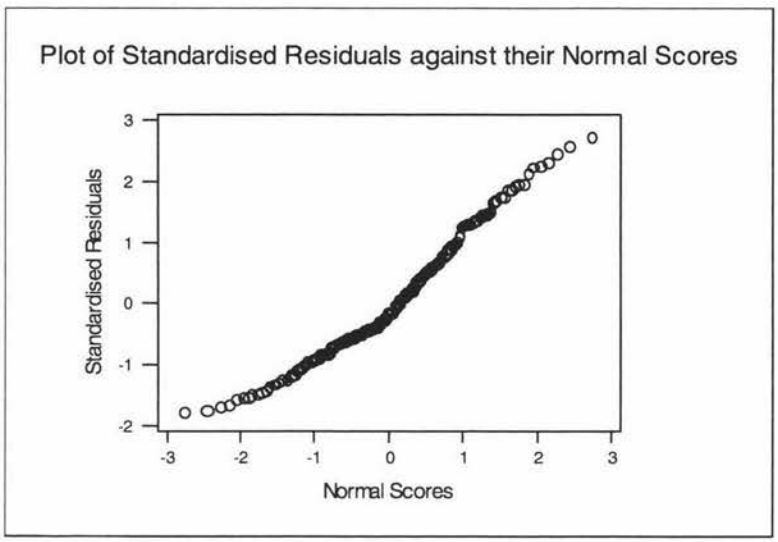


The second assumption is that the residuals are not correlated with each other. In particular that there is no serial correlation. This is commonly checked by the Durbin–Watson test statistic. Small values of the statistic indicate positive serial correlation while large values indicate negative serial correlation. A Durbin–Watson test value of 2.14, as given with the output in table 5.6, indicates that with 6 explanatory variables and over 200 data units, there is no serial correlation problem in the model.

The third critical assumption is that the distribution of the residuals is normal. In a graphical analysis this is frequently checked with a plot of the standardised residuals against their normal scores. If the resulting line is approximately linear then the third assumption has been reasonably well satisfied. Figure 5.7 shows that this is the case for the regression analysis presented in table 5.6.

The statistical validity of the model presented in table 5.6 is further confirmed by the absence of multicollinearity. A multicollinearity problem exists when the explanatory variables are highly correlated with one another. It results in the value of the coefficients being biased downward. The variable inflation factor (VIF) is a statistic that indicates whether a multicollinearity problem is present in a given model. All the variable inflation factors in table 5.6 are less than 10, so there is no evidence of multicollinearity.

Figure 5.7 Normal probability plot of standardised residuals.



5.3.5 Different Means Test

Regression analysis can be used to determine if there are statistically significant differences in the mean or average value of the dependent variable for each group. In the case of this research, "willingness to pay" is regressed against the DTap and DHor variables. Russell is used as the "base" community again, so in the simple regression equation that results, the "constant" term is the average willingness to pay of Russell respondents. The coefficients for DTap and DHor are the values that must be added to, or deducted from, this constant to find the average willingness to pay of respondents in each of these communities. Table 5.7 gives the equation that resulted from running this regression on all valid responses.

Table 5.7 Equation and statistics for the different means test.

The regression equation is

WTP = 16.6 - 0.63 **DTap** - 6.85 **DHor**

Explanatory	*Coef*	*Stdev*	*t-ratio*	p-value
Constant	16.599	1.170	14.19	0.000
DTap	-0.628	2.939	-0.21	0.831
DHor	-6.849	3.606	-1.90	0.059

The p-values for the coefficients presented in table 5.7 suggest that there is no difference between the average willingness to pay of respondents in Russell and Tapeka, but there is a difference between those in Russell and those in Horeke. The high p-value (0.831) for the DTap explanatory suggests that the value of its coefficient (-0.628) is not statistically

different from zero. The p-value (0.059) for the DHor explanatory indicates that the value of its coefficient (-6.849) is statistically different from zero at the 6% level. Since the p-vlue is very close to the commonly used 5% level, for all practical purposes the value of the DHor coefficient is different from zero. The average willingness to pay of respondents in Horeke is therefore different from those in Russell and Tapeka.

5.4 Distribution Analysis

In deciding whether to undertake a sewerage project, decision-makers may be interested in the distribution of the willingness to pay amounts. By examining the distribution of willingness to pay, the decision-maker can determine whether the average figure is a result of the majority of people willing to pay a similar amount, or a minority of people willing to pay a very large or very small amount. Typically this is done by comparing the average willingness to pay with the median willingness to pay.

Each of the three figures below graph the dollar amounts by the percentage of the respondents willing to pay each amount or more. The solid vertical lines indicate the median willingness to pay of the valid responses from each community, while the thin vertical lines represent average willingness to pay. Without exception, in each community the median willingness to pay is less than the average willingness to pay. This means that the majority of respondents are not willing to pay the average calculated for their community. The large willingness to pay amounts of a smaller group of individuals, has inflated the average willingness to pay. Decision-makers can take this into account by using the median rather than the average willingness to pay.

Figure 5.8 Percentage of Russell respondents willing to pay various amounts for a community sewerage system.

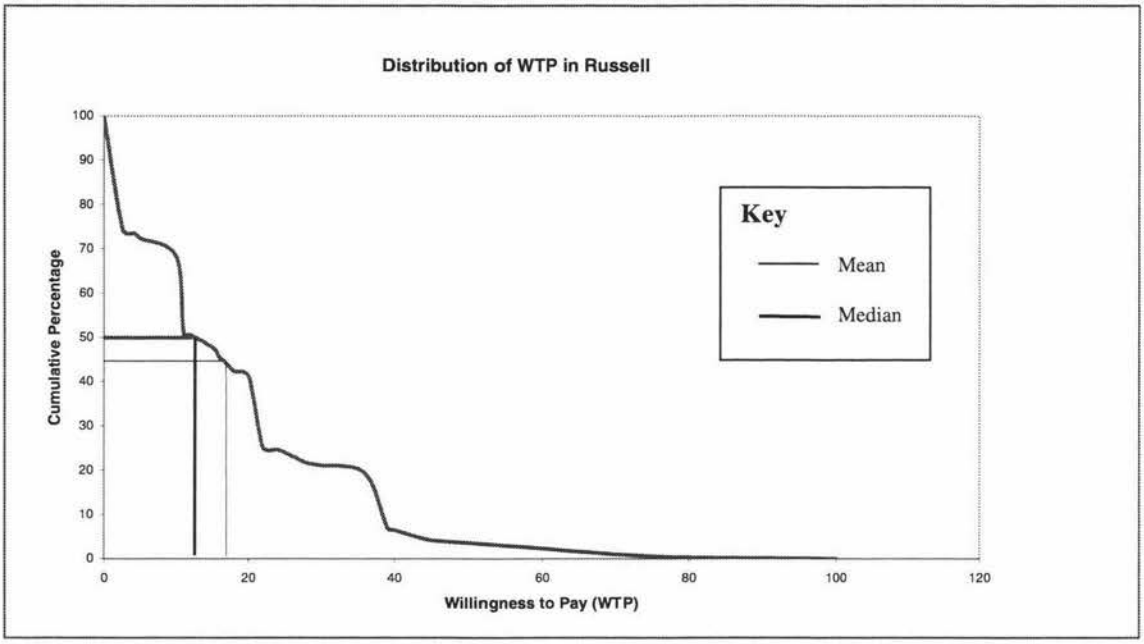


Figure 5.9 Percentage of Tapeka respondents willing to pay various amounts for a community sewerage system.

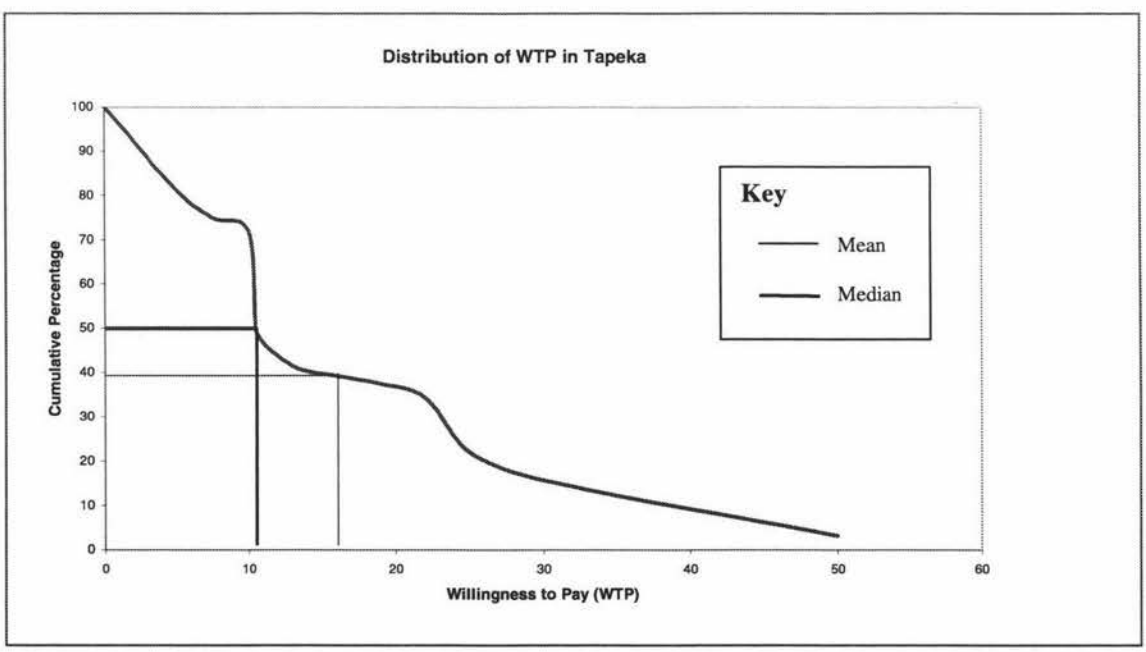
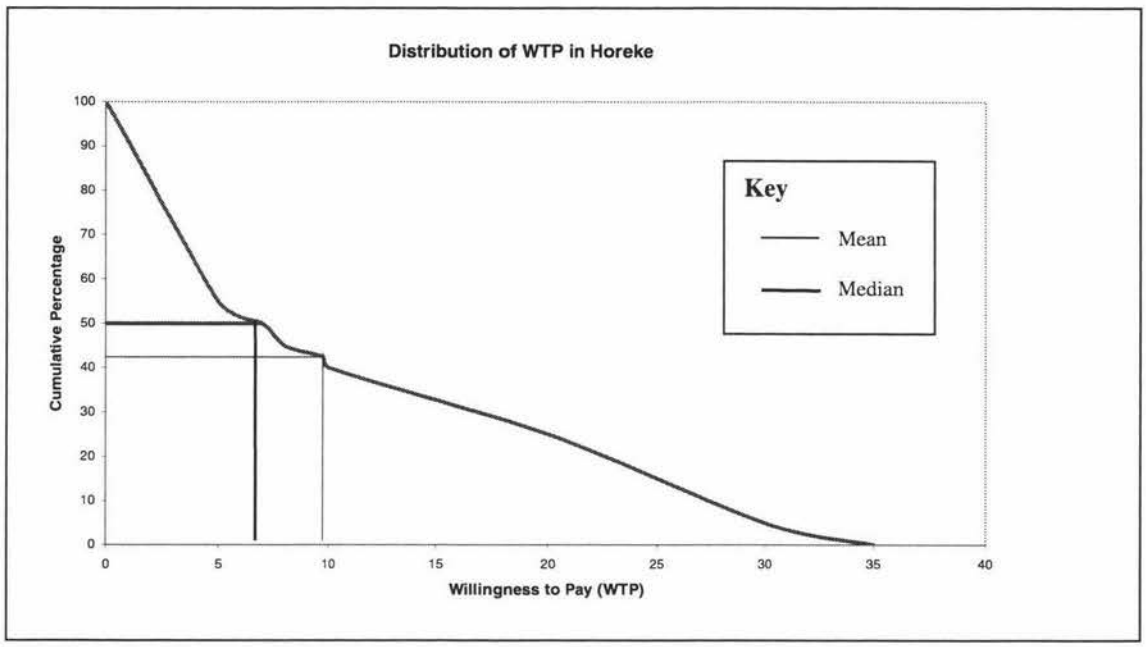


Figure 5.10 Percentage of Horeke respondents willing to pay various amounts for a community sewerage system.



5.5 Summary

The data analysis in this chapter revealed what most decision-makers would have feared and many suspected. The majority of respondents in each of the three communities are not willing to pay enough to finance an adequate sewerage system. Information provided in the 'Summary Statistics' presented in appendix 6, and distribution analysis, indicates that in most cases, what community members are willing to pay falls well short of what is required.

The 'Summary Statistics' revealed only minor differences between each community. In all three it was found that most community members engage in the majority of "coastal" activities. As a result the regression analysis revealed that "use" of the coastal environment did not contribute to explaining any variation in willingness to pay. The 'Summary Statistics' also indicated that the extent of health problems is uncertain, although most likely minimal.

The regression analysis revealed that there are no differences between the three communities which can not be explained by factors present in all three small coastal communities. This is the case even though the average willingness to pay in Horeke was found to be statistically different to that in Russell and Tapeka. It is this result that suggests

the regression equation and further findings of the research, could be used as precursors to thorough investigations in other small coastal communities. In the next chapter information revealed by the data analysis will be used to make some recommendations.

6 Discussion of Results and Recommendations

6.0 Introduction

The goal of this research was to provide a methodology to determine what value a small coastal community places on the benefits associated with a reticulated sewerage system. The methodology chosen to meet this goal was contingent valuation, in the form of a mail questionnaire. A central element of the research has been to illustrate the methodology developed with case studies. The purpose of this chapter is to assess how informative the research methodology is, and to make some recommendations for each case study according to the results produced by the methodology. Suggestions will also be made, as a result of the outcomes of the research, on how territorial authorities and the central government can improve the equity of current legislative requirements. The chapter will conclude by considering the future research required on small coastal community sewerage in New Zealand.

6.1 Assessing the Methodology

The questionnaire methodology was designed with the primary intention of determining whether or not a small coastal community, values the benefits of the least cost option of community sewerage sufficiently to pay for it. Further, the methodology had two secondary objectives. The first was to solicit information to determine the most significant factors influencing a household's willingness to pay for community sewerage. The second was to gain information on the perceived and current consequences of poor sewage disposal in the community of interest. In meeting these objectives, the methodology would provide a local authority with better information to decide what level of sewerage services is optimal in a small coastal community. This section will discuss how successful the methodology was in achieving these objectives. It will do this by examining some of the trends in responses to the questionnaire, by identifying the shortcomings of the questionnaire methodology, and by making some recommendations for future applications.

6.1.1 Response Trends

In looking at the responses from Russell and Tapeka, one could easily be left with the impression that the questionnaire was not very successful in soliciting the maximum households were willing to pay. Of those who responded, a large proportion of the willingness to pay answers were protest bids.

However, the questionnaire was designed to gain information that would help make a decision, not to confirm a decision made. In Russell and Tapeka the decision to provide adequate sewerage has already been made. Several respondents commented that financing the sewerage system is an emotive issue because most residents have already been forced to pay for it. In this sense these communities did not provide a good basis to test the questionnaire. In Horeke, even though the response rate was very low, none of the responses stood out as being obviously biased. In spite of the low response rate, this would suggest that the questionnaire can be successful in eliciting the willingness to pay of households. It is simply not as reliable in a community that has had past adverse experiences with the authority managing their sewerage.

For those respondents who gave a valid response, there appeared to be no indication of the starting point problem mentioned in chapter 4. Question 18 provided the respondents with a figure that equated to the likely charge for the system. This was to help them determine the highest amount they would be willing to pay for it. From the returned questionnaires it was apparent that many respondents gave some thought to what they were willing to pay. Some respondents had calculated out the yearly amount in the margins, and others had compared the stated amount to what they were currently paying. A comparison of the willingness to pay results of Russell and Tapeka provides further evidence to suggest the absence of a starting point problem. Even though the figure mentioned in question 18 ($36 for Russell and $22 for Tapeka) was different, the average amount people were prepared to pay was similar ($16.60 and $15.97 respectively).

On the whole the broad cross section of questions present in the questionnaire, provided an excellent range of information. The questionnaire was successful in meeting its second objective, which was to provide information to determine the most significant factors that influence willingness to pay. The analysis in the previous chapter confirms this. Nevertheless there were a few questions where it was obvious that some respondents were

reluctant to answer. These included the income and age questions in the section on respondent personal details, and the question on cultural values in the section on the use of the coastal environment. Despite this reluctance, all three questions are very important and should not be removed on account of the lack of answers by some respondents. In the case of this research, objective two was not significantly hindered by the lack of answers.

The third objective, to gain information on the perceived and current consequences of poor sewage disposal, was also successfully met. Returned questionnaires revealed a significant desire among respondents to make use of the opportunity to describe some of their experiences and views at the back of the survey. A number also went further than this and provided letters with their returned survey. Together with the information provided by the questions throughout the questionnaire, many of the comments provided useful confirmation of the background information given at the front of the questionnaire.

While the intention of question 1 was only to bridge the gap between the background information and the rest of the questionnaire, a number of respondents viewed it with suspicion. From the comments provided by some respondents, it was obvious that they did not consider that the question was relevant to the questionnaire. In trying to elicit their opinion of water quality it did not seem to give all respondents the feeling that their views were important. Instead a number commented that they wouldn't have a clue, and neither did they think anyone else would. To be more effective the question could be reworded to say something along the lines of "decision-makers are interested in what you think". The frailty of this question highlights some of the shortcomings of applying the methodology to small coastal sewerage. These are considered next.

6.1.2 The Shortcomings of the Questionnaire Methodology

The questionnaire, by involving those who are asked to pay in the decision making process, attempts to ensure transparency and accountability. Still, the experience of this research reveals that the methodology is not free from some shortcomings. One of the most significant shortcomings of the methodology is the potential for a low response rate. Decision-makers can always make a decision based on the responses they do get, and argue that people had the opportunity to voice their opinions, but this is not very satisfactory. To make an informed decision, there needs to be a good response rate to the questionnaire.

In this study the lack of representation was addressed, in part, by calculating a range about the mean willingness to pay of each community. Ideally it would have been better to measure the degree to which the willingness to pay of non-respondents differed from respondents. Attributing the difference to demographic characteristics and perceptions of the sewerage problem etc. could have helped determine whether the lack of representation was a significant problem. Money and time constraints prevented this. In a small coastal community of approximately 50 ratepayers, it may be better to pursue a high response rate by measures besides mail follow-ups. These measures will be considered in the recommendations.

A difficult shortcoming of the methodology, which was experienced in this research, is its need to have a payment vehicle that results in those benefiting from the proposed sewerage, paying for it. If the council intends to finance the proposed sewerage through rates, then for non-rate paying users, a rate charge is not a meaningful payment vehicle. In New Zealand the property owner is the ratepayer, not the tenants who would use the system. On the other hand, an absent property owner would not receive any of the use benefits of the proposed sewerage system. The questions that get the respondent to think about his or her willingness to pay are irrelevant to the property owner. The methodology is based on those who would actually use the system.

On reflection, this problem may not be as much a shortcoming of the methodology, as it is New Zealand's public infrastructure financing practise and legislation. This research has determined that New Zealand's legislation requires "users" to pay. Councils need to try and comply with this, and also be given the capacity and ability too. Still, until they are, the likely success of the questionnaire methodology is reduced in situations where those who would be billed for the use of proposed sewerage at a property, do not actually benefit from its services.

Of course, one can proceed to survey the potential users of the proposed sewerage system, in anticipation that a rate increase would be passed on in the form of higher property rents. This however, is a second best option. The full rate increase may not be passed on to renters. Further, finding a realistic payment vehicle under such circumstances is difficult.

In this research, a decision was made to adopt a payment vehicle that was independent of the Far North District Council and its rates. This decision was made in the belief that the

Council was considering charging mechanisms for use of a given sewerage system, that were unrelated to general Council activities. Unfortunately, for Russell and Tapeka, the preamble before the willingness to pay questions did not expressly state that the respondents maximum willingness to pay, would not be in addition to the amount they currently paid in rates as a sewerage debt service fee. A limited number of respondents expressed confusion over this point.

Another shortcoming of the survey methodology in the case of these communities, was the imperfect user list of relevant households and businesses. Since the Council's list of ratepayers did not exactly correspond to potential users, the application of the methodology was deficient in the sense that not all users were given the chance to answer the questionnaire. In a small coastal community, as illustrated by this research in the case of Horeke, this can be remedied by consultation with community members.

These shortcomings do not invalidate the methodology. As a non-market valuation method, it is well understood that the results it yields are not perfect. "If the results of non-market valuation exercises are used as a tool for aiding decision-makers, rather than as a rule for decision-making, the theoretical and practical limitations of the methods are of less concern" (Kerr, 1986). In the next section recommendations will be made on how some of the practical limitations encountered in the questionnaire process, might be overcome.

6.1.3 Recommendations for Improving the Questionnaire Process

For decision-makers wishing to employ the questionnaire methodology in the future, the experience of this research suggests that it would be preferable to take a more interactive approach. In a community of approximately fifty households and businesses, several strategic meetings to inform people of the questionnaire and its purpose, would in all likelihood lead to a good response rate. Those conducting the meetings would need to make sure that their agendas are impartial, and that they encourage people to express their own values in the questionnaire, not those of dominant individuals in the community. With a small community more interactive reminders, such as telephone calls, may also contribute to a higher response rate.

It is also recommended that some of the questions in the questionnaire be tailored to meet the individual circumstances of the community to be surveyed. If long drops are thought to

be a common sewage disposal method, then a long drop category should be included in the relevant question (question 4). Decision-makers may also be able to deduce other improvements that can be made to the methodology from the conclusions drawn for the case study communities. These conclusions are considered in the next section.

6.2 Recommended Approaches to Sewerage in the Case Study Communities

Without some form of intervention, the consequences of not improving the sewerage in each of the communities investigated in this research would be very similar. Growing adverse effects would be experienced and eventually some form of crisis may occur. Even though these communities currently have very similar problems with their sewage disposal, from the results of this research it is difficult to recommend a similar approach for each.

The intention of this section is to draw some conclusions and make some recommendations for decision-makers trying to determine the best plan of action for sewerage in Russell & Tapeka, and also Horeke. This will be done on the basis of the knowledge gained from all of the research, not just on the willingness to pay values.

6.2.1 Russell and Tapeka

The Far North District Council has proposed to build a community sewerage system that would service both Russell and Tapeka. This is very sensible given that in the long run a single system would be cheaper than two separate systems. However, there has been substantial political controversy over the proposal, a lot of which has centred on its cost.

A charge of $36 per fortnight/premise in Russell is necessary to cover Russell's share of the infrastructure financing, maintenance and service requirements. The necessary charge per premise in Tapeka is lower, $22. This is because the reticulated piping and other minor infrastructure is already in place. In OECD countries the average cost of both water and sewerage services is between 1 and 2 percent of household disposable income. Two percent of the average income of Russell and Tapeka respondents is approximately $24 and $27 respectively[1]. The necessary charge in Russell is much higher than 2% of household

[1] These figures are likely to be the upper bounds of 2% of the household disposable income in each community. There are two reasons for this. The first is that some respondents could have thought of and

disposable income. In Tapeka the necessary charge is less than 2% of the average respondent's disposable income. This however, says nothing of the average disposable income of non-respondents, nor of what portion of the 2% should be attributed to the cost of water services. If one agrees with Lee and Jouravlev (1992), then the sewerage charge should be such that it does not exceed more than 2% of household disposable income for the less well-off sections of the community.

Taking into account the figure based on 2% of household income, and the average willingness to pay in each community, it is obvious that there is a real reluctance to pay for the planned sewerage scheme. In Russell, the upper bound of the 40% confidence interval about the average willingness to pay ($16.60) calculated in chapter 5, is $23.16. It does not even come close to the $36 required. In Tapeka the upper bound, $22.36, just surpasses the amount required, $22. When one considers that these figures are likely to be biased upwards, the possibility that members of the Tapeka community may actually be willing to pay for their share of the system is doubtful. The values discussed here are based on respondents who gave valid answers. These respondents form under 50% of the households and businesses in each community. It would be unrealistic to assume that the average willingness to pay would be as large amongst non-respondents[2]. Further, since the median willingness to pay for Russell and Tapeka, $11.50 and $10.50 respectively, is lower than each average, a decision-maker would be prudent to acknowledge that the stated average willingness to pay is very likely higher than what most people are prepared to pay.

In both the Russell and Tapeka communities there is a high proportion of holiday homeowners. According to one Tapeka resident, only half the premises in Tapeka are permanently occupied. The regression analysis conducted in chapter 5 showed that on average, holiday homeowners were willing to pay less than other types of premise occupants. This is understandable considering they will not benefit to the same extent as more permanent occupants. The Council needs to be aware of this problem, although

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stated their household income in gross rather than disposable terms. The second is that non-respondents will have, in all likelihood, a lower average income than respondents.

[2] "Since in the case of public goods interest in the subject matter is likely to be correlated with the value the good has for the respondent, it is likely that nonrespondents to mail surveys will hold lower or even zero value for the good compared with those of equivalent demographic categories who do answer" (Mitchell and Carson, 1989: 282).
Evidence for the lower average willingness to pay of non-respondents is also provided by the significant number of studies which have found they have had lower income levels (see Mitchell and Carson, 1989: 267–282).

accounting for it in a financing arrangement would not be easy. Unfortunately, present legislation does not allow local authorities to charge according to effluent volume (Local Government NZ, 1997). Even if it did, since many permanent residents feel that the sewerage problem is a result of the influx of holidaymakers in summer, the same charge for all premise occupants may be the only solution.

Many residents in both Russell and Tapeka commented on paying rates of over $3000 for very few services (commonly many thought none). A number of residents commented that the rates they pay were much higher than anywhere in Auckland, and Auckland residents enjoy good sewerage, a town water supply, and refuse collection. Others mentioned that they had already paid over $3000 for a non-existent system, by paying a debt service fee in the rates. It may be sensible for the Council to have an information evening or something similar, that would outline the reasons for the high rates and how they would change when the sewerage system is built.

If the council is to proceed with the planned sewerage system, it must justify this decision by means other than favourable financial circumstances. Evidence from the survey conducted in this research does not support the planned sewerage scheme on economic grounds. It appears as though most people do not consider the benefits of the sewerage system to be sufficient to cover the cost. The general impression gained from answers to the questionnaire, is that most respondents feel that a reticulated system is needed, but that they are not willing to pay for the cost of the planned one. Understandably, some respondents were not happy about the cost increasing from three million to six million dollars as a result of the Planning Tribunal decision[3]. The $36 per fortnight required to finance the system is a consequence of the Planning Tribunal decision. The results of this research provide evidence that supports the Council's original proposal, in favour of the one adopted as a result of the Planning Tribunal decision.

The information respondents volunteered in the questionnaire does not dispute the need for some sort of reticulated system. Many provided comments that support the background information and description of possible effects given at the beginning the questionnaire.

[3] The Tribunal held that the Council had not given sufficient consideration to the 'deep bore option'. Compared to the system originally proposed, the 'deep bore option' better provided for the cultural and spiritual values of the Ngaphui tribe. The Tribunal directed the Council to plan for the 'deep bore option'. The Council could complete the presentation of its defence of the original proposal, only if the 'deep bore option' was found to be unfeasible. (For more information see chapter 1).

This was particularly so for the central business district of Russell and other low lying areas. A number of Tapeka respondents commented that their community system was noisy and odorous.

With regard to the possible health implications that could result from the inadequate sewerage, most of the comments made by residents acknowledged that there is a health risk. Most of these comments also indicate that there have not yet been any widespread infection or disease outbreaks. Some respondents said they purposely don't swim or fish in front of the Russell township because of the possible health implications. Others said that where they swim and fish (commonly Longbeach), there is no potential health problem because currents take bacteria etc. away.

While virtually all of the respondents acknowledged that there is a problem with sewage disposal in Russell and Tapeka, and that it must be fixed, a number said that they did not feel they contributed to the problem. Others said that there was no problem in the area in which they resided, so why should they have to pay for a problem in some other area of the community? In the case of Russell, a number of respondents who occupied premises at Longbeach did not consider that there was any problem with their sewage disposal, or that there was potential for a problem to arise. Further, some respondents also expressed concerns over the equity of having to pay for a community system, when they had just upgraded their personal system to what they thought was a more than adequate level.

Respondents in both Russell and Tapeka mentioned that boats mooring in the Bay are also partly responsible for the sewage problem. They did not consider it fair that people could live on these boats permanently and not contribute to eliminating the problems caused by sewage. Two respondents suggested that holding tanks on boats should be made mandatory, and that pump out facilities with an access charge should be installed on shore.

A large number of Tapeka respondents also considered it unfair that they were being made to join the Russell system. Some mentioned that the Council had previously promised members of the Tapeka community that they would not be made to join any proposed system for Russell. Still others mentioned that the only reason why their current community system is inadequate, is because of Council mis-management. Respondents cited the Council's permission given to the Te Maiki Villas, Titore Way residences and some Timeshare/Motel units, as the reason for the extra pressure on their system. One or two

Tapeka residents also expressed concerns at the lack of water for transporting the sewerage waste to the treatment site.

The wide range of comments and opinions given in the returned questionnaires, suggests that the Council needs to develop an effective education program. This is to inform and educate those who are being asked to pay. With respect to the Council's conduct, it is in its best interest to try and install some confidence in the members of these communities. By doing so, people may be more willing to face up to the problem of financing the adequate sewerage facilities they require.

6.2.2 Horeke

Horeke is a small coastal community that is amongst the poorest in the country. As one resident put it to the researcher, a compulsory charge of $60 per fortnight/household for use of an adequate community sewerage system, would simply result in the dispersal of the Horeke community to localities outside the connection area.

Of the twenty households and businesses who responded to the questionnaire (out of fifty-four), the average willingness to pay per fortnight was $9.75 and the median was $7.50. Both are well short of the $60 required. For those who responded, the required charge is nearly 10% of the average household income ($619.74). This is more than five times the average of that found in OECD countries, and the maximum 2% recommended by Lee and Jouravlev (1992). Allowing for the likelihood that non-respondents have a lower income level than those who did respond, people in Horeke simply could not afford the sixty dollars required to finance a community sewerage system.

It is very evident that the benefits to the Horeke community of reticulated sewerage are not sufficient to cover the cost of it. Given that any benefits of community sewerage which fall outside the community are unlikely to be large, it would also be very difficult to justify a decision to provide Horeke with community sewerage from 'outside funds'. The reasons for this are not only financial. The physical nature of the site indicates significant adverse effects are unlikely. The community is not situated next to an enclosed bay. Rather, it is situated on an estuary that has a swift flow of water. There is evidence to suggest (Harris, 1995), as many respondents claimed, that this swift flow of water takes nutrients and bacteria out to sea where they have a negligible impact. There is also a rich plantation of

Mangroves extending along the shore next to the majority of the community. Some of the nutrients travelling through the groundwater to the surface water, are likely to be intercepted by the Mangroves (Gunn, personal communication). A good portion of those households and businesses that responded to the questionnaire also said the groundwater had a high iron content and was contaminated anyway. It could not be used even in the absence of sewage wastewater pollution.

Based on the results of this research it is not recommended that a community sewerage system be constructed to service premises in Horeke. This recommendation stands whether the community would have to finance the system itself, or whether it receives help from the regional or even the national community. The adverse effects generated by current sewage disposal practices can be mitigated by less costly methods. With some precautionary measures the potential for significant environmental effects in the future is virtually non-existent.

Since the Horeke community has had experience with troublesome aesthetic and potential health effects as a result of poor sewage disposal, some form of infrastructure upgrade is recommended. Making appropriate amendments to on-site systems can eliminate all raw sewage spillovers, potential health impacts, and odour problems. A $10,000 system has just been installed for the Horeke community hall. According to one respondent, this system has eliminated the adverse effects hall sewage was causing. Other problems, particularly with the sewage disposal from premises right on the waterfront, can be dealt with in a similar way. Some respondents commented that these premises are really the only ones causing a discernible problem. It is recommended that the Council looks into a low cost collective solution for these premises. If desirable, this solution could include some form of financial support.

6.3 Territorial and Central Government Policy Issues

The issues that territorial authorities and the central government are confronted with when dealing with sewage disposal have both efficiency and equity characteristics. If one were to draw implications from this research for small coastal communities in general, community financed reticulated sewerage would very rarely be a potential Pareto improvement. When this is the case, it is difficult to see the fairness in making these communities pay for such

sewerage. There are a number of policy issues raised when examining the efficiency and equity of a high cost system. Territorial authorities and the central government must confront these policy issues.

6.3.1 Issues for Territorial Authorities

The key issue for many territorial authorities, in regards to sewage disposal, is in deciding how much discretion they have. The Resource Management Act does not require a total elimination of pollution. Territorial decision-makers have some discretion in deciding what level of pollution is tolerable, and therefore what type of treatment infrastructure is required. They should be careful that they do not adopt a pollution free ideology. Authorities that do this will burden their constituents with expensive infrastructure that may be of very little benefit to them. These authorities need to consider their communities' circumstances, and search for solutions that are realistic and cost effective.

Under current government legislation, the financing mechanisms available to territorial authorities are not designed to solve the ability to pay constraint through transfers and income redistribution. Territorial authorities faced with ability to pay issues need to resist the temptation to subsidise the income-constrained community. Authorities contemplating different financing and management options must stay within their legislated bounds. If these bounds need to be altered or clarified, it is essential that territorial authorities lobby central government.

Territorial authorities need to develop good personal relation, education and consultation strategies on sewerage issues. People in small coastal communities appear to be largely ignorant of the effects of inadequate sewage disposal, and the mandate an authority has to remedy these. The issue is to find a way to inform all of the community, not just a limited part of it.

6.3.2 Issues for the Central Government

New Zealand's central government has sought to remove itself from the management and financing of community infrastructure. This policy is based on well-reasoned arguments, but has left a void by creating an ability to pay issue. In the case of needed infrastructure,

the central government neither subsidises it, nor has any redistribution measures that help low income earners pay for their share and use of it.

If the government wishes to maintain its no grant or subsidy policy, then it needs to seriously consider a redistribution policy that will help low income families pay for needed community infrastructure. One possibility is to make the 'Accommodation Supplement' more accessible to low income families. The government could do this by broadening the definition of what the supplement can be used for, and relaxing the large constraints that must be met before it is received.

An alternative the government could consider is some form of contribution based on grounds of significant need. There would need to be very stringent specifications and constraints on what the "contribution" was given to, so that it did not fall into many of the traps previous government grant programmes did. In the case of sewerage infrastructure, if a territorial authority found that the only option to prevent a high risk health or environmental crisis was a community sewerage system, then under certain circumstances the government could consider covering a portion of the infrastructure cost. These circumstances could include evident ability to pay constraints, significant national benefits, and qualified accounts of the possibility of serious adverse effects.

Another issue that central government needs to confront is the seeming inconsistency of the Local Government Act and the Rating Powers Act. The Local Government Act is based on "user pays", but the charging mechanisms that a council is limited to under the Rating Powers Act are based more on practical methods for raising finance. A clear set of charging mechanisms needs to be provided to councils so that they are not in breech of their legislative duties.

6.4 Future Research

The methodology used in this research has basically been a pilot study that has met with various degrees of success. One of the administered communities for this research, Russell, is not typical of small New Zealand coastal communities. It is a community that has far more than the 50 or so households the research methodology has been designed for. Sewage disposal in Russell is also surrounded by much political controversy. To make a fair

evaluation of the research methodology, it needs to be trialed on other communities. A future evaluation should be based on how worthwhile the extra information yielded is for decision-makers, given that the recommendations in this research are adopted.

The research has also been hindered by a lack of clear knowledge and ideas on how local authorities should best finance and manage the infrastructure they are required to provide. Future research is needed to provide local authorities with examples and recommendations on how to finance and manage various levels of community infrastructure. Obviously any future research needs to be consistent with New Zealand legislation, but ideally it would recommend ways to improve this legislation. An important part of such research would be an examination of issues and government policy on whether local authorities should charge the actual user of the infrastructure, or the person who pays the rates associated with the premises the infrastructure services. When local authorities have this knowledge, they will be in a much better position to determine whether community sewerage is worthwhile in a small coastal community.

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APPENDIX 1
Sections of the RMA

Relevant Sections of the Resource Management Act (1991).

PART I
Interpretation and Application

2. Interpretation – (1) In this Act, unless the context otherwise requires, –

"Best practical option", in relation to a discharge of a contaminant or an emission of noise, 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:

"Environment" includes –

(a) Ecosystems and their constituent parts, including people and communities; and
(b) All natural and physical resources; and
(c) Amenity values; and
(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters:

3. Meaning of "effect" – In this Act, unless the context otherwise requires, the term "effect" ... includes –

(a) Any positive or adverse effect; and
(b) Any temporary or permanent effect; and
(c) Any past, present, or future effect; and
(d) Any cumulative effect which arises over time or in combination with other effects – regardless of the scale, intensity, duration, or frequency of the effect, and also includes –
(e) Any potential effect of high probability; and
(f) Any potential effect of low probability which has a high potential impact.

PART II
Purpose and Principles

5. Purpose – (1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while –

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonable forseeable needs of future generations; and
(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
(c) Avoiding, remedying, or mitigating any adverse effects on the environment.

6. Matters of national importance – In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:
(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:
(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:
(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

7. Other matters – In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to –

(a) Kaitiakitanga:
(b) The efficient use and development of natural and physical resources:
(c) The maintenance and enhancement of amenity values:
(d) Intrinsic values of ecosystems:
(e) Recognition and protection of the heritage values of sites, buildings, places, or areas:
(f) Maintenance and enhancement of the quality of the environment:
(g) Any finite characteristics of natural and physical resources:
(h) The protection of the habit of trout and salmon.

8. Treaty of Waitangi – In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

PART III
Duties And Restrictions Under This Act

Discharges

15. Discharge of contaminants into environment –

(1) No person may discharge any –
  (a) Contaminant or water into water; or
  (b) Contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant eminating as a result of natural processes from that contaminant) entering water; or
  (c) Contaminant from any industrial or trade premises into air; or
  (d) Contaminant from industrial or trade premises onto or into land –

unless the discharge is expressly allowed by a rule [in a regional plan and in any relevant proposed regional plan], a resource consent, or regulations.

(2) No person may discharge any contaminant into the air, or into or onto land, from –
  (a) Any place; or
  (b) Any other source, whether movable or not, –

In a manner the contravenes a rule in a regional plan or proposed regional plan unless the discharge is expressly allowed by a resource consent or allowed by section 20 (certain existing lawful activities allowed).

PART V
Standards, Policy Statements, And Plans

Regional Policy Statements

61. Matters to be considered by regional council –

(2) In addition to the requirements of section 62 (2), when preparing or changing a regional policy statement, the regional council shall have regard to –

(a) Any–

(ii) Relevant planning document recognised by an iwi authority affected by the regional policy statement

Regional Plans

66. Matters to be considered by regional council –

(2)In addition to the requirements of section 67 (2), when preparing or changing a regional plan, the regional council shall have regard to –

(c) Any –

(ii) Relevant planning document recognised by an iwi authority affected by the regional plan;

District Plans

74. Matters to be considered by territorial authority –

(2) In addition to the requirements of section 75 (2), when preparing or changing a district plan, a territorial authority shall have regard to –

(b) Any –

(ii) Relevant planning document recognised by an iwi authority affected by the district plan;

PART VI
Resource Consents

Decisions

107. Restriction on the grant of certain discharge permits –

(1) Except as provided in subsection (2), a consent authority shall not grant a discharge permit [or a coastal permit to do something that would otherwise contravene section 15] allowing –

(a) The discharge of a contaminant or water into water; or
(b) A discharge of a contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water, –

If, after reasonable mixing, the contaminant or water discharged (either by itself or in combination with the same, similar, or other contaminants or water), is likely to give rise to any or all of the following effects in the receiving waters:

(c) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials:
(d) Any conspicuous change in the colour or visual clarity:
(e) Any emission of objectionable odour:
(f) The rendering of fresh water unsuitable for consumption by farm animals:
(g) Any significant adverse effects on aquatic life.

(2) A consent authority may grant a discharge permit [or a coastal permit to do something that would contravene section 15] that may allow any of the effects described in section (1) if it is satisfied –

(a) That exceptional circumstance justify the granting of the permit; or
(b) That the discharge is of a temporary nature; or
[(c) That the discharge is associated with necessary maintenance work]

(3) In addition to any other condition imposed under this Act, a discharge permit or a coastal permit may include conditions requiring the holder of the permit to undertake such works in such stages throughout the term of the permit as will ensure that upon the expiry of the permit the holder can meet the requirements of subsection (1) and of any relevant regional rules.]

FIRST SCHEDULE
Preparation, Change, And Review Of Policy Statements And Plans

Analysis
PART I
Preparation And Change Of Policy Statements And Plans By Local Authorities

3. Consultation – (1) During the preparation of a proposed policy statement or plan, the local authority concerned shall consult –

(d) The tangata whenua of the area who may be so affected, through iwi authorities and tribal runanga.

APPENDIX 2
Sections of the NZCPS

Relevant Sections of the New Zealand Coastal Policy Statement (1994)

CHAPTER 1 – NATIONAL PRIORITIES FOR THE PRESERVATION OF THE NATURAL CHARACTER OF THE COASTAL ENVIRONMENT, INCLUDING PROTECTION FROM INAPPROPRIATE SUBDIVISION, USE AND DEVELOPMENT

Policy 1.1.3

It is a national priority to protect the following features, which in themselves or in combination, are essential or important elements of the natural character of the coastal environment:

(a) landscapes, seascapes and landforms, including:

(i) significant representative examples of each landform which provide the variety in each region;
(ii) visually or scientifically significant geological features;
(iii) the collective characteristics which give the coastal environment its natural character including wild and scenic areas.

(b) characteristics of special spiritual, historical or cultural significance to Maori identified in accordance with tikanga Maori:

(c) significant places or areas of historic or cultural significance.

CHAPTER 5 – THE MATTERS TO BE INCLUDED IN ANY OR ALL REGIONAL COASTAL PLANS IN REGARD TO THE PRESERVATION OF THE NATURAL CHARACTER OF THE COASTAL ENVIRONMENT, INCLUDING THE SPECIFIC CIRCUMSTANCES IN WHICH THE MINISTER OF CONSERVATION WILL DECIDE RESOURCE CONSENTS.

5.1 Maintenance and Enhancement of Water Quality

Policy 5.1.1

Rules should be made as soon as possible with the object of enhancing water quality in the coastal environment (including aquifers) where that is desirable to assist in achieving the purpose of the Act, and in particular where:

(a) there is a high public interest in, or use of the water;

(b) there is particular tangata whenua interest in the water;

(c) there is particular value to be maintained or enhanced; or

(d) there is a direct discharge containing human sewage.

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.

S1.10 Discharges to the coastal marine area

(a) Any discharge of human sewage to the coastal marine area, except from vessels, which has not passed through soil or wetland, shall be a restricted coastal activity.

(b) Any discharge to the coastal marine area in respect to which the applicant may wish to rely on section 107(2)(a) shall be a restricted coastal activity.

APPENDIX 3
Sections of the Proposed RCP for Northland

Relevant Sections of the Proposed Regional Coastal Plan for Northland

Section 26 – Rules

26.3 MARINE 1 (PROTECTION) MANAGEMENT AREA

26.3.4 Discretionary Activities

(k) The **discharge of treated effluent** to coastal water from land-based wastewater treatment plants.

26.4 MARINE 2 (CONSERVATION) MANAGEMENT AREA

26.4.4 Discretionary Activities

(l) The **discharge of treated effluent** to coastal water from land-based wastewater treatment plants.

APPENDIX 4
Sections of the RPA

The Mechanisms for Sewerage Charges under the Rating Powers Act (RPA)

Charging Mechanism	Incidence	Section of RPA	Nature
Part of the general rate	Every SRP	s 12	• uniform or differential basis, • max gen. rate = 1.25 cents in the dollar of net capital value.
Part of uniform annual general charge	Every SRP	s 19	
A separate rate for sewerage	On every SRP in the district or part of the district benefiting	s 16	• uniform or differential basis.
	On serviced and serviceable properties only	ss 16 & 17	• instead of levying a separate rate on all properties, can levy only on serviced properties, • can levy up to a half rate on serviceable properties.
Separate uniform annual charge for sewerage	On all separately rateable properties in the district or part of the district	s 20	• instead of or in addition to levying a rate under s 16, • s 25(1)(b) – these are exempt from the calculation of the 30% maximum proportion of rates.
	On serviced and serviceable properties only	ss 20 & 17	• in stead of levying a charge on all properties, can levy only on serviced and serviceable properties, • can levy up to half charge on serviceable properties, • s 25(1)(b) – these are exempt from the calculation of the 30% maximum proportion of rates.
Sewerage charge	Per urinal or water closet connected	s 30	• instead of or in addition to levying a rate under s 16 or a charge under s 20, • a charge of a uniform sum annually on each connection, • one household is deemed to have only one connection, • may have a scale of charges for multiple connections.

Source: (Simpson Grierson Consultants)

Relevant Sections of the Rating Powers Act 1988

PART XII_A

Accountability and Accounting

223_C. Conduct of affairs – (1) Every local authority and, where applicable, every community board shall, in conducting its affairs, ensure that, –

(d) So far as practicable, its regulatory functions are separated from its other functions:

APPENDIX 5
The Questionnaire

6TH October 1998

MASSEY
UNIVERSITY

Private Bag 11222
Palmerston North
New Zealand
Telephone +64-6-356 9099
Facsimile +64-6-350 5660

COLLEGE OF BUSINESS

DEPARTMENT OF
APPLIED AND
INTERNATIONAL
ECONOMICS

Dear Sir or Madam:

Greetings. My name is Richard Moore, and I am undertaking research under the administration of Professor Anton Meister and Dr. Robert Alexander on what people think of their coastal environment and sewage disposal in it.

In the past few years there has been a lot of discussion about sewage disposal in small coastal communities. You may well be aware of and perhaps even taken part in different discussions on sewage disposal in Horeke. For people to live in a good quality environment, New Zealand legislation encourages good sewage disposal practices. However, no-one really knows how people who live, work and holiday in small coastal communities, regard the coastal environment or their sewage disposal in it.

Since you occupy a dwelling or business premise in Horeke, you are being asked to provide information on the issues raised above. The person who is responsible for the management of the household or business is invited to answer each question in the enclosed questionnaire. In order that the results will truly represent the experience and thoughts of the people that occupy Horeke, it would be appreciated if each question was answered and the completed questionnaire returned.

The questionnaire will take approximately 15 minutes to complete. It can be returned in the freepost envelope provided. No stamp is required.

Your response to the questionnaire will be held in complete confidence. The property the questionnaire refers to is identified on its cover, but the identification label will be removed when the questionnaire is returned. Once all responses are received, the list of postal addresses will be destroyed.

The research is being done in conjunction with the Far North District Council, and a full report will be given to the Council. If you would like a summary of the results please fill out the address card and post it back with the questionnaire. We will send you your address card and a copy of the results.

I would be most happy to answer any questions you might have. Please write or call. The telephone number is (06) 350-5974.

Thank you for your assistance.

Sincerely,

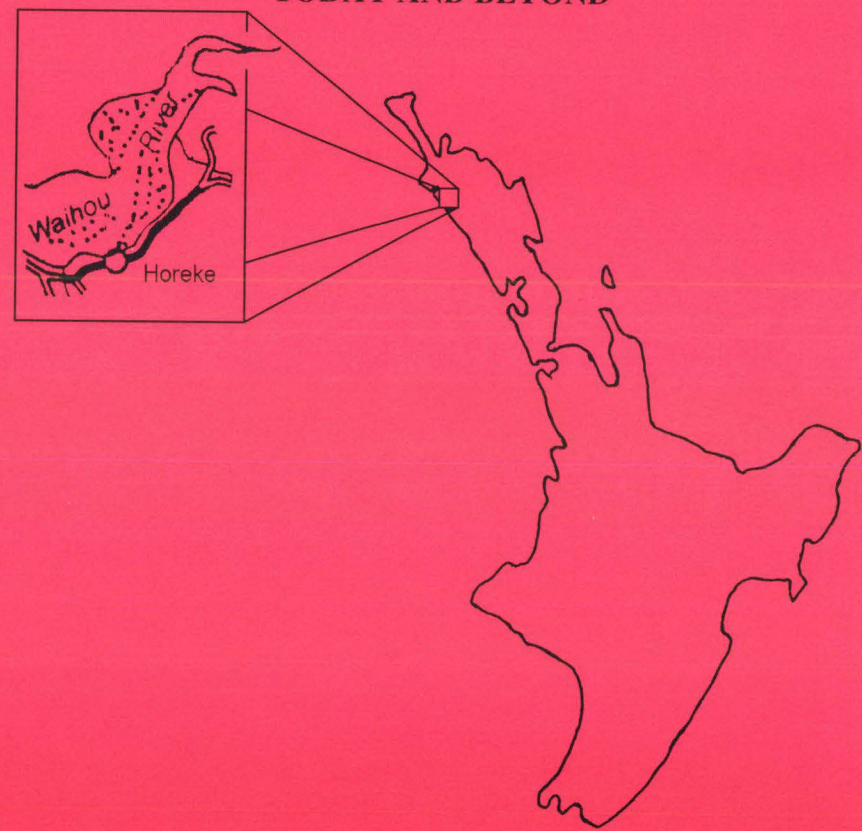
Richard R. Moore
Graduate Student

Dr. Robert R. Alexander
Supervisor

Prof. Anton D. Meister
Supervisor

MASSEY UNIVERSITY PRIVATE BAG 11222 PALMERSTON NORTH

HOREKE'S COASTAL ENVIRONMENT TODAY AND BEYOND



A SURVEY OF YOUR OPINIONS

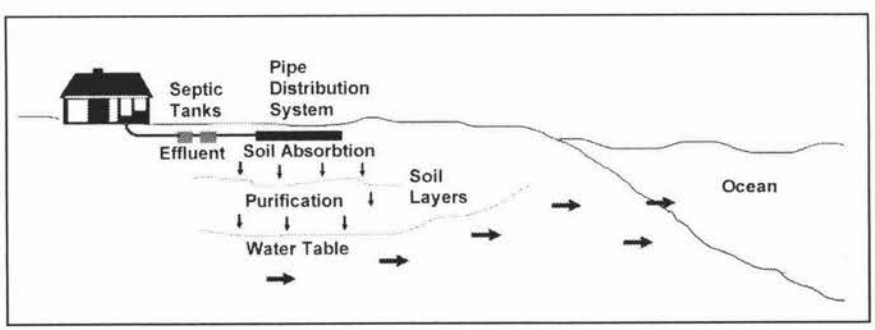
HOREKE'S COASTAL ENVIRONMENT TODAY AND BEYOND

A SURVEY OF YOUR OPINIONS

Please consider the following carefully

Background

In small communities, sewage treatment is often achieved by each dwelling having an individual sewage disposal system. This can be adequate if the right conditions are present, but can lead to low standards of treatment and disposal if this is not so. Some of the reasons for a low standard of treatment can include: infrequent 'holiday' use, incorrect soil type, a high water table, steeply sloped land, and a high density of treatment systems. A consequence of a low standard of treatment is that wastewater from these systems filters through to the groundwater and travels to major water bodies nearby. In coastal communities this could have a major impact on the level of the water quality in the sea or bay. The diagram below illustrates how the process works.



Tests overseas have shown that high proportions of nutrients still present in the waste water, are at least partially responsible for localised coastal impacts. These impacts have included, algae blooms, increasingly murky water, decreases in the local catch of desirable fish species, and changes in the composition of marine-life.

Studies by Northland Regional Council have found higher than normal levels of disease producing bacteria in coastal waters next to Horeke. No formal links have been made between these higher than normal levels and ill-health, but elsewhere minor effects such as boils, ear infections and general sickness for one or two days, have been linked with sewage polluted water. Overseas, more serious diseases, including hepatitis A and typhoid, have resulted from poor sewage disposal.

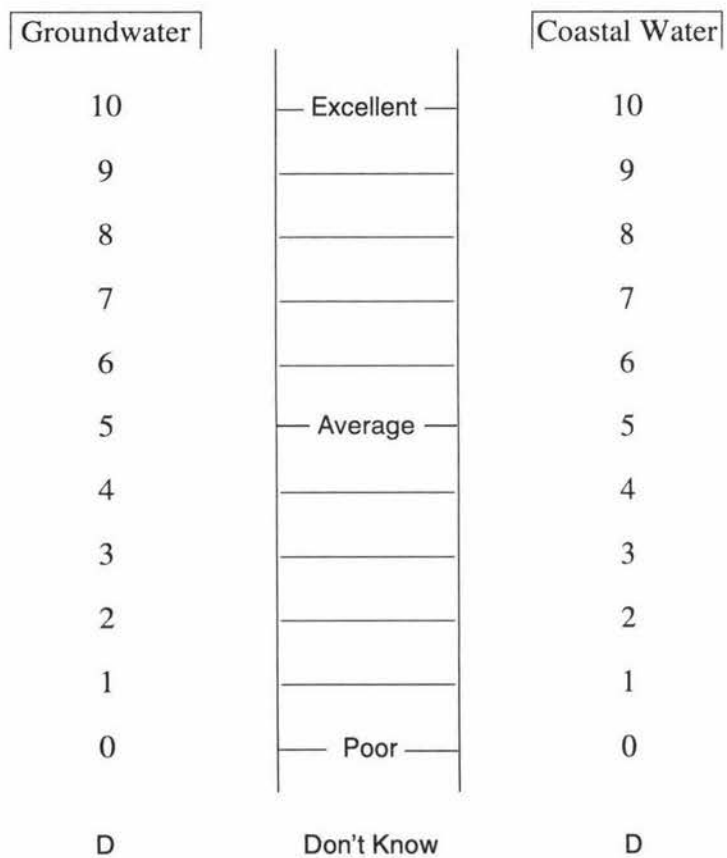
Floating oil, solids, and water discoloration, can all occur in local coastal waters next to communities with unsuitable sewage disposal systems. Odours from each system can also be experienced within these communities.

For a given community, accurately predicting the risk of any one of these effects is currently impossible. Further, accurate predictions of the area they may cover and their severity, are also very difficult to make. The information that is available suggests that over time the impacts may add up, and can grow collectively larger.

Please turn the page to begin the questionnaire

Your reply will be treated as strictly confidential

1. **On the water quality ladder below, what number do you think best represents the groundwater quality in your community (left column) and the sea water quality right next to your community (right column)?** *(please circle one number for each).*



The next few questions concern the wastewater disposal at the premises on the cover of this questionnaire.

2. **As an occupant of these premises, which of the following do you class yourself as?** *(please circle one number)*

   1. Home Owner
   2. Home Renter
   3. Holiday Home Owner
   4. Business Manager / Owner
   5. Other _____
      (Please specify)

3. **Where does your sink, laundry and bath/shower water drain?** *(please circle one number)*

   1. Septic Tank
   2. Sewage Well or Pit
   3. Public Drain
   4. Garden
   5. Other _____
      (Please specify)

4. **Where does the sewage from your toilet discharge to?** *(please circle one number)*

   1. Septic Tank
   2. Sewage Well or Pit
   3. A Community Treatment System
   4. Other _____
      (Please specify)

5. **How long has your septic tank, sewage well/pit, or other type of system been in use?** *(please circle one number)*

   1. 0 to 10 Years
   2. 10 to 20 Years
   3. More than 20 Years

6. **Do you think the sewerage system you currently use will need major restoration within the next 5 years?** *(please circle one number)*

   1. Yes
   2. No

7. **Have you had any problems with your sewerage system in the last 3 years?** *(please circle the applicable numbers)*

   1. No Problems
   2. Overflow
   3. Odours
   4. Blocked
   5. Other _____
      (Please specify)

8. **On average, how much does your household or business spend on the operation, maintenance and repair of your sewerage system each year?**

   _____
   (Please specify in $)

The next few questions concern the use of the coastal waters near Horeke by the occupants of the premises this questionnaire refers to – you, your household, employees, or residing customers.

9. **During the past 12 months did you, or a member of your household, or an occupant of your premises, swim or wade in the coastal water next to the Horeke community?** *(please circle one number)*

   1. Yes
   2. No
   3. Don't Know

10. **During the past 12 months did you, or a member of your household, or an occupant of your premises, use the coastal water next to the Horeke community for boating? Boating examples: motor-boating, sailing, canoeing, kayaking, rafting, windsurfing, water-skiing, or similar** *(please circle one number)*

    1. Yes
    2. No
    3. Don't Know

11. **During the past 12 months did you, or a member of your household, or an occupant of your premises, use the coastal water next to the Horeke community for recreational fishing, including shellfish gathering?** *(please circle one number)*

    1. Yes
    2. No
    3. Don't Know

12. **During the past 12 months did you, or members of your household, or occupants of your premises, relax, picnic, barbecue, walk, or view the wildlife and scenery, next to the coastal waters of Horeke?** *(please circle one number)*

    1. Yes
    2. No
    3. Don't Know

13. **Have you, or members of your household, or occupants of your premises, at any time become sick or had skin or ear infections, as a result of any activity involving contact with the coastal water next to Horeke?** *(please circle the applicable numbers)*

    1. General Sickness
    2. Skin or Ear Infections
    3. Never had any ill Health Effects
    4. Don't Know

14. **What activities did these ill health effects result from?** *(please circle the applicable numbers)*

    1. Swimming
    2. Boating
    3. Fishing
    4. None
    5. Other _____
    (Please specify)

15. **Do you, or members of your household, or occupants of your premises, consider the coastal waters next to Horeke to be of cultural and/or spiritual significance?** *(please circle one number)*

    1. Yes
    2. No
    3. Don't Know

16. **Do you, or members of your household, or occupants of your premises, work in an occupation or earn income from an activity that depends on the quality of the coastal water next to Horeke? Examples: tourist work, restaurants, hotels** *(please circle one number)*

    1. Yes
    2. No
    3. Don't Know

Next I'd like you to think about how much having good quality coastal water next to Horeke is worth to you and your household or premise occupants. Some people may believe that controlling the pollution of Horeke's coastal environment from sewage wastewater is of great value, while other people may not feel that controlling this pollution is very important to them.

To reduce the risk of a lower quality coastal environment next to Horeke, a community sewerage system could be built. This system will pipe the sewage away from the coastal water to a place where it can be treated to remove damaging pollutants. A community sewerage system will eliminate the effects and possible impacts caused by current sewage wastewater.

17. Do you think that a community sewerage system would provide benefits such as reliability, convenience, and absence of odour, over and above your existing system? *(please circle one number)*

1. Yes
2. No

One way to pay for the community sewerage system is with a fortnightly payment made to a sewerage utility. This utility would most likely be independent from any other authority and would aim to provide a quality sewage disposal service.

In light of previous answers, please take a moment to consider the possible benefits you would receive from a community sewage disposal service.

18. Remembering that there are many other calls on your budget, would you be willing to pay $60 a fortnight so you could obtain the service, and the benefits it provides? *(please circle one number)*

1. Yes
2. No

19. What is the highest amount you would be willing to pay per fortnight, so you could obtain the service, and the benefits it provides?

$ _____ per fortnight.

20. If your answer to question 19. was zero (0), what are your reasons? *(please circle the applicable numbers)*

1. Your household or premise occupants would not receive any benefits from a community sewerage service
2. Your household or business can not afford it
3. Other (Please specify in the space below)

_____
_____
_____
_____
_____
_____
_____
_____

21. Which two (2) of the following reasons for preventing sewage wastewater pollution in Horeke, are most important to you (including your household or premise occupants)?
(please circle the applicable numbers)

1. Your household's or premise occupants use of Horeke's coastal water for swimming and boating
2. Your household's or premise occupants use of Horeke's coastal water for fishing and shellfish collecting
3. Your household's or premise occupants use of the area surrounding Horeke's coastal water for relaxing, picnicking, walking, and viewing the wildlife and scenery
4. Your household or premise occupants get satisfaction from knowing that other people may use and enjoy Horeke's coastal water
5. Your household or premise occupants consider Horeke's coastal water to be of cultural and/or spiritual significance
6. Members of your household or premises are employed in a job that depends on the quality of Horeke's coastal water

Finally, I would like to ask a few questions about you, and the members of your household or occupants of your premises, to help interpret the questionnaire.

22. Are you male or female?
(please circle one number)

1. Male
2. Female

23. What year were you born?

_____

24. How many people live in your house or occupy your premises?

_____

25. How many people over the age of 18?

_____

26. For how long have you lived in a dwelling / owned a holiday home / run a business in Horeke that requires sewerage services?

_____

27. What number best describes your level of education?
(please circle one number)

1. Primary School
2. Secondary School
3. School Certificate
4. Higher School Qualification
5. Post School Qualification
6. Trade/Technical Certificate
7. Diploma
8. Bachelor Degree
9. Higher Degree

28. What number best describes the total income per fortnight of all persons in your household / turnover per fortnight of the business, to which this questionnaire refers?
(please circle one number)

1. UNDER $50
2. $51 TO $100
3. $101 TO $150
4. $151 TO $250
5. $251 TO $350
6. $351 TO $500
7. $501 TO $750
8. $751 TO $1000
9. $1001 TO $1500
10. $1501 TO $2000
11. MORE THAN $2001

29. How many people contribute to your household income / business turnover?

_____

30. Are you a member of an environmental organisation?
(please circle one number)

1. Yes
2. No

Remember, your response to this questionnaire will be treated as strictly confidential. Your name will not be connected to any work done with your answers.

THANK YOU FOR YOUR TIME

We are grateful for the effort you made to complete this questionnaire. Your answers are very valuable to us. Please mail the questionnaire in the stamped envelope provided as soon as possible.

If you wish, please also take the opportunity to respond to the invitation on the back page.

Is there anything else you would like to tell us about the quality of Horeke's coastal environment, and/or sewage disposal in Horeke? If so, please use this space for that purpose.

Your contribution to this effort is greatly appreciated. Thank you.

Reminder Card

Front

Joe Bloggs

c/o Postal Delivery Centre

Horeke 0451

Back

October 14, 1998

Last week you should have received a questionnaire seeking your opinion about sewage disposal in Horeke's coastal environment. As part of the Horeke community your opinion is valuable to us.

If you have already completed and returned the questionnaire, please accept our sincere thanks. If not, please do so today. We want to be sure that the results of the questionnaire truly represent the views and values of all the people in Horeke.

If you did not receive the questionnaire, or if it has been misplaced, please call the free-phone number (0800 920 029), and another copy will be posted to you today.

Sincerely

Richard R. Moore	Dr. Robert R. Alexander	Prof. Anton D. Meister
Graduate Student	Supervisor	Supervisor

APPENDIX 6
Summary Statistics

Section 1: The State of Current Sewage Treatment

Washing wastewater destination (Question 3)

	Percentage	Number
Septic Tank	86.04%	228
Sewage Well/Pit	6.04%	16
Public Drain	0.75%	2
Garden	5.28%	14
Other	1.89%	5
	100.00%	265

Sewage destination (Question 4)

	Percentage	Number
Septic Tank	94%	252
Sewage Well/Pit	3%	7
Community System	0%	0
Other	4%	10
	100%	269

Respondents who indicated their washing wastewater goes to a different destination to their septic wastewater (Questions 3 & 4)

Percentage	11.99%

Age distribution of respondent sewage systems (Question 5)

	Percentage	Number
0 to 10 years	25.94%	69
10 to 20 years	30.83%	82
More than 20 years	43.23%	115

Respondents who indicated they think their system needs major restoration (Question 6)

Percentage	34.34%

Respondents who indicated they have had some sort of problem with their system in the last 3 years (Question 7)

	Percentage	Number
An overflow or blocked system	21.93%	59
All problems	43.82%	117

Average amount spent on systems actually used (Question 8)

Amount	$ 138.96	
Amount (figures < $1000)	$ 84.71	per year

Section 2: Use Of The Coastal Environment

Respondent engagement in coastal activities (Questions 9, 10, 11 & 12)

	Percentage	Number
Swimming	86.79%	230
Boating	85.61%	226
Fishing	77.65%	205
Relaxing	94.30%	248

Respondent health problems (Question 13)

	Percentage	Number
Had a health problem	11.20%	27
Did not know	11.81%	32
General sickness	2.58%	7
Skin and ear infections	7.38%	20
Problem resulted form swimming	8.33%	22

Rrespondents who considered the coastal water to be of cultural and/or spiritual significance (Question 15)

Percentage	44.13%

Respondents who indicated they work in an activity that depends on the quality of the coastal waters (Question 16)

Percentage	35.06%

Section 3: Willingness to Pay for a New Sewerage System

Respondents who indicated that a community system would provide them with reliability and convenience (Question 17)

Percentage	77.70%

What respondents are willingness to pay (WTP) (Questions 18 & 19)

Percentage who indicated they were willing to pay the $36	13.08%

	Average	Median
Average WTP for those who were not biased against the payment vehicle or the Council's past management of sewerage	$ 16.60	$ 11.50
Average WTP for those who stated a non zero amount	$ 22.22	$ 20.00

Respondents who gave a zero WTP amount (Questions 19 & 20)

	Percentage	Number
Percentage who indicated they weren't WTP because they wouldn't receive any benefits	11.57%	31
Percentage who indicated they weren't WTP because they couldn't afford it	15.67%	42
Percentage of WTP responses removed because of probable bias	37.69%	101

Respondents who gave the stated reason as being in the top two for preventing sewage wastewater pollution (Question 21)

	Percentage	Number
Swimming and Boating	61.45%	161
Fishing	42.53%	111
Relaxing	37.02%	97
Benefits to others	35.88%	94
Cultural and/or Spiritual	12.98%	34
Livelihood	16.41%	43

Section 4: General Background Information

Respondent groupings (Question 2)

	Percentage	Number
Home Owner	61.48%	166
Home Renter	2.59%	7
Holiday Home Owner	23.70%	64
Business Manager /Owner	9.63%	26
Other	2.59%	7
	100.00%	270

Respondent Gender (Question 22)

	Percentage	Number
Male	62.55%	167
Female	37.45%	100

Age of respondents (Question 23)

Average Age	57 years

Occupant Statistics (Questions 24 & 25)

Average number of occupants per dwelling	4.16
Average number of occupants per dwelling over 18	3.68

Average time respondents have resided in Russell (Question 26)

Average	17.39 years

Education (Question 27)

Average education	5.79 (Equivalent of a Trade/Technical Certificate)

Income (Question 28)

Average Income/turnover	$ 1,188.63 per fortnight

Average number of contributors to income/turnover (Question 29)

Average number of income/turnover contributors	3.05

Environmental organisation membership (Question 30)

	Percentage	Number
Respondents who indicated they were members of an environmental organisation	28.68%	76

Section 1: The State of Current Sewage Treatment

Washing wastewater destination (Question 3)

	Percentage	Number
Septic Tank	3.17%	2
Sewage Well/Pit	20.63%	13
Public Drain	36.51%	23
Garden	3.17%	2
Other	36.51%	23
	100.00%	63

Sewage destination (Question 4)

	Percentage	Number
Septic Tank	3.17%	2
Sewage Well/Pit	6.35%	4
Community System	87.30%	55
Other	3.17%	2
	100.00%	63

Respondents who indicated their washing wastewater goes to a different location to their septic wastewater (Question 3 & 4)

Percentage	53.97%
A better approximation	14.30%

Age distribution of respondent sewerage systems (Question 5)

	Percentage	Number
0 to 10 years	17.86%	10
10 to 20 years	39.29%	22
More than 20 years	42.86%	24
	100.00%	56

Respondents who indicated they think their system needs major restoration (Question 6)

Percentage	74.58%

Respondents who indicated they have had some sort of problem with their system in the last 3 years (Question 7)

	Percentage	Number
An overflow or blocked system	35.94%	23
All problems	47.54%	29

Average amount spent on systems actually used (Question 8)

Amount	$ 297.88	per year

Section 2: Use of the Coastal Environment

Respondent engagement in coastal activities (Questions 9, 10, 11 & 12)

	Percentage	Number
Swimming	95.31%	61
Boating	90.77%	59
Fishing	86.15%	56
Relaxing	93.75%	60

Respondent health problems (Question 13)

	Percentage	Number
Had a health problem	4.76%	3
Did not know	3.13%	2
General sickness	1.56%	1
Skin and ear infections	3.13%	2
Problem resulted form swimming	3.13%	2

Respondents who considered the coastal water to be of cultural and/or spiritual significance (Question 15)

Percentage	31.15%

Respondents who indicated they work in an activity that depends on the quality of the coastal water (Question 16)

Percentage	18.18%

Section 3: Willingness to Pay for a New Sewerage System

Respondents who indicated that a community treatment system would provide them with reliability and convenience (Question 17)

Percentage	83.87%

What respondents are willing to pay (WTP) (Questions 18 & 19)

Percentage who indicated they were willing to pay the $22	20.34%

	Average	Median
Average WTP for those who were not biased against the payment vehicle or the Council's past management of sewerage	$ 15.97	$ 10.50
Average WTP for those who stated a non zero amount	$ 18.93	$ 13.60

Respondents who gave a zero WTP amount (Questions 19 & 20)

	Percentage	Number
Percentage who indicated they weren't WTP because they wouldn't receive any benefits	6.25%	4
Percentage who indicated they weren't WTP because they couldn't afford it	15.63%	10
Percentage of WTP responses removed because of probable bias	51.56%	33

Respondents who gave the stated reason as being in the top two for preventing sewage wastewater pollution (Question 21)

	Percentage	Number
Swimming and Boating	83.87%	52
Fishing	54.84%	34
Relaxing	30.65%	19
Benefits to others	32.26%	20
Cultural and/or Spiritual	4.84%	3
Livelihood	3.23%	2

Section 4: General Background Information

Respondent groupings (Question 2)

	Percentage	Number
Home Owner	48.44%	31
Home Renter	1.56%	1
Holiday Home Owner	37.50%	24
Business Manager /Owner	6.25%	4
Other	6.25%	4
	100.00%	64

Respondent Gender (Question 22)

	Percentage	Number
Male	73.44%	47
Female	26.56%	17

Age of respondents (Question 23)

Average Age	58 years

Occupant Statistics (Questions 24 & 25)

Average number of occupants per dwelling	3.10
Average number of occupants per dwelling over 18	2.26

Average time respondents have resided in Tapeka (Question 26)

Average residing time	10.52 years

Education (Question 27)

Average education	5.56 (Equivalent of a Trade/Technical Certificate)

Income (Question 28)

Average Income/turnover	$ 1,348.18 per fortnight

Average number of contributors to income/turnover (Question 29)

Average number of income/turnover contributors	1.70

Environmental organisation membership (Question 30)

	Percentage	Number
Respondents who indicated that they were members of an environmental organisation	14.29%	9

Section 1: The State of Current Sewage Treatment

Washing wastewater destination (Question 3)

	Percentage	Number
Septic Tank	65.00%	13
Sewage Well/Pit	15.00%	3
Public Drain	0.00%	0
Garden	5.00%	1
Other	15.00%	3
	100.00%	20

Sewage destination (Question 4)

	Percentage	Number
Septic Tank	80.00%	16
Sewage Well/Pit	5.00%	1
Community System	0.00%	0
Other	15.00%	3
	100.00%	20

Respondents who indicated their washing wastewater goes to a different destination to their septic wastewater (Questions 3 & 4)

Percentage	40.00%

Age distribution of respondent sewage systems (Question 5)

	Percentage	Number
0 to 10 years	35.29%	6.00
10 to 20 years	29.41%	5.00
More than 20 years	35.29%	6.00

Respondents who indicated they think their system needs major restoration (Question 6)

Percentage	35.00%

Respondents who indicated they have had some sort of problem with their system in the last 3 years (Question 7)

	Percentage	Number
An overflow or blocked system	25.00%	5
All problems	45.00%	9

Average amount spent on systems actually used (Question 8)

Amount	$ 84.69	per year

Section 2: Use of the Coastal Environment

Respondent engagement in coastal activities (Questions 9, 10, 11 & 12)

	Percentage	Number
Swimming	89.47%	17
Boating	78.95%	15
Fishing	78.95%	15
Relaxing	94.74%	18

Respondent health problems (Question 13)

	Percentage	Number
Had a health problem	5.26%	1
Did not know	25.00%	5
General sickness	0.00%	0
Skin and ear infections	5.00%	1
Problem resulted form swimming	10.00%	2

Respondents who considered the coastal water to be of cultural and/or spiritual significance (Question 15)

Percentage	85.00%

Respondents who indicated they work in an activity that depends on the quality of the coastal waters (Question 16)

Percentage	25.00%

Section 3: Willingness to Pay for a New Sewerage System

Respondents who indicated that a community system would provide them with reliability and convenience (Question 17)

Percentage	50.00%

What respondents are willing to pay (WTP) (Questions 18 & 19)

Percentage who said they were willing to pay the $60	0%

	Average	Median
Average WTP for those who were not biased against the payment vehicle or the Council's past management of sewerage	$ 9.75	$ 7.50
Average WTP for those who stated a non zero amount	$ 16.25	$ 15.00

Respondents who gave a zero WTP amount (Questions 19 & 20)

	Percentage	Number
Percentage who indicated they weren't WTP because they wouldn't receive any benefits	20.00%	4
Percentage who indicated they weren't WTP because they couldn't afford it	30.00%	6
Percentage of WTP responses removed because of probable bias	0.00%	0

Respondents who gave the stated reason as being in the top two for preventing sewage wastewater pollution (Question 21)

	Percentage	Number
Swimming and Boating	66.67%	12
Fishing	66.67%	12
Relaxing	5.56%	1
Benefits to others	38.89%	7
Cultural and/or Spiritual	38.89%	7
Livelihood	5.56%	1

Section 4: General Background Information

Respondent groupings (Question 2)

	Percentage	Number
Home Owner	70.00%	14
Home Renter	10.00%	2
Holiday Home Owner	5.00%	1
Business Manager /Owner	5.00%	1
Other	10.00%	2
	100.00%	20

Respondent Gender (Question 22)

	Percentage	Number
Male	50.00%	10
Female	50.00%	10

Age of respondents (Question 23)

Average Age	48 years

Occupant Statistics (Questions 24 & 25)

Average number of occupants per dwelling	5
Average number of occupants per dwelling over 18	3

Average time respondents have resided in Horeke (Question 26)

Average residing time	17 years

Education (Question 27)

Average education	4 (Equivalent of a Higher School Qualification

Income (Question 28)

Average Income/turnover	$ 619.74 per fortnight

Average number of contributors to income turnover (Question 29)

Average number of income/turnover contributors	2

Environmental organisation membership (Question 30)

	Percentage	Number
Respondents who indicated they were members of an environmental organisation	15.00%	3.00

APPENDIX 7
The Data Set

Explanatory Abbreviations

HRenter	Respondent is a **home renter**
HHOwner	Respondent is a **holiday home owner**
Bus M/O	Respondent is a **business manager or owner**
Other	Respondent is an **other** type of premise occupant
Restor	Respondent thinks their current system needs **restoration**
Problems	Respondent has had **problems** with their current system
Expenses	The yearly **expenses** incurred by respondent on their system
Use	Respondent **uses** the local coastal environment for some pleasure activity
Health	Respondent has had ill **health** that they believe resulted from inadequate sewage disposal in their coastal environment
Culture	Respondent believes their coastal environment is of **cultural** and/or spiritual significance
Livelih	Respondent's depends on the coastal environment for their income and **livelihood**
Conven	Respondent believes that a community sewage system would provide **convenience** and reliability benefits etc.
WTP	Respondent **Willingness To Pay** (This is the dependent variable)
Gender	Respondent **Gender**

Age	Respondent **Age**
#Occup	Number of **occupants** at respondents premises
Occup>18	Number of **occupants** at respondents premises **over eighteen**
Time	Length of **time** the respondent has resided in the community
Education	**Education** of the respondent
Y/Turn	Gross **income or turnover** of the respondents household or business
Contrib	Number of **contributors** to household income or business turnover
EnvOrg	Respondent is a member of an **environmental organisation**
DTap	**Dummy variable for Tapeka** – respondent is from Tapeka
DHor	**Dummy variable for Horeke** – respondent is from Horeke

Occupancy Type																							
HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
0	0	0	1	0	0	148	1	0	1	0	1	36	1	51	2	2	2	6	2500	2	0	0	0
0	0	0	0	1	1	0	1	0	0	1	0	20	1	48	2	2	4	5	625	2	0	0	0
0	0	0	0	0	0	148	1	0	1	1	0	0	0	39	3	2	4	9	125	2	1	0	0
0	0	0	0	1	1	200	0	0	0	0	1	36	1	76	2	2	14	9	1750	2	0	0	0
0	0	0	0	0	0	50	1	0	1	0	0	0	1	62	1	1	14	9	1750	0	1	0	0
0	0	0	0	0	0	30	1	0	0	0	0	10	1	70	2	2	25	5	875	2	0	0	0
0	0	0	0	0	0	148	0	0	0	0	1	20	1	56	3	3	19	6	875	2	0	0	0
0	1	0	0	0	0	0	0	0	0	0	1	5	0	56	2	2	17	8	1250	2	0	0	0
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0	0	0	0	0	0	0	1	0	0	0	0	0	1	68	2	2	8	7	875	2	0	0	0
0	0	0	0	0	0	0	1	0	0	0	1	20	1	69	2	2	25	1	1250	2	0	0	0
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0	0	0	0	0	0	100	1	1	0	0	0	0	0	44	2	1	5	7	625	1	0	0	0
0	1	0	0	1	0	148	1	0	0	0	1	36	0	54	3	2	48	7	425	1	0	0	0
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0	0	0	0	1	0	148	1	1	1	0	1	5	1	62	3	3	20	4	1250	0	0	0	0
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0	1	0	0	1	1	100	1	0	0	0	1	0	1	50	2	2	1	6	875	2	1	0	0
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0	1	0	0	0	0	0	0	0	0	0	1	10	1	56	1	1	1	6	875	1	0	0	0
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0	1	0	0	0	1	150	1	0	0	0	1	2.5	0	38	3	2	15	8	875	2	0	0	0
0	1	0	0	0	0	10	1	0	0	0	1	20	1	61	5	5	24	4	2500	1	1	0	0
0	0	0	0	0	0	60	1	0	1	0	0	20	1	71	2	2	28	4	625	2	1	0	0
0	0	0	0	0	1	20	1	0	1	1	1	4	1	53	4	2	10	8	300	1	1	0	0

HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
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HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
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0	0	1	0	1	1	187	1	0	1	0	1	10	0	47	3	3	20	7	1250	1	0	0	0
0	0	0	0	0	0	200	1	1	1	1	1	0	0	36	3	2	26	3	425	1	1	0	0
0	1	0	0	0	1	0	1	0	1	0	1	0	1	68	3	3	30	3	875	2	0	0	0
0	0	0	0	1	1	150	1	0	0	0	1	0	1	48	3	2	40	8	1750	2	0	0	0
0	1	0	0	1	1	148	1	0	0	1	1	36	1	31	2	1	6	8	2500	2	0	0	0
0	0	0	0	0	1	50	1	0	0	0	1	28	1	72	2	2	30	7	1250	2	0	0	0
0	0	1	0	0	0	100	1	0	0	1	1	20	0	58	1	1	20	3	425	1	0	0	0

HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
0	0	0	0	1	0	50	1	0	1	0	1	16.6	1	60	2	2	4	6	300	1	0	0	0
0	0	0	0	0	0	100	1	3	0	1	1	10	1	44	4	2	20	6	1750	2	0	0	0
0	0	1	0	1	1	148	1	0	1	1	1	50	0	64	12	12	20	9	2500	6	1	0	0
0	0	1	0	1	1	1000	0	0	1	1	1	50	0	64	12	12	20	9	2500	6	1	0	0
0	0	0	0	0	0	80	1	0	1	0	1	10	1	64	1	1	15	6	300	1	0	0	0
0	0	1	0	1	1	148	1	0	1	1	1	14	0	44	6	6	40	5	875	2	0	0	0
0	0	0	0	1	0	148	1	0	1	0	1	0	1	70	3	2	4	7	875	2	0	0	0
0	0	0	0	0	1	50	1	0	1	0	0	20	0	91	1	0	37	4	125	0	0	0	0
0	0	0	0	0	0	200	1	0	0	0	1	36	1	55	3	2	7	7	1750	1	1	0	0
0	0	0	0	0	0	120	1	1	1	0	1	30	0	65	2	2	34	2	425	1	0	0	0
0	0	0	0	1	0	0	1	0	0	0	1	20	1	50	2	2	12	8	2500	2	0	0	0
0	0	0	0	1	0	200	1	0	1	0	1	10	1	48	2	2	4	8	825	2	0	0	0
0	1	0	0	0	0	0	1	0	1	0	1	10	1	67	2	1	7	3	2500	0	0	0	0
0	0	1	0	1	0	0	1	0	0	1	1	30	1	50	2	2	2	7	300	1	0	0	0
0	0	0	0	1	0	100	1	0	1	1	1	10	0	43	4	2	2	9	2500	2	0	0	0
0	0	0	0	1	1	200	1	0	1	1	1	20	1	62	4	4	16	6	425	4	0	0	0
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0	0	0	0	0	1	148	1	0	1	1	1	36	1	54	4	2	10	5	1250	2	1	0	0
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0	0	0	0	0	1	180	1	0	1	1	1	36	0	40	4	2	15	8	875	2	1	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	1	69	1	0	50	2	625	0	0	0	0
0	0	1	0	1	1	148	1	0	0	1	1	10	0	58	2	2	20	3	425	1	0	0	0
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0	0	1	0	1	0	0	1	0	0	1	1	30	0	53	0	0	4	9	425	1	0	0	0
0	1	0	0	0	1	300	1	0	0	0	1	20	1	65	2	2	10	1	1250	2	0	0	0
0	0	1	0	1	1	3500	1	1	0	1	1	75	0	33	20	20	6	3	825	3	0	0	0
0	0	1	0	1	1	148	1	0	1	1	1	50	0	46	9	9	1	6	2500	9	0	0	0
0	0	1	0	0	1	200	1	0	0	1	1	10	1	69	2	2	3	8	2500	2	0	0	0
0	1	0	0	1	0	148	1	0	0	0	1	36	1	41	5	2	5	3	2500	1	0	0	0
0	0	0	0	0	1	0	1	1	1	0	1	10	1	57	3	3	3	4	2500	1	0	0	0
0	0	0	0	1	0	90	1	0	0	0	1	36	1	76	4	2	16	4	875	0	0	0	0
0	0	0	0	0	0	150	1	0	0	0	1	0	1	58	3	2	10	3	300	1	0	0	0
0	0	1	0	0	0	148	1	0	0	1	1	0	0	69	1	1	5	6	875	2	0	0	0
0	0	1	0	1	0	500	1	0	0	1	1	36	1	55	10	10	2	5	2500	4	0	0	0
0	0	1	0	1	0	1000	1	0	0	1	1	100	1	48	3	2	16	4	2500	2	0	0	0

HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
0	0	1	0	0	0	0	0	0	1	1	1	36	1	56	2	2	18	6	875	2	0	0	0
0	0	0	0	1	1	200	1	0	1	0	1	10	1	41	5	4	4	4	2500	3	0	0	0
0	0	0	0	1	0	0	1	0	1	0	1	10	1	79	2	2	4	6	625	2	0	0	0
0	1	0	0	1	0	200	1	0	1	0	1	10	0	44	6	2	40	7	1250	1	0	0	0
0	0	0	0	0	0	20	1	0	0	0	0	14	1	58	3	3	22	6	1250	2	0	0	0
0	0	0	0	0	1	50	1	0	1	0	0	0	0	79	1	1	27	7	425	1	1	0	0
0	0	0	0	0	0	150	1	1	1	0	1	10	1	52	2	2	20	8	625	2	1	0	0
0	0	0	0	0	1	148	1	0	1	1	1	0	0	75	1	1	53	2	200	0	1	0	0
0	1	0	0	0	0	0	1	0	0	0	0	4	1	68	2	2	8	2	300	1	0	0	0
0	0	1	0	0	1	148	1	0	0	0	1	0	1	67	1	1	17	8	300	1	0	0	0
0	0	0	0	1	1	150	1	0	1	1	1	36	1	49	3	2	15	8	425	2	0	0	0
0	0	1	0	1	0	500	1	0	0	1	1	50	1	53	2	2	1	6	2500	2	0	0	0
0	0	0	0	1	1	150	1	0	1	1	1	36	0	39	6	2	11	7	875	1	0	0	0
0	0	0	0	1	0	200	1	0	1	0	1	10	1	57	2	2	3	3	75	2	0	0	0
0	0	0	0	1	1	50	1	0	0	0	1	14	1	48	2	2	28	6	425	2	0	0	0
0	0	0	0	0	1	148	1	0	1	1	1	16.6	0	56	3	2	17	6	875	2	0	0	0
0	0	0	0	0	1	100	1	0	1	1	1	5	1	42	4	2	27	7	50	2	0	0	0
0	0	0	0	0	0	190	1	0	1	0	0	15	1	48	6	3	11	8	875	2	1	0	0
0	0	0	0	0	0	148	1	0	1	1	0	16.6	0	56	2	2	17	6	875	2	0	0	0
0	1	0	0	0	1	0	1	0	0	0	1	10	0	46	7	4	9	7	2500	2	0	1	0
0	0	0	1	1	1	126	1	0	0	0	1	13.6	1	43	4	2	6	8	2500	2	0	1	0
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0	0	0	0	0	0	500	1	0	1	0	1	22	1	74	2	2	20	8	875	2	0	1	0
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0	1	0	0	0	1	480	1	0	1	0	0	7.5	1	53	6	3	10	9	1750	3	0	1	0
0	0	0	0	0	0	510	1	0	0	0	1	30	1	52	2	2	2	5	1750	2	0	1	0
0	0	0	1	0	1	0	0	0	0	0	1	10	1	48	3	2	15	7	875	2	1	1	0
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0	0	0	0	1	1	0	1	0	0	0	1	10	0	82	1	1	22	2	625	1	0	1	0
0	1	0	0	1	0	0	1	0	1	0	1	10	1	57	4	3	21	7	1750	2	0	1	0
0	0	0	1	0	0	300	0	0	1	0	1	0	0	32	2	2	2	4	2500	2	0	1	0
0	0	1	0	1	1	510	1	0	0	0	1	22	1	45	4	2	6	4	2500	1	0	1	0
0	1	0	0	0	1	252	1	0	0	0	1	11	0	62	2	2	28	4	425	1	1	1	0
0	0	0	0	1	1	509	1	0	0	0	1	19	1	74	2	2	14	9	875	2	0	1	0
0	0	0	0	1	0	510	1	1	0	0	1	10	0	50	2	2	11	9	2500	2	0	1	0

HRenter	HHOwner	Bus M/O	Other	Restor	Problems	Expenses	Use	Health	Culture	Livelih	Conven	**WTP**	Gender	Age	#Occup	Occup>18	Time	Education	Y/Turn	Contrib	EnvOrg	DTap	DHor
0	0	1	0	1	1	300	1	0	0	0	1	10	0	60	2	2	0	3	875	2	0	1	0
0	0	0	0	1	1	141	1	0	0	1	1	22	0	45	2	2	2	5	875	2	0	1	0
0	0	0	0	1	0	300	1	0	0	0	1	10	0	78	1	1	22	2	425	0	0	1	0
0	1	0	0	1	1	565	1	0	0	0	1	5	0	68	1	1	5	6	425	0	0	1	0
0	0	0	0	1	0	300	1	0	0	0	1	0	1	59	4	4	4	6	1250	1	0	1	0
0	0	0	0	1	1	100	1	1	0	0	1	10	1	71	1	1	3	9	875	1	0	1	0
0	1	0	0	0	1	282	1	0	1	1	1	22	1	59	2	2	16	4	1250	2	0	1	0
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0	0	0	0	1	1	300	1	0	1	0	1	5	1	46	6	2	2	3	1250	1	1	1	0
0	1	0	0	0	0	300	1	0	0	0	1	0	1	67	2	2	12	3	625	2	0	1	0
0	0	1	0	0	1	350	1	0	1	1	1	12	1	50	6		4	6	2500	1	0	1	0
0	1	0	0	1	1	509	1	0	0	0	1	0	1	61	3	3	4	4	1750	2	0	1	0
0	0	0	0	1	0	0	1	0	0	1	1	20	1	61	4	4	40	4	425	2	0	0	1
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0	0	0	0	0	0	0	1	0	0	0	0	8	1	35	2	2	3	6	300	1	0	0	1
0	0	0	0	1	1	0	1	0	1	0	1	30	0	56	2	2	30	1	625	2	1	0	1
0	0	0	0	0	0	75	1	0	1	0	0	0	0	31	5	2	10	7	625	2	1	0	1
0	0	0	0	0	0	0	1	0	1	0	0	0	0	32	3	1	0	3	300	1	0	0	1
0	0	0	0	1	1	125	1	0	1	0	1	7	0	36	7	3	5	3	425	2	0	0	1
0	0	0	0	1	1	70	1	0	1	0	1	10	1	36	5	3	8	5	425	1	0	0	1
0	0	0	1	0	0	40	1	0	1	0	1	20	0	48	18	8	17	3	875	1	0	0	1
0	0	0	0	0	0	0	1	0	1	0	0	5	0	40	5	2	10	8	1250	1	0	0	1
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0	0	0	0	0	1	85	1	0	1	0	0	0	1	48	2	2	23	3	620	1	0	0	1
0	0	1	0	0	1	200	1	0	1	0	1	35	1	42	3	3	5	9	2500	1	1	0	1
0	0	0	0	0	1	250	1	0	1	1	0	10	1	72	2	2	37	3	300	2	0	0	1
1	0	0	0	1	0	85	1	1	1	0	1	0	0	48	4	2	4	3	625	1	0	0	1
1	0	0	0	1	1	205	1	0	1	0	1	10	0	34	6	2	3	6	875	1	0	0	1
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0	0	0	0	0	0	40	1	0	1	0	0	20	0	59	6	4	5	3	625	4	0	0	1
0	0	0	0	0	1	85	0	0	0	0	0	0	1	72	1	1	17	3	300	1	0	0	1