4 PART

Management, Funding And Selection Of Wastewater Options

The fact that management is as important to the success of your wastewater venture as choosing the technical systems themselves has already been stressed. Indeed, a key question your community should ask itself is: what is the capacity of individual households or the community to manage a wastewater system in the long term? The answer to this question will be a significant factor in deciding whether you want a system that can be managed by an external agency – such as a local council – or whether you will stay with local responsibility. Section 11 discusses this management issue.

By this stage, if you have made your way through the manual, you may feel rather overwhelmed with all the information you have been presented with. *Section 12* tries to help by providing a framework for decision-making, in which various criteria can be applied to assess the various options you now face.

Management and Funding of Wastewater Systems

Obviously cost will be a significant factor in choosing a technical solution. There will be ongoing maintenance and operating costs that will need to be paid for. The relative costs of different on-site systems are discussed in *Appendix 6*. The more general issues of funding are discussed here.

11.1 *Management of wastewater systems*

Traditionally, wastewater systems have been managed in two ways. The first is where on-site or individual systems have been managed by the householder or stand-alone business. The construction, maintenance and operation of the system lie with the individual. In contrast, centralised collection and treatment systems are managed by a central agency, usually the local authority, which undertakes all management activities in a co-ordinated approach to wastewater servicing. This has normally been the practice on a regional or district or cluster approach to management of community-wide wastewater schemes. Occasionally, responsibility would be transferred to a separate agency, which would be governed in some way by the local authorities concerned. Auckland region's Watercare is an example of this.

However, there is an international trend towards placing on-site wastewater systems under integrated management programmes, particularly with respect to their operation, maintenance and monitoring. This trend is becoming evident in some areas of New Zealand, and is the recommended approach in the joint Australian/New Zealand Standard (2000) for on-site domestic wastewater management.

The newer cluster systems can be managed by a local authority (if they constructed them) or by a corporate entity. The latter would be set up by the property owners to manage the system on their behalf. This 'centralising' of management reflects both the need to have a clear line of responsibility and the complexity of the systems being managed.

So a more comprehensive picture of wastewater systems management can look something like that outlined in *Figure 11.1*.

On-site systems

The individual household management of on-site systems has come under increasing scrutiny by agencies concerned about public health. It is common to find that septic tanks and other on-site systems are poorly maintained and operated. There are often consequent problems with discharges on to land and waterways, and contamination of the water supply. Sometimes the cause of failure is lack of information about how to operate and maintain the systems. Sometimes it is an issue of cost.

Another problem is that failure to maintain the on-site system can mean that its 'life' is drastically reduced. The homeowner may save money in the short term, but the system may have to be replaced earlier than normal. The value of the asset is lost. This recent scrutiny is likely to force communities who are otherwise comfortable with their on-site systems to review the situation.

One of the problems with this on-site system failure is that it can push a community into choosing off-site cluster or centralised systems. This physical technical system may not be necessary if the on-site systems are well managed.

There are two types of management solution you can consider when you explore technical solutions.

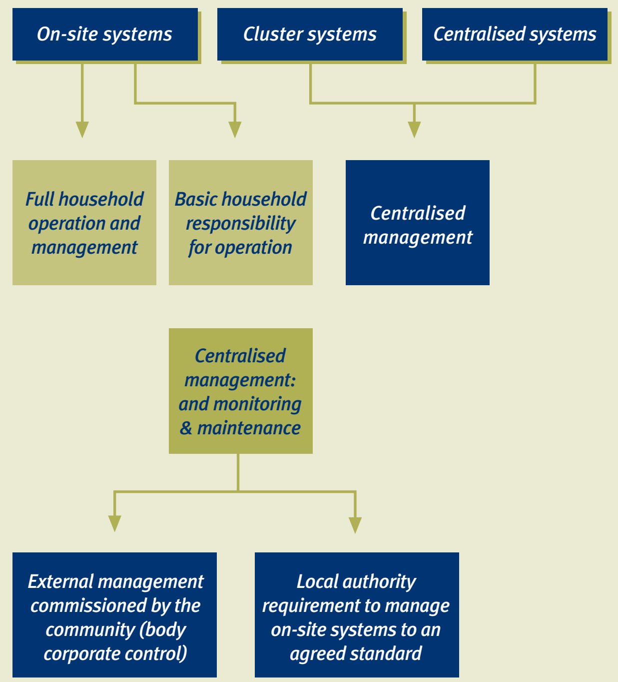

Figure 11.1 Wastewater systems management

A collective approach to maintaining systems

For example, your bach settlement might consist of 100 houses, all with septic tanks. Fifty of these houses have permanent residents and 50 have summer visitors, who have limited knowledge of septic tank systems. One solution may be for the owners to get together and pay a third person to monitor and maintain these systems for a set price. Capital costs to upgrade and repair a particular septic tank would still be the responsibility of the individual land owner.

A collective approach to improved management of septic tanks

The majority of the community may feel that some regulation to require management of the on-site systems is necessary. Or your community may want to clearly indicate the expected standard for any new people settling in the area. A simple way to do this is to require everyone to perform to a certain level. This two-pronged approach may reduce pressure to move to a centralised technical system because the management of the on-site systems is faulty.

Such integration can:

- provide for the involvement of professional operation and maintenance servicing (O&M), which removes the direct responsibility from the homeowner
- protect the investment in the on-site system hardware and soil treatment capacity by maintaining long-life performance
- bring better environmental and public health results.

This concept of integrating the management of on-site systems is referred to overseas as 'decentralised wastewater management' (DWM). The objective of DWM is to provide centralised management of decentralised facilities, such as on-site septic tank and soakage trench systems on individual properties. This means that a level of management service equivalent to that of centralised and cluster wastewater systems can be accomplished. Sometimes overseas this DWM can include investigation and design of the system.

This approach to operating and maintaining on-site systems would still need the householder to take some responsibility; for example, making sure that toxic substances do not enter the system.

Environment Bay of Plenty (BOP) Maintenance Certification Scheme

In 1999 Environment BOP introduced a system of on-site wastewater system inspections for properties at 14 coastal communities in the Tauranga Harbour and Rotorua Lakes areas. There was concern that the high density of residential development and un-maintained septic tank effluent soakage systems were contributing to environmental effects on natural water quality. To initiate the programme, Environment BOP ran training courses for prospective certifiers, who were recruited from the drainlaying and tank-servicing industry. All homeowners in the community areas were given ample information on the reasons for and the method of carrying out the inspections, and advised that following a satisfactory inspection, a compliance certificate would be issued. Those systems that required remedial work to bring them up to a satisfactory standard would be certified following completion of the work. A deadline was set for homeowners to engage a certifier and have the inspections completed, whereupon certificates would be issued by Environment BOP.

The on-site system inspection process involved lifting the lid of the septic tank, pumping the tank out, inspecting its size and structural condition, and checking out the condition of the soakage field. In addition, the location of the system in relation to environmental features on the site (such as groundwater level, nearness to streams, water courses, lake and harbour sides, as well as site boundary conditions) were noted and reported on. A scoring system based on demerit points associated with non-compliance with regional rules for on-site system installation was used to rank the suitability and performance of each system. Payment for the inspection and septic tank pump-out was arranged directly by the owner through the certifier who arranged all the work. A fee was recovered by the certifier to pay Environment BOP for the issue of the compliance certificate, as well as administration costs, including auditing of inspections.

The inspection programme indicated that several settlements needed to change to a community sewerage scheme. For the remaining localities, inspections are to continue at three-yearly intervals.

Levels of management

There are different levels of management associated with the use, operation and maintenance of on-site systems involving householders, owner body corporate agencies, or local authority agency. Examples are as follows.[19]

Level 1: leave all responsibility for O&M management in the hands of householders, but the local authority develops an inventory of systems, and provides information to owners and users on a regular basis.

Level 2: inspection and maintenance certification – agree a standard of maintenance, which would be carried out by an external operator engaged by the householder. This would require the council to set a consistent standard across all the systems in an area, which might involve upgrades to an agreed level first. All mechanical treatment systems would be subject to maintenance contracts. The council would keep records of all maintenance certificates and contract reports.

Level 3: a utility operator takes over the monitoring and maintenance. A council may take on the maintenance programme and charge back the cost via rates or a direct charge. Alternatively, a private organisation (body corporate) could manage the O&M activity with reporting back to the council.

Level 4: the assets are actually vested in the agency, which manages them directly. This might be a council or a body corporate-type approach.

Levels of inspection

Clearly, with large lot sizes and low density of development, on-site systems are likely to have limited potential for creating environmental effects beyond the site boundary. Hence, the frequency and detail of monitoring inspections could be modified to accommodate the intensity of development and the likely performance of on-site systems.

Table 11.1 provides a model for the levels of inspection and procedures involved for various types of facility.

Assessing whether it is a management or a technical system problem

The previous discussion identifies some approaches to management options, which, if adopted, might mean that your community continues with on-site systems. How then do you balance this kind of management approach against other factors that might be pointing you to technical solutions? How can you be sure that it is a fixable management issue and not a technical problem?

First, you need to know:

- the scale of the problem – this may involve working with your local council to do a full review of on-site systems
- the extent that people do actually maintain their on-site systems
- whether the systems are suitable for the physical environment, the soils, the water table, the topography and other physical attributes of the site.
- the cost of an upgrade.

In the end it may come down to a decision about how far your community's on-site systems have declined in quality, and how much it will cost to haul them back to an acceptable level.

Make sure you factor in information about how your community manages its on-site systems and match that with the scale of any problems and with the condition of the systems. Remember that there are a variety of choices, including continuing with well-managed on-site systems for parts of the community. (The choices are covered in *Part Three*.)

[19] Concepts are derived from the US Environmental Protection Agency model for requiring integrated decentralised wastewater management.

Inspection level	*Application*	*Inspection procedures*
Class 1 (low level, 5–10 year intervals)	• *remote area recreational facilities* • *farmhouses* • *lifestyle blocks (on large lots >2 ha)* • *rural/residential dwellings (>4000 m^2)* • *where significant clearances are available to property boundaries (50 m or more)* • *where an established history of good environmental performance exists* • *where environmental, public health and economic consequences of poor performances are considered insignificant.*	*Class I low-level inspections may involve a check on the septic tank and/or other pre-treatment unit sludge and scum levels, and a visual inspection of the general location of the land application area and on-site system environment.*
Class II (intermediate level, 3–5 years)	• *rural/residential subdivisions of fewer than 5 lots* • *rural/residential subdivisions on medium- sized lots (>1000 m^2)* • *urban dwellings on medium-sized lots (>1000 m^2)* • *isolated rural dwellings on lots >800 m^2* • *where the site coverage allows ample room for providing a replacement system to modern design standards* • *where seasonal occupancy is the norm (ie, holiday resort areas)* • *where overall performance of local systems is judged satisfactory.*	*Class II intermediate-level inspections may involve (in addition to the low-level assessment) the search of building consent records, distribution system inspections, probing to locate soakage field elements, full sketch plans of site and on-site system elements, general soil assessment, and an overall environmental performance review.*
Class III (high level, 1–3 years)	• *rural/residential subdivisions of more than 5 lots* • *rural/residential subdivisions on smaller lots (<1000 m^2)* • *isolated rural residential dwellings on smaller size lots (less than 800 m^2)* • *urban area dwellings in smaller lot sizes (<1000 m^2)* • *where site coverage results in restricted room for a replacement system to modern design standards* • *where permanent occupancy is the norm in rural/residential areas* • *where overall performance of local systems is judged unsatisfactory* • *where a high level of failures of existing systems is evident (>than 20% of systems are affected)* • *where potential environmental and public health effects are judged to be significant.*	*Class III high-level inspections may involve (in addition to intermediate assessment): emptying pre-treatment units via pump-outs of septage and then evaluating the physical condition of the unit; excavating elements of the land application system/area to assess liquid retention and current operational capability; undertaking detailed solid profile determination and soil category assessment to confirm design suitability; sampling and analysing pre-treatment effluent quality; and undertaking environmental effects assessment (including groundwater and surface water monitoring within and beyond the site, as well as checking soil condition and plant health in the vicinity).*

Table 11.1 ***A New Zealand model for on-site inspection***

What are the operational and maintenance issues that need management?

Operational issues

'Operations' usually applies to the day-to-day actions that need to take place to run a system. For example, to run a central wastewater treatment system, electricity is needed, as well as someone to monitor and oversee the system. These are operating costs.

In choosing an option the costs of operating any system need to be factored in. Interestingly, the operating costs of on-site systems tend not to be factored into decisions. Costs are generally absorbed directly by the homeowner or businessperson – in terms of time and effort to monitor and look after the system. This is very misleading because it is the willingness of the owner to operate and maintain the system that is such a big factor in its long-term success.

At the very least, the time needed by an owner to run a system should be estimated and converted to some sort of hourly rate. If the community decides to commission external operations and maintenance, the costs will then be comparable.

For on-site systems, the operational issues are probably relatively small but will include monitoring and inspections.

Monitoring technologies

The development of new technologies for monitoring on-site system treatment units and transferring monitoring data by phone lines to a central management and servicing agency now provides high-level, economical support to inspection programmes. Remote monitoring of a large number of systems on individual properties can be accommodated by computer data processing, with fault detection and alarm call-out procedures initiating maintenance responses to deal with emergency situations. Such monitoring technologies enable labour cost savings associated with operation and maintenance inspections (see Golden Valley subdivision example, *Section 9.4*).

Maintenance

This includes all the activities needed to keep the physical system at a high quality. Time and money spent on maintenance will extend the 'design life' of the asset and mean that you don't have to replace the system earlier than is needed. Maintenance can include routine cleaning of any pipes and screens, pump-outs of septic tanks, and associated testing. Monitoring of the physical state of a system will also be necessary.

Replacement

Any system will have a life, beyond which it will be 'worn out'. It will need replacing at some stage and an important management concern will be to ensure that it is replaced at the best possible time. As much as possible, this needs to be right at the point where the system is still functioning well (so service levels are maintained) but just before it might fail. This involves expert judgement, and puts an onus on the homeowners to make that judgement, or to know when to seek expert advice. More often than not that advice is sought when the system fails. Commissioned management assistance may avoid this problem.

New assets and upgrades

Building a new system, improving the quality of an existing system, or increasing its capacity may all be needed from time to time.

Centralised and cluster systems

The management regimes for cluster and centralised servicing are well established, and may be administered by one of the following agencies:

- local authority
- regional authority
- council controlled organisation (previously called a LATE – local authority trading enterprise)
- private enterprise servicing company.

The resources and procedures for operation and maintenance and monitoring of both the sewerage system and the treatment plant and ecosystem re-entry facilities will have been developed and refined over many years, with trained and experienced staff providing oversight of this full service approach.

In the case of a small subdivision in a rural area, sometimes a 'sewage package plant' is an acceptable solution to the local authority. This requires some form of legal agreement between the benefiting parties to provide for maintenance and management. This can be supplied under a turn-key contract and there are a number of suppliers of such systems operating in New Zealand. Speak with the New Zealand Water and Waste Association for an up-to-date list.

In urban communities a communal system of wastewater service is the most efficient and effective delivery mechanism. Typically in New Zealand the system has been provided and maintained by the local council, but in recent times arrangements have evolved to include other options, including:

- transfer of the activity to a council-controlled organisation (previously called a LATE – local authority trading enterprise), so the activity is managed on a more business-like basis
- maintenance of the system by contractors – usually on a relatively short-term basis (eg, 3–10 years)
- franchising of wastewater services under a long-term contract (eg, Papakura District Council).

Since the enactment of the Local Government Act 2002, franchising (in the Papakura form) is no longer an option and the general provisions relating to the ownership and operation of 'water services' by local authorities (water supply, sewerage treatment and disposal and stormwater drainage) are much more constrained.

Every territorial authority that provided water services at the commencement of the Act is required to maintain that capacity, the transfer of ownership or control to a person that is not a "council-controlled organisation" is prohibited, and contracts for the operation of water services cannot exceed 15 years.

The principal legislative requirements that have to be complied with are:

- the Local Government (Rating) Act 2002 – especially the provisions in *Section 16* and *Schedule 3* relating to targeted rates
- *Sections 108 & 407* of the Resource Management Act 1991, and *Sub-parts 1* and *2* of *Part 7*, and *Sub-part 5* of *Part 8* of the Local Government Act 2002 regarding water services and development contributions, respectively
- *Section 148* in the Local Government Act 2002 (being the power to make a new by-law for tradewastes).

(For more information on the implications of the Local Government Act 2002, see *Appendix 2*.)

11.2 *Funding*

Whatever the system, be it public or private, it will have to be paid for somehow. This will include the:

- capital cost – the cost of building a new system, or of upgrading or extending an existing system
- annual cost of operating and maintaining the system
- cost of making provision for future replacement (depreciation).

For on-site systems, the owner will have to cover all costs, including capital, operating, monitoring and maintenance costs. Most owners of on-site systems make no provision for replacement costs, by setting aside money for depreciation of the asset. This would be like setting aside a sum each week to replace your washing machine when it wears out; the amount set aside would be an estimate of the replacement costs divided by the number of years of the life of the machine.

The following discussion deals with the funding of cluster or centralised wastewater systems managed by a body corporate, local authority trading enterprise, or council agency.

Capital cost

The capital cost of providing a proposed new system is of course very important – but it is not as important as the cost that is going to have to be paid annually over subsequent years. In *Appendix 6* some alternative systems arrangements are described with suggestions of possible ranges of capital costs. It may sometimes be better to select a system that is more expensive to build but cheaper to operate and maintain, than one that is cheaper initially but expensive to operate. However, the cost of loan servicing and the amount that is going to have to be put aside for depreciation are other important matters that will influence this decision.

In terms of a public system, there are three main ways of funding this capital cost.

- If the system is small, or there are many properties to share the cost, the property-owners involved might agree to contribute a single lump sum, or to pay a capital contribution by instalments.
- If sub-dividers and developers are likely to benefit in future, as well as requiring them to reticulate their own subdivisions and developments, contributions may be sought from them.
- The most common way is for the local authority concerned to raise a loan – usually for a term of 25–30 years.

Annual cost

The annual cost will be made up of direct maintenance and operating charges, loan interest and repayments, provision for depreciation, and, in the case of a council system, an amount for management and general overheads.

There are many ways these costs can be shared, and the first thing that needs to be done is to agree how much should be paid by the users and how much by the community at large. The answer to this question will vary from area to area, but normally the full cost (or almost all of it) will be required to be met by those whose properties are connected, or able to be connected, to the new system.

While rating according to the land, the capital or rateable value of properties is permitted, this is not often used for funding wastewater costs these days – except in some rural districts where a targeted rate may be levied over an 'area of benefit'. The disadvantage of land-value rating is that the individual amounts charged often do not bear any resemblance to the use being made of the system, and this raises questions of funding equity.

Ideally, the method for collecting the annual charges should be one that encourages water conservation, but (except in certain industrial situations, where the tradewaste provisions mentioned later apply) in reality charging according to the quantity of water discharged is not legally allowed.

The most common method used is to levy charges 'per pan or urinal connected', subject to the provision that every separately occupied household is deemed to have only one pan. The charge may be uniform or according to a scale that reduces in price the greater the number of pans.

Another de facto user pays method is to levy a uniform annual charge per rating unit, or per separately rateable portion of every rating unit, that is able to be connected to the system. This option is particularly useful in the early years of the system's life, until the number of properties connected makes the pan charging approach viable.

It should be noted too that the availability of the system also benefits properties that are capable of being, but are not presently, connected, in that the ability to connect increases the value of the land. The usual practice is for the owners of non-connected properties to be required to pay a reduced fee – usually 50% or 60% of the basic charge.

Some specific issues to be aware of

School charges

There have been long-running arguments about what schools should be required to pay. However, you should note that the former Rating Powers (Special Provision for Certain Rates for Education Establishments) Amendment Act 2001, commonly known as 'the Donnelly Act', now no longer applies and councils are free to decide what the charges for schools should be.

Tradewastes

Ensure that tradewastes (wastes discharged from a trade premises in the course of any trade or industrial process or operation) are adequately controlled. In order to be able to levy tradewaste charges, a bylaw will be required. The usual approach is for the council to recover the reasonable costs for treating discharges of such strength and volume in excess of sewage of a domestic nature that would be discharged from a property of 'substantially similar rateable value'.

Financial contributions

Ensure there is a process in place for requiring the payment of financial contributions to public wastewater systems by sub-dividers and developers. Before sub-dividers and developers can be required to contribute, unless the council is still able to use the provisions of the Local Government Act 1974 as a transitional measure it has to have an 'operative rule' in its district plan. Getting such a rule operative can be a long and difficult process. Another option in future is to use the new development contribution provisions in the new Local Government Act 2002.

Public consultation

Whatever the funding system proposed, if it is a local authority wastewater system there will have to be plenty of public discussion and consultation. The matter will have to be canvassed through the annual plan, and in future the proposed long-term council community plan. The provision of a new sewerage system is often very contentious, and anyone who makes a written submission about it has to be given the opportunity to be personally heard.

Another matter you may have to decide is how the proposed new system is to be accounted for in future. Often rural councils manage quite a few separate, relatively small schemes and there will be the question of whether there should be different charges for each or whether they should be managed and funded as one. Because of the impact of depreciation and of future capital renewal needs, the latter system has some distinct advantages.

Other sources of funding

A new and significant source of assistance for smaller communities is the Government's subsidy scheme for wastewater systems. It provides small and isolated communities with the ability to develop systems they might not otherwise be able to afford. The scheme is outlined below.

It is important to note that the assistance is for the *capital costs* of a project. If your community is considering the scheme, you need to make sure you have determined whether the operating, maintenance and replacement costs will be affordable. Note also that the subsidy is focused on off-site systems.

Sanitary Works Subsidy Scheme (SWSS)

The following are the main criteria the Government has decided on for a Sanitary Works Subsidy Scheme (SWSS). The scheme is primarily aimed at improving sewage treatment and disposal for small, largely rural communities that are unable to fund the necessary upgrades to meet public health and RMA requirements. More detailed criteria will be developed prior to the scheme starting on 1 July 2003. Applications have been possible since 1 January 2003.

The main criteria are:

a) the health risks posed by each community's existing treatment/disposal system and discharge (priority criterion)

b) the environmental and cultural needs will be covered by the scheme to the extent required to obtain relevant resource consents under the RMA

c) the size and definition of eligible community to be communities between 100 and 10,000 people

d) the maximum subsidy for eligible capital works to be 50% for communities up to 2,000, reducing in a straight line to 10% for communities of 10,000

e) the socioeconomic conditions of the community in question to be considered in reviewing applications

f) the size of subsidy to a community sanitary works to be at least matched by an equivalent contribution from the relevant territorial authority, and an undertaking to ensure adequate maintenance and operating arrangements

g) the responsible territorial authority to agree that constraints may be introduced as part of the grant agreement to ensure that the benefits of the subsidy are passed on to ratepayers.

Any SWSS would *not* apply to:

- industrial discharges
- new or future subdivisions
- domestic wastewater discharges within the property boundary
- maintenance costs
- city councils
- upgrading existing reticulation systems.

Administrative arrangements will be developed around the following criteria.

a) The application will be reported on and approved by the medical officer of health as meeting public health objectives.

b) Eligibility of applications (including the report of the medical officer of health) will be considered by a technical advisory committee convened by the Ministry of Health, which will make recommendations to the Minister of Health for approval after consultation with the Minister for the Environment.

c) Priority for funding will be given to those communities with:

- a high health risk (first priority)
- high measured rates of water-borne communicable disease
- significant environmental risk
- a poor score in the deprivation index
- a low rating ability and limited debt finance levels
- a significant Māori population, or inequalities
- no previous funding subsidy from any SWSS scheme.

For further information on the SWSS, please contact your local public health service.

Purchasing options

On-site systems

In this case the property owner is the purchaser of the on-site system, and engages an engineer or a drainage contractor to:

- carry out site and soil investigations and detailed design
- arrange council consents
- organise construction
- provide as-built plans
- draw up operation and maintenance guidelines
- make recommendations for ongoing monitoring and inspection of the system.

The owner will have to engage O&M services, either through a maintenance contract or on a casual basis as demand requires. Where council maintenance certification schemes are in place to ensure sound operation and management practice across a locality or a district, owners will have to pay for the inspection and certification services as and when required under the terms of the council scheme. Where a body corporate structure is formed by a group of owners, such as in a rural–residential subdivision, the body corporate will levy a uniform annual charge for operation and maintenance, and engage a servicing company to undertake the work.

Lake Hayes Wastewater Scheme, Queenstown Lakes District Council

In December 2001 the Queenstown Lakes District Council (QLDC) tendered a 'design-build-operate' (DBO) contract for the Lake Hayes Water Supply and Sewage Disposal Scheme. The wastewater management component of the scheme included several kilometres of gravity sewer and four wastewater transfer pumping stations. The project required the contractor to:

- obtain all resource consents
- obtain all land easements
- obtain designations for the pump-station sites
- undertake public consultation
- design the entire scheme
- construct the works
- operate the scheme for an initial period of 10 years, with a right of renewal of a further two five-year periods.

The QLDC selected Transfund's 'Brookes Law' procedure as the tender evaluation method. This method is not common in DBO tender evaluations. Council believed this method provided the best selection method for the potentially difficult consent, easement and public consultation aspects of the project. In addition, the method allowed for the inclusion of high-quality engineering within the works – an important consideration for a location such as Lake Hayes.

A joint venture between a civil engineering construction company and a consulting company was selected as the contractor with the highest attributes relating to experience, technical and management skills, and proposed methodology. The final contract price, including management, consultation, design and construction, and future operating costs, was negotiated within the council's budget, providing a win-win result for both parties.

The tendering method identified the contractor's attributes in a manner that allowed the council to select the best possible team to undertake the project. Construction was completed at the end of 2002.

Cluster and centralised systems

Local councils have traditionally provided wastewater schemes through their works division or department. This can be via direct labour, or (more often) via council engagement of consultants to design the work, arrange tendering of the construction contract, and supervise the construction. The council processes the relevant planning and environmental consents; arranges funding via loans, or direct charges against budgeted capital works funds, and on completion of the work; and funds monitoring, inspection, and operation and maintenance services against its operational budget.

Two methods of purchasing wastewater schemes have been employed by some councils in recent years, although the Local Government Act 2002 may have made these alternatives less likely to be utilised. These are design-build-operate (DBO), and build-own-operate-transfer (BOOT) contracts.

In DBO the client, which may be a council or body corporate, engages a contractor to design and build the wastewater scheme and carry out the operation and maintenance for a defined period. The contract price includes purchase of all services leading to the construction of the scheme, and then operation and maintenance costs over the agreed period.

A BOOT project is a totally private venture in which the client pays annual fees to the BOOT company over a defined period, during which the company recoups its capital investment and operating costs. At the end of the defined period the BOOT company transfers ownership to the client, who then takes over responsibility for ongoing operation and maintenance costs. The advantage of BOOT to a council is they do not have to raise a loan to cover the capital costs. The BOOT company handles all financing.

BOOT contracts are more applicable for large projects, but DBO contracts are suitable for small community wastewater schemes. The Lake Hayes wastewater scheme undertaken by Queenstown Lakes District Council in 2002 is an example of DBO in action.

CRITERIA FOR SELECTING A WASTEWATER SERVICING OPTION

This handbook aims to provide sufficient information to enable communities and individuals to participate in making decisions about the best wastewater servicing option for their community. The options vary from a larger centralised wastewater servicing system to individual on-site wastewater systems. There are a variety of options for both the individual technological components of such systems and for the ways these different individual technologies can be fitted together to provide a total wastewater servicing system. There are also several options for the way these systems might be managed. All these factors can influence the decision on which is the best system to install.

This handbook emphasises that a wastewater servicing system can be linked to ecosystem services such as water supply, stormwater, and food and fibre production (via the nutrient cycles), as well as social and cultural services such as education and research. These factors are discussed in *Section 1*.

These various interrelated issues can make the process of selecting the best option very complex. To enable more holistic decision-making, and a better integration of services within these human and natural ecosystems, we have provided a framework for decision-making in this section. The basis of this framework is illustrated in *Figure 12.1*. From this is derived a series of criteria for evaluating the various options. The information required for these criteria has been provided in earlier sections of this handbook.

Scoping the options

Two levels of option assessment are offered to help you with your decision. Each site will have certain characteristics that will eliminate particular options.

The first level of evaluation, given in *Tables 12.1* and *12.2*, is an initial scoping exercise to eliminate the options that are clearly not suitable. The second level of evaluation, given in *Table 12.3*, provides more detailed criteria against which a reduced number of options can be assessed.

The detail of the criteria for evaluating the different options for wastewater technologies and wastewater system is extensive, complex and site-specific. As a result, it is strongly recommended that as a community you:

- *identify your own goals* in relation to your need for wastewater systems
- *set your own criteria* for evaluating the different wastewater system options
- *identify indicators* that would enable ongoing monitoring of the chosen system.

A systems approach is about selecting the option that best fits the total natural and human ecosystem within which it is embedded

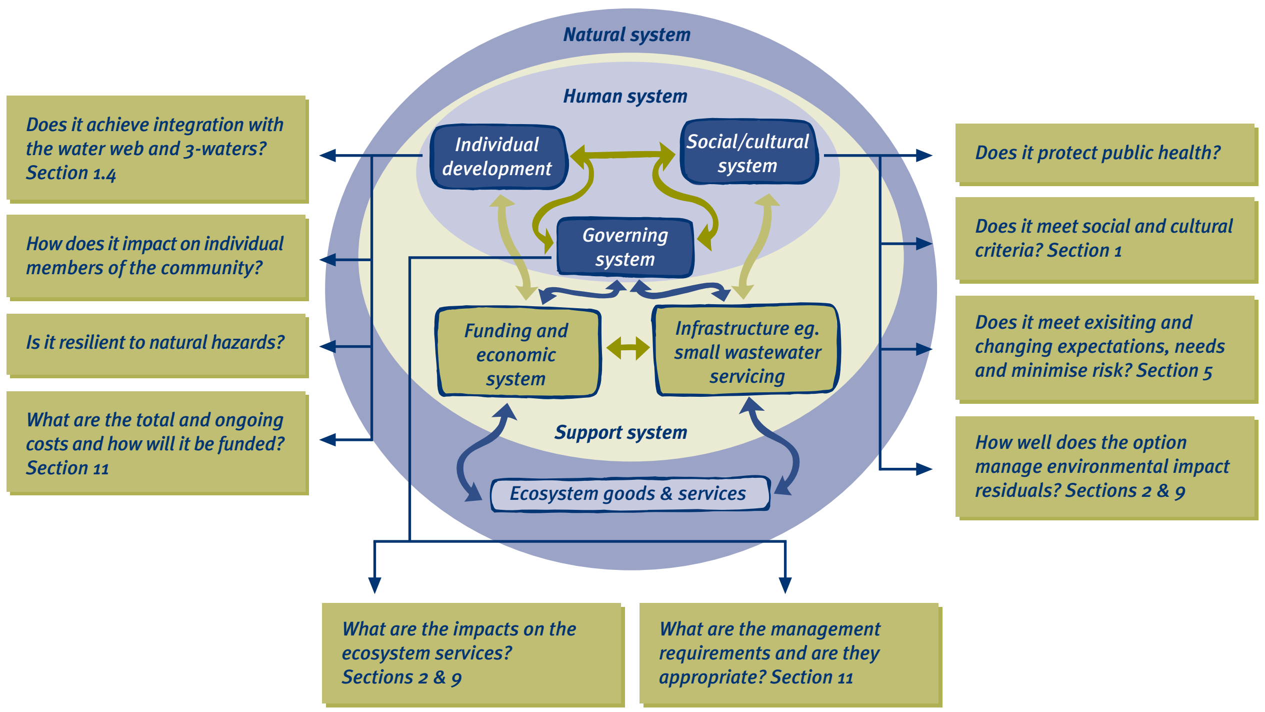

Figure 12.1 Criteria for selecting options

Type of system	*Brief description and possible benefits*	*System and site limitations*
On-site: basic treatment system	Wastewater is treated and then discharged within the property boundaries. Treatment is usually by a simple septic tank system followed by some dispersal system, such as sub-surface trenches or a mound. This is the lowest-cost on-site option. If well designed, it can be reliable with minimal maintenance and operational requirements.	These systems are likely to be inappropriate on properties with the following limiting factors: • very small section • steep sloping section • high ground-water table at any time during the year • very poorly draining soils or rocky section. It can be an expensive option in urban areas, with costs of $4,000–$7,000 per standard home, and $50 to $100 annual maintenance costs.
On-site: high-quality treatment	Wastewater is treated and then discharged within the property boundaries. Treatment may be by an active aerated system or multi-chamber septic tank, followed by a sand-filter system. The treated wastewater is of higher quality and can be dispersed by sub-surface irrigation, and is therefore better suited to sites with poorly draining soils. Irrigation effects can be beneficial.	These systems are likely to be inappropriate on properties with the following limiting factors: • very small section • steep sloping section • poor surface drainage. It may cost $8,000–$13,000 per standard home and up to $150/year operating and annual costs.
Cluster	The wastewater from a collection of local houses, or other activities, is reticulated to a nearby treatment plant, where it is treated and then returned to land, usually within the site area set aside for treatment and ecosystem re-entry. Cost sharing can mean lower cost per connection while maintaining a high quality of treatment. Water recycling is made easier; loading to the centralised system is reduced.	This is best suited for a housing development specifically designed for a cluster system. It requires a local area of suitable land for the treatment plant and re-entry of the treated effluent to the ecosystem. Adequate soil types, groundwater conditions and topography are required. An appropriate management and servicing structure is required. Costs are variable, and will depend on the design, site and number of connections.
Centralised	All wastewater is collected at the source and then transported (through sewer pipes) to a central site for treatment and final return to the ecosystem. This may be the lowest-cost option (although full environmental costs are often not factored in). Management and control are very easily centralised.	This is not appropriate in sparsely populated areas (eg, rural areas) due to cost. Because such systems can involve very large wastewater volumes, there may be site limitations in providing a sustainable ecosystem re-entry technique. Costs per property are usually less than on-site options.

Table 12.1 Scoping the options: conventional systems – benefits and limitations

Type of system	*Brief description and possible benefits*	*System and site limitations*
Reclaimed water recycling	*Reclaimed water sourced from treated wastewater effluent can be recycled for non-potable water uses, although this requires a high standard of treatment. Such systems include multi-stage treatment, recirculating sand filters and disinfection. Recycling of reclaimed water for on-site toilet flushing, laundry and car washing and irrigation is possible. This is an appropriate option to consider if potable water is expensive or in short supply.*	*Careful consideration must be given to potential health risks. Such systems require a high standard of treatment, disinfection and management. Separate and clearly labelled plumbing and outlets are necessary.* *No NZ guidelines are yet in place to cover such on-site recycling uses, so local authorities are unlikely to grant approval until the Ministry of Health has assessed risks and devised appropriate guidelines for risk elimination.*
Composting toilets	*Composting toilets are waterless (dry) or minimal water use (wet) toilets that use aerobic bacteria and other micro-organisms to biodegrade the faeces and other organics. There are various designs suitable for outdoor installations (eg, forest parks) and domestic installations. Modern composting toilets are designed for domestic use as clean, odourless facilities. Benefits include low water use, and recycling of organic matter and nutrients.*	*Well-designed domestic composting toilets can be expensive and require competent, consistent and dedicated management. Some require sufficient under-floor clearance for the composting chamber. The composted solids require handling and appropriate safe burial. Most composting toilets will not accept greywater, so a separate and approved greywater system will be required. Many councils are reticent about approval because of perceived health risks if compost toilet systems are not properly operated and maintained. Compost removal must be undertaken to strict hygiene standards, so regulatory obstacles often face people seeking to use this type of system.*
Vacuum toilets	*Vacuum toilets for domestic applications are not common in NZ (the only system is at Turoa Skifield, Mt Ruapehu). They have been used in countries where water is expensive or in short supply. These toilets use very low water volumes (0.5–1.5 L/flush). Benefits include low water use and wastewater volumes. Concentrated blackwater offers better technological opportunities for nutrient recovery (eg, liquid composting).*	*The vacuum unit, toilets and vacuum pipes are expensive and require skilled installation and design. For some people the noise of the vacuum can be off-putting, although recent designs have eliminated this problem.* *Technology and expertise are not common in NZ.*
Separated systems: greywater, blackwater, faeces and urine	*Separation of the various wastewater components enables separate management and recovery of the water and the wastewater nutrients. Most nutrients are contained in the urine, while most of the water is in the greywater. Urine-separating toilets are available and plumbing can be installed to separate these streams.*	*Separate plumbing is required and will increase building costs. No cost benefits are gained if connected to a centralised system. On-site systems require suitable treatment systems for each component, and land area and soils for ecosystem re-entry. Many councils are not familiar with these options.*

Table 12.2 ***Scoping the options: less common systems – benefits and limitations***

Physical characteristics of the site:
- *limitation of site or area (eg, soils)*
- *resilience to natural hazards.*

Ecological:
- *effect on habitat*
- *effect on ecosystem services*
- *effect on waterways*
- *effect on marine ecosystems*
- *effect on overall natural systems*
- *ecological restoration opportunities*
- *resource efficiency – closing of ecological cycles.*

Compatibility with Māori perspectives:
- *issue of passage onto land*
- *protection of mauri.*

Other cultural concerns:
- *sensitivity to other cultures*
- *local stewardship/responsibility*
- *potable re-use of treated water*
- *inter-generational issues.*

Public health:
- *operational safety*
- *effects of failure on community health*
- *residue and human proximity.*

The technical system:
- *reliability*
- *serviceability*
- *engineering life of the system*
- *resilience to acts of vandalism*
- *linkages with other opportunities and services (eg, water supply).*

Ability to be changed:
- *extendability*
- *flexibility*
- *adaptability.*

Management:
- *convenience*
- *operation and maintenance implications.*

Economic factors:
- *capital costs*
- *ongoing annual costs.*

Community effects:
- *level of local control*
- *need for external expertise/management.*

Community change:
- *pressure for future growth*
- *capacity to absorb growth*
- *declining population*
- *ageing population*
- *visual and noise effects.*

Other potential benefits:
- *leisure and recreation*
- *education*
- *research.*

Formal processes:
- *familiarity to decision-makers*
- *technical demands*
- *differing demands*
- *ease of the consent process.*

Table 12.3 ***Examples of detailed criteria for assessment***

An example of a matrix showing some of the above criteria evaluated against the broad wastewater services categories is given in *Appendix 7*.