Choosing an On-site Wastewater Management System, OWMS, for home owners

Prepared by A Dakers (ecoEng Ltd)
Reviewed by: J Cocks (John Cocks Ltd), S Ormiston (Ormiston Associates), F Ambury (Whiterock Consulting Ltd), T Long (Bay of Plenty Regional Council Toi Moana).
For Water NZ

WHO NEEDS AN OWMS?

If we live in a larger urban area it is likely that management of our household wastewater is taken care of by the Council, with a reticulated sewer system outside our front gate. Some small cluster developments may provide a private reticulated sewer system. It is recommended that if a reticulated sewer network is available, you should connect to this. However, there is a significant proportion of our population (about 20%) who live without a reticulated sewer system. In such cases these people will be responsible for managing their own household wastewater within the boundaries of their properties. The type of system used on such properties is generally described as an on-site wastewater management system (OWMS). Such a system is required to comply with legislation and regulations administered by Regional Councils and Territorial Authorities.

This technical sheet is written for those who want to choose an affordable, sustainable and effective OWMS for their property. It is written for home owners rather than for those wanting an OWMS for other activities such as camping grounds, public toilets, offices, maraes and schools. It is recommended that specialist advice be sought for these projects.

Choosing an on-site wastewater management system (OWMS) for your property is not as easy as choosing a car or a washing machine. There are complicating issues involved, and costs can vary between $10,000 and $40,000, depending on the circumstances and risks at your property.

An OWMS comprises four key components:

1. The wastewater source fixtures and activities which can affect the quantity and quality of the wastewater to;
2. the treatment plant,
3. a dosing system and
4. a land application system (or dispersal field).

In NZ there are over 60 different off-the-shelf treatment units you could buy and there are a range of different dispersal field designs. How do you choose what is best for your site and your family? For some sites it can be quite OK to install a septic tank, with effluent gravity dosed to a simple well designed and installed soakage trench. There are, circumstances where a more sophisticated treatment plant and land application system will be required. The types of constraint that would require an improved solution are;

limited available land area,

high groundwater,

poorly draining clay soils,

nearby streams and surface water bodies,

flood risks,

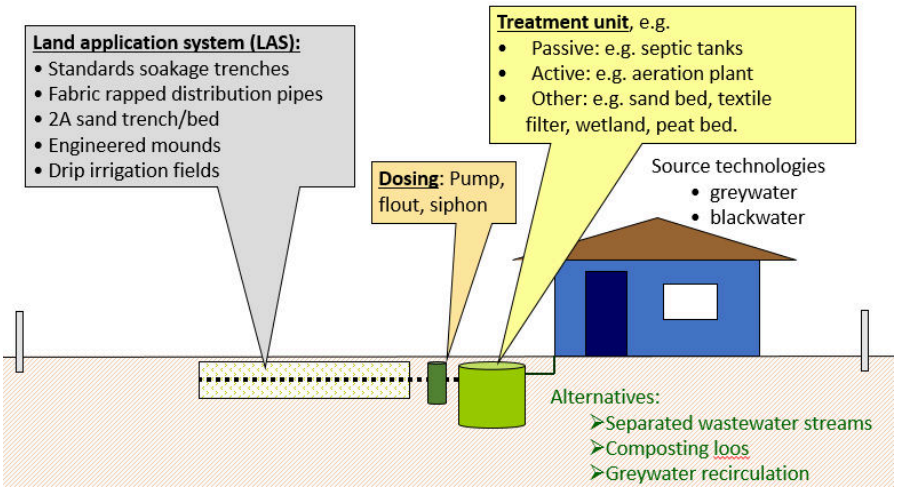
densely populated settlements, or,

nearby private or community water supply wells.

It is likely the more sophisticated the systems is the higher the capital and operating costs. When selecting a system take into account the factors listed above and the needs of your family.

COMPONENTS OF AN OWMS?

As explained, an OWMS has several key physical components and involves a number of different people as providers (practitioners). The physical components are the wastewater source fixtures (e.g. showers, baths, toilets, sinks, washing machine), the treatment unit, the dosing device and the land application system (LAS). The key practitioners normally include a site assessor and system designer, the technology provider/s, the installer(s), the regulators and their advisors, and the servicing technician(s). There are a number of alternative systems, as noted in the illustration, for which specialist advice should be sought. Achieving sustainable and effective on-site wastewater management requires high quality technologies and components, responsible practitioners and operators (system owners)



THE RISKS AND THE NEED FOR STANDARDS, RULES AND REGULATIONS

As a matter of principle people should be separated from their waste. Domestic wastewater can contain high levels of contaminants such as pathogens (disease causing organisms), grease, fats and oils, nutrients (such as nitrogen, phosphorus) residual pharmaceuticals, trace organics and other emerging contaminants that have entered to human food chain. These contaminants may not only cause blockages in pipes and fittings and cause wear and tear on equipment such as pumps, but also, if poorly managed, may impact on human health and sensitive ecosystems. OWMS are therefore required to meet best practice engineering standards and to comply with regulations to mitigate these risks. Regional Councils administer rules under the Resource Management Act (RMA) while Territorial Councils administer regulations under the Building Act and, sometimes, establish bylaws under the Local Government Act.

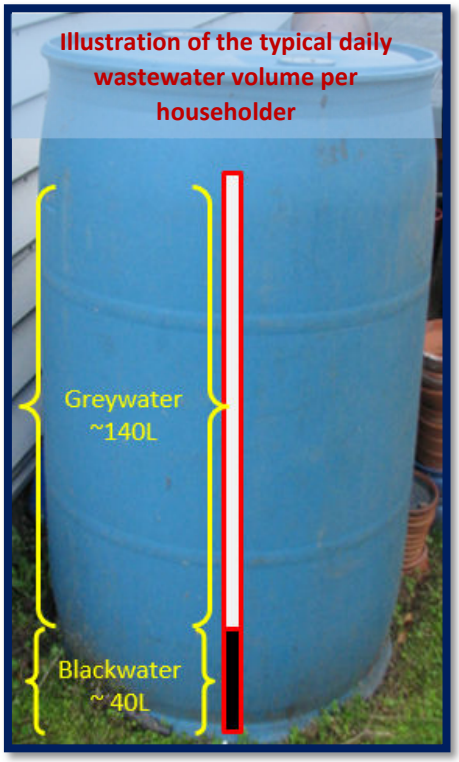
THE NATURE OF DOMESTIC WASTEWATER

We commonly define two categories of domestic wastewater:

- **Blackwater** refers to wastewater from flush toilets and urinals
- **Greywate**r refers to wastewater from kitchen and other sinks, tubs, baths, showers and laundry.

Domestic wastewater discharges are generally sourced from houses, schools, offices, marae, camping grounds, country huts, public toilets and other facilities that accommodate people. The focus of this booklet is domestic wastewater from family homes only.

Stormwater from roofs and paved areas should not be directed to the wastewater system. Surface flow of stormwater should be directed away from the land application area.



Daily Domestic Wastewater Volumes

One key consideration in the sizing and design of the components of an OWMS (particularly the treatment plant and the land application system, LAS) is the design daily volume of wastewater. The daily volume of wastewater (black and grey water) from a dwelling ranges between 120 to 220 L per person (typically - 180L). For the purpose of designing an OWMS, the daily volume is not based on the actual number of people living in the house but on the total number of potential bedrooms. Standards and Council guidelines will recommend the number of occupants to design for based on the number of bedrooms. For example, typically for a 3 bedroom dwelling we would design for 5 occupants at 200L/person = 1000L/day. If your local Council does not provide a recommendation a guideline would be 1.5 occupants for each bedroom. The daily volume per person will depend on the type of wastewater producing fixtures in the dwelling (toilet flush volumes, shower heads, washing machine) and other factors (such as spa baths).

Domestic wastewater is a messy, unpleasant and complex medium, the bulk of it being water, but it also includes faecal matter, urine, infectious organisms (pathogens), fats, oils, grease, hair, lint, dirt, soap suds, cleaning agents, residual pharmaceuticals, a range of organic matter and a whole variety of material people shouldn't put down the sink or flush down the toilet. Therefore, a system designed to treat and safely manage this very complex material is assigned a very challenging task. The complete on-site wastewater management system, from wastewater source to final land disposal, requires a competent site-specific design, requires durable and reliable high quality technologies and must be regularly serviced. It won't be a cheap service to buy and maintain, and we should not expect it to be. We are dealing with a very hazardous product.

Treatment Plants

The commonly known wastewater treatment plant is the septic tank, which may be single chamber or multiple chambers and will be fitted (or should be) with a special outlet filter. The treatment process provided by a septic tank is called **primary treatment**. This treatment process reduces fats/greases and removes the larger solids, through floatation, settling and crude filtering, but most other risk contaminants (pathogens and nutrients) remain in the discharge from the septic tank (i.e. the effluent). Land application systems (LAS) receiving this primary effluent must and can be designed to cope with this low quality effluent.


Septic tank discharge (effluent)

Higher quality effluent is produced by units described as a **secondary treatment** plants. If even higher levels of treatment levels are required, there is a treatment category described as **advanced secondary treatment**.

Secondary and advanced secondary treatment plants (commonly called package plants) usually involve a number of chambers incorporating components such as, aerators, contact media, balanced activated biomass recirculation, sand and textile filters and specialised membranes. Such plants must be designed by qualified wastewater process engineers, where septic tanks (primary treatment units) do not require the same level of design input. Advanced secondary treatment may be required where it will be necessary to disinfect the treated effluent using ultra violet (UV) lamps, or reduce the nutrient (e.g. nitrogen) concentration by additional treatment stages. Advanced treatment may also mean, in certain circumstances, that slightly less land is required for the application system.

Secondary treatment plant discharge (effluent).

We have in NZ (in Rotorua) a facility (OSET NTP) that provides independent performance testing of secondary and advanced treatment plants. The reports can inform good design of and OWMS. This service is discussed later.

There are other ways of achieving higher standards of treatment, such as sphagnum peat beds, vented in-ground pipe systems with biofilm and sand filtering, vermiculture beds and constructed wetlands; all requiring specialised and qualified design input.

Land Application Systems, LAS

Common practice in the early days was to treat the household wastewater (sometimes blackwater only) in a septic tank (usually a small tank with no outlet filter fitted) with the effluent then trickle loading (no dosing device used) to a soak hole (also called boulder pit or deep bore). However, in poorly draining soils, soaks pits commonly blocked and failed while in free draining soils (sandy gravelly soils) ground water was at high risk of being contaminated. Therefore, in most regions throughout New Zealand, soak holes and boulder pits are no longer permitted.

LAS designs for septic tank effluent includes conventional soakage trenches, discharge control trenches or beds, LPED irrigation fields and mounded systems. Dose loading (using pump, flout or siphon), rather than trickle loading, is commonly recommended or required.

LAS designs for effluent from secondary and advanced secondary treatment plants commonly include dose loading to drip irrigation fields (commonly pressure compensating drip irrigation, PCDI). In specific circumstances there can be benefits to secondary treat the wastewater before dose loading to trenches, sand beds and mounded systems.

As previously stated, the type and specifications of the most appropriate LAS for a particular site will depend on the site specific conditions such as available land area and slopes, access, soil types and seasonal soil saturation risks, surface and subsurface drainage characteristics, depth to groundwater, risks to drinking water supplies (surface and subsurface), any site contamination issues, existing or proposed vegetation cover, existing or proposed land use, required setbacks from boundaries, development densities, flooding risks, proximity to protected and sensitive ecosystems, cultural, community and heritage sites.

For some LAS designs it is important (and may be a Council requirement) to set aside a reserve area for a replacement LAS, should the original LAS fail.

Selection of the Optimum On-site Wastewater Management System (OWMS)

Who selects the OWMS for a particular property? It should be a collective decision between the owner and wastewater system designer. It is, however, not uncommon for this decision to be influenced by the drainlayer, preferred system supplier or the housing company.

Listed below are the common expectations for an OWMS. This technical sheet has been written to assist those with expectations with the green tick (✓)

OWMS expectations	
Cheapest option and requires no or minimal servicing	x
Affordable	✓
Low risk of odours	✓
Low noise levels	✓
Convenient, reliable and durable service	✓
No health risk to users, occupiers, neighbours, public	✓
Minimal risk to local ecological systems	✓
Does not devalue accepted cultural and social values	✓
Requires (minimal) servicing	✓
Minimal operating (power) and servicing costs	✓
Fit for purpose for the specific site conditions	✓
Long life – 15+yrs	✓


Failed soakage field due to incompetent design

Many buyers will want a complete service package that is affordable and compliant. Some companies who sell treatment plants present themselves as providing the full service package. Buyers may need to be alert to the possibility that advice from some companies may be unduly influenced by their desire to sell their technologies (tanks, pumps, pipes) without adequately addressing the need for an OWMS (the complete system) that is fit for purpose and optimum for the specific site conditions. On the other hand, too many purchasers regard the wastewater system as a necessary but nuisance expense that once installed can be forgotten about and not require regular servicing. They may also be careless and irresponsible about what they allow to be flushed or drained into the OWMS. They can become quite annoyed when it fails and costs money as a consequence of their lack of care and commitment to having the system regularly serviced. There are few, if any, OWMSs that don't require regular servicing. You only have to look at a Council-run sewage treatment plant. It can have 2 or more full time operators and a number of contractors regularly servicing the plant to keep it performing.


Drip lines must be regularly flushed to prevent biofilm build-up and blockage.

Our advice is that property owners accept that a reliable and enduring system needs to be designed for the specific conditions of their site.


Excessive filter clogging due to poor treatment plant performance

WHERE CAN ADVICE BE SOUGHT?

There are various people who may be willing to offer advice on the appropriate OWMS for your property. For example, the local drain layer, your architect, the housing company, the geotech engineer, a commercial supplier of a particular brand of treatment plant (which is only one component of an OWMS), someone from your local Council (although they are not permitted to advise), your neighbour or a consultant.

There are some polished websites offering advice. Be wary.

Some District or Regional Councils may provide a register of approved site assessors, designers and installers.

When seeking advice, make sure you ask the right questions and get satisfactory answers. Determine the experience (especially local experience) and qualifications of your advisor. Determine how well they understand the local rules and regulations, and how competently they have assessed the constraints and attributes of your particular site and produced a customised design for your OWMS, from source to final dispersal to land. Ask how long the recommended type of treatment system has been operating in the region and whether it has been independently certified. Seek evidence that it conforms to recognised standards? If you are not comfortable with the advice you receive, get a second opinion.

A FEW TIPS

Site assessment, system selection and design	Check that: • The assessment and design are in accordance with accepted standards. • Wastewater quantity and quality have been accurately determined, including seasonal variations. • Site and soil constraints and attributes have been fully assessed by a qualified assessor • OWMS selection and design have been carried out by competent and qualified designer. The preferred OWMS is the best compliant fit option for the site. • Compliance requirements in terms of the discharge (RMA) and Building Code have been assessed. A resource consent to discharge may be required if the proposal does not satisfy the local permitted activity rules. **Note: the site assessor can't be held responsible for any changes made to the site after their assessment; for example, earthworks, landscaping, installation of a well.**
Septic tanks	Check that: • Structural integrity, water tightness, design and installation instructions are in accordance with AS/NZS1546.1 2008. Request design and construction producer statements from the tank manufacturer[1]. • Working capacity is in accordance with AS/NZS 1547:2012 or an equivalent or better standard. • Special design measures are taken in case of a high groundwater table or flood prone areas • The septic tank has a good quality effluent outlet filter fitted. • Venting and other requirements are in accordance with AS/NZS 1546.1:2008 and Building Code G13 or equivalent or better standards. **Note: Typically septic tanks, once installed, are NOT designed for traffic loads. They must not be driven over by vehicles**.
Secondary and advanced secondary treatment plants	Check that: • Structural integrity and water tightness of tanks are in accordance with AS/NZS1546.1 2008 or an equivalent or better standard. Request design and construction producer statements from the tank manufacturer[1]. • If using a proprietary system, it has been independently assessed by an approved qualified agency and in accordance with AS1546.3: 2017 or an equivalent or better standard. If it is a custom designed system, then it needs to have been designed by a suitability qualified wastewater engineer or technician. Request a design producer statement from the designer or manufacturer verifying that the secondary treatment plant conforms to AS1546.3:2017 or and equivalent or better standard[1].

	• Design producer statement, full warranty details for all components, full installation instructions, and a complete operating and maintenance manuals, have been provided by the supplier. **Note: Typically in-ground tanks, once installed, are NOT designed for traffic loads. They must not be driven over by vehicles**.
Dosing device selection and design	• Ensure that the dose volume and device (pump, flout, siphon) match the hydraulic requirements of the land application system. Request a Producer Statement verifying this. • Ensure that all pump chambers include high water level alarm floats or equivalent, connected to a warning light or/and audible alarm.
Emergency storage	• Typically, as part of the treatment and dosing components, provision for a minimum of 24hr emergency storage is recommended or may be required.
Land application system (LAS) design	Check that: • The site and soil assessment and design are in accordance with requirements of AS/NZS1547:2012 or and equivalent or better standard • The hydraulic design of the land application system has been done by a qualified designer • The system has durable components and appropriate flush points to ensure a long life. • The system is compliant in terms of regional rules and the Building Code • A design producer statement (PS1) has been provided by the designer of the land application system • Full warranty details for all components have been provided by the supplier • Ensure that provision has been made for a reserve area for LAS that require this.
Installation and commissioning	• Installation should be done by an experienced and qualified installer. For secondary and advanced secondary treatment plants, the installer should be specifically trained for the particular OWMS. A registered drain layer is likely to be required for installation and sign-off of drains. • An installation Producer Statement (PS3) is provided by the installer.
Servicing and maintenance	• All OWMS requires regular servicing. A servicing contract is recommended and may, in some cases, be a requirement of a Resource Consent. The servicing technician should be well qualified and trained for the specific OWMS.
Key documentation to be provided and filed	The following documentation should be provided: • Full warranty details for tanks, mechanical components, electrical components and, in some situations, the treatment process performance • Design producer statement (PS1) to be provided by the designer of the OWMS • Installation producer statement (PS3) to be provided by the manufacturer of proprietary components and the installer • Loading certificate (in accordance with AS/NZS1547:2012, Section 7.4.2 (d)) to be provided by the installer or designer. The loading certificate specifies the operating capacity of both the treatment unit and the land application system • Building Code documentation; Building Permit and Certificate of Code Compliance • Operator's manual and Servicing Manual • A detailed scaled as-built plan of the installed OWMS including dimensions and setbacks The following documentation may be required: • Producer Statement for construction review, PS4 • Discharge resource consent (from Regional or Unitary Council) • Land use Consent (from territorial authority or unitary council)
Note. 1. When seeking a producer statement in relation to a particular design standard, you can request that the supplier of the statement specify the clauses within the standard that the producer statement applies to. It can then be assumed that all clauses not listed do not apply to the certification or producer statement.	

Appendix A provides a template of a Quotation Checklist that covers most of the above points. This could be sent to your providers.

INDEPENDENT PERFORMANCE ASSESSMENT OF SECONDARY AND ADVANCED SECONDARY TREATMENT PLANTS

There are a number of different domestic wastewater treatment technologies that can be purchased, within the NZ, that claim to be suitable treatment component for a compliant OWMS.

There is an independent National Testing Program (NTP) and facility, based in Rotorua, that reviews, tests and provides performance certificates and benchmarking of secondary and advanced secondary wastewater treatment on-site effluent treatment (OSET) systems typically used by homeowners and other on-site domestic wastewater applications. The facility was set up by Water New Zealand, (www.waternz.org.nz/OSET). The programme, known as OSET NTP, has recently been revised. From October 2018, the testing and assessment will based on a number of the performance criteria specified in the Australian standard, AS 1546.3:2017.


OSET NTF testing bed, Rotorua

It is important to note that OSET NTP provides a partial but useful assessment of the treatment plant, which is just one component of an OWMS. The independent performance results of the treatment plant will provide valuable information to assist the OWMS designer. The performance of an OWMS depends on many other site-specific factors, for example; what homeowners discharge into the systems, how competently the systems has been designed, how competently it has been installed and how competently and regularly it is serviced.

Additional details about OSET NTP, including the list treatment units tested at OSET NTP since 2007 and their downloadable performance certificates, can be viewed and obtained at http://www.waternz.org.nz/OSET .

IN SUMMARY

For the design and selection of your on-site wastewater management system, choose a reputable, experienced and local practitioner, who not only provides sound technical design advice but also can guide you through your local compliance procedures. In addition to requiring a reliable, high quality treatment plant (for secondary or advanced treatment plants, independently performance tested or certified, e.g. OSET NTP), you want a compliant and a complete on-site wastewater system that is the optimum for your specific site. Ensure your site and soils are competently assessed and that it is this information informs the choice and design of the best-fit OWMS. Be aware that if your OWMS designer is a technology salesperson, their commercial interests may conflict with achieving the best site-specific total system design. Be confident that the installer of your system is experienced and competent with your chosen system. Be prepared to pay a fair price. Be well informed about what can and shouldn't be flushed and drained into your system. Check the system regularly. It is strongly recommended that you sign up to a servicing contract, again with a competent and experienced local servicing agent.


Site and soil assessment. Banks Peninsula

Insist on obtaining, in writing, clear answers to critical questions. Use the OWMS Quotation Checklist, Appendix A.

APPENDIX A: OWMS QUOTATION CHECK LIST

Site address	
Owner contact details	
Provider details. Name and contact details	
Brief Description of proposed OWMS	
Date of site visit and assessment	
Brief explanation of why this particular proposal in considered the best fit option for this site	

Each OWMS practitioner is to agree to the following, as relevant.

Item	Signature
Agree to check location of existing OWMS	
Agree to consult with land owner on: type/brand and location of treatment plant, location of control box and alarm system. Location of LAS and LAS field components.	
Evidence of independent treatment plant certification will be or has been provided. The supplied unit has not been modified in any way relative to the unit certified. (Secondary and advanced secondary treatment units only)	
Warranty details of installed tanks will be or have been provided.	
Warranty details of electrical components will be or have been provided. (If required)	
Warranty details of mechanical components (pumps, aerators) will be or have been provided. (If required)	
Warranty details of treatment process and treatment performance will be or has have been provided. (For secondary and advanced treatment systems only)	
Installer(s) are suitably qualified and have been specifically trained to install and commission the treatment plant and dosing system.	
Installer (s) will produce evidence of the treatment system meeting performance standards following commissioning e.g effluent quality test results from a certified laboratory. (For secondary and advanced treatment systems only)	
Installer(s) are suitably qualified and have been specifically trained to install and commission the specified land application system and required components as specified.	
The land owner/operator will receive a full briefing on the use and operation of both treatment plant and land application system and will be provided with detailed owner's manual.	
Agree to take full responsibility of all completion documentation including: • Documents as required by Resource Consent (if issued) • Documents as required by Build Consent #..... • OWMS loading certificate in accordance with AS/NZS1547:2012, Section 7.4.2 (d) • Installation producer statement (PS3) and as–built plans.	
If required by the land owner, details of servicing contract have been, or will be provided	
Company has appropriate Health and Safety protocol	
Any special planting, fencing and landscaping requirements will be or has been discussed and agreed with the land owner.	
Making good the site at completion is included in the quotation	

SPECIAL REQUIREMENTS

List any special requirements for this site.

SCHEDULE OF COSTS

Item	Amount, $
Preliminary and general	
Decommissioning (if an existing system will be replaced)	
Treatment plant and LAS dosing device. Supply and install	
Land application system. Supply and install	
Contingencies	
GST	
Annual costs (gst excl) including: • Servicing contract cost • Estimate of annual power cost • Estimate of annual maintenance costs (e.g. pump, aerator..... life and replacement costs)	
Notes, exclusions, tags, conditions	
Notes **Exclusions** **Tags** **Conditions**	