

Australian/New Zealand Standard™

On-site domestic wastewater management



AS/NZS 1547:2012

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee WS-013, On-set Domestic Wastewater Management. It was approved on behalf of the Council of Standards Australia on 13 February 2012 and on behalf of the Council of Standards New Zealand on 10 February 2012. This Standard was published on 27 February 2012.

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Australian/New Zealand Standard™

On-site domestic wastewater management

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Originated in New Zealand as part of NZS 4610:1982.
AS 1547:1994 and part of NZS 4610:1982 jointly revised,
amalgamated, and redesigned as AS/NZS 1547:2000.
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FOREWORD

This 2012 Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS-013 On-site Domestic-wastewater Management to supersede AS/NZS 1547:2000 *On-site domestic-wastewater management*.

If on-site domestic wastewater systems are to be effective and sustainable, and to play their part in protecting public health and the environment, a system of management and control needs to be in place. While this will often fall to the regulatory authorities to administer, private management and control will have a part to play. Nevertheless, formulation of a regulatory process is not part of this Standard, and the application of this Standard does not circumvent other approvals, licences, or permits needed from any regulatory authority.

The Committee has adopted an approach that focuses on sustainably managing the risk to public health and the environment. For example, it is stressed that a risk management approach entails looking more at the risk of a particular situation than the numerical values which are put forward in this document as guidance. This Standard, covering as it does a range of climates, soils, and jurisdictions can only provide conservative advice. Local conditions and local experience should be used whenever possible, where they demonstrate that there are no significant risks to public health or to the environment and that the proposed design is more cost-effective than when using this Standard prescriptively. Guidance on collating local knowledge and experience has accordingly been provided. New knowledge or techniques are to be encouraged where there is adequate demonstration that the risk of failure is small.

Readers of the previous Standard will notice that much of the methodology is unchanged, even though the document has been reworked to reflect a risk-management approach. This is deliberate. The previous Standard incorporated much that was already essentially the management of risk. What was felt necessary was that features such as monitoring and feedback should be expressed more clearly. Accordingly, the Standard has been restructured to allow for the integration of the design, construction, installation, and maintenance of on-site domestic wastewater systems into a risk management framework. It follows that in any development, the option of installing full sewerage shall also be considered.

The main purpose of the Standard is to set out the performance objectives, requirements, and criteria, together with the means of not only complying with these criteria but of continually improving the techniques employed by all stakeholders.

To assist users familiar with the structure of AS/NZS 1547:2000, Appendix V provides information on where the equivalent clauses are now located in the 2012 version. For example, Appendix 4.2D of the 2000 version is now Appendix H.

This revision acknowledges the importance of water conservation, however it also maintains that sustainable reuse is beyond the scope of this Standard. For guidance on sustainable reuse, refer to national or state guidelines.

ACKNOWLEDGEMENT

Standards New Zealand gratefully acknowledges the use of some figures from ARC Environment, Technical Publication No. 58, 2nd edition, November 1994, published by the Auckland Regional Council.

CONTENTS

FOREWORD.....	(i)
ACKNOWLEDGEMENT.....	(i)
1 GENERAL.....	5
1.1 Purpose of Standard	5
1.2 Scope.....	5
1.3 Application.....	6
1.4 Risk management framework	7
1.5 Structure of this Standard	8
1.6 Interpretation	9
1.7 Referenced documents	10
1.8 Legislation	11
1.9 Definitions.....	12
1.10 Abbreviations	18
1.11 Conversion of per cent grade, slope, and gradient	19
2 RISK MANAGEMENT PROCESS	20
2.1 Scope.....	20
2.2 Performance requirement	20
2.3 The risk management process.....	21
2.4 Implementing risk management.....	22
2.5 Review and evaluation.....	22
3 ROLES AND RESPONSIBILITIES	23
3.1 The regulatory authority	23
3.2 Planners/surveyors/land developers.....	23
3.3 Site evaluators and soil assessors.....	27
3.4 Designers.....	27
3.5 Installation contractors.....	28
3.6 Equipment manufacturers and suppliers.....	28
3.7 Maintenance and desludging/pumpout contractors	28
3.8 Property owners.....	29
3.9 Estate agents and property transfer agents	29
4 PERFORMANCE STATEMENTS.....	30
4.1 Primary performance objectives	30
4.2 Secondary performance objectives.....	31
4.3 Primary performance requirements	32
5 DESIGN OF ON-SITE SYSTEMS	34
5.1 Scope	34
5.2 Site-and-soil evaluation	35
5.3 Design flow	41
5.4 Wastewater treatment units	41
5.5 Land application system design	48
6 CONSTRUCTION, INSTALLATION, OPERATION, AND MAINTENANCE.....	58
6.1 Scope.....	58
6.2 Construction and installation	58
6.3 Operation, maintenance, and monitoring	62

7	ADMINISTRATIVE GUIDANCE	68
7.1	Administration and management	68
7.2	Construction, installation, and operation	68
7.3	Advice and education	69
7.4	Reports	70

APPENDIX

A	Risk management process guidelines (Informative)	71
B	Site-and-soil evaluation procedures (Normative)	83
C	Site-and-soil evaluation for planning, rezoning, and subdivision of land (Normative)	90
D	Site-and-soil evaluation for individual lots (Normative)	96
E	Site-and-soil properties (Normative).....	104
F	Dispersive soil and sodicity (Informative).....	111
G	Soil permeability measurement – Constant head test (Normative)	112
H	Typical domestic wastewater flow design allowances (Informative)	121
J	Recommended capacities for septic tanks (Informative)	125
K	Land application systems – Guidance on selection (Informative)	128
L	Land application methods – Trenches, beds, and ETA/ETS systems (Normative)	142
M	Land application methods – Irrigation systems (Normative)	155
N	Land application methods – Mounds (Normative).....	170
P	Disinfection (Informative).....	177
Q	Water balance and land application systems (Informative)	180
R	Recommended setback distances for land application systems (Informative).....	184
S	Nutrients (Informative)	191
T	Operation and maintenance guidelines (Informative)	196
U	Monitoring records for on-site systems (Informative)	203
V	Comparison of sections between AS/NZS 1547:2000 and AS/NZS 1547:2012 (Informative).....	207

TABLE

1.1	Slope conversion table.....	19
3.1	Implementation processes and persons involved – Essential stages.....	24
5.1	Determination of soil category	39
5.2	Soil categories and recommended design irrigation/loading rates (DIR/DLR) for land-application systems.....	55
A1	Examples of design risk reduction measures.....	77
A2	Examples of operation and maintenance risk reduction measures	79
A3	Examples of administrative risk reduction measures	81
B1	Summary of investigation procedures	86
B2	Soil properties	87
D1	Site assessment factors – Individual lot.....	97
E1	Assessment of soil textures	106
E2	Abundance of coarse fragments.....	107
E3	Size of coarse fragments.....	107
E4	Structure.....	108
H1	Typical domestic wastewater design flow allowance – Australia	121
H2	Typical domestic wastewater design flow allowances for each fixture – Australia	122
H3	Typical domestic wastewater design flow allowances – Domestic wastewater from households – New Zealand	123
H4	Typical domestic wastewater design flow allowances – Domestic wastewater from commercial premises – New Zealand	124

J1	All-waste septic tank operational capacities	127
J2	Greywater septic tank operational capacities	127
J3	Blackwater septic tank operational capacities	127
K1	Land application systems – Limitations due to site, soil, and climatic factors	130
K2	Selecting the land application system to fit the site and the soil	135
L1	Recommended design loading rates for trenches and beds	145
L2	Typical dimensions of conventional trenches and beds.....	146
M1	Recommended design irrigation rate (DIR) for irrigation systems.....	160
M2	Recommended reductions in DIR according to slope.....	163
N1	Recommended mound design loading rates.....	172
R1	Guidelines for horizontal and vertical setback distances	185
R2	Site constraint scale for development of setback distances.....	187
S1	Typical nutrient contributions for residential dwellings.....	191

FIGURE

1.1	Management framework for on-site systems	8
6.1	Example record sheet – Septic tank and trench system.....	65
6.2	Example record sheet – AWTs and irrigation system	66
6.3	Emergency flow chart.....	67
A1	The risk management process.....	73
B1	Site-and-soil evaluation form: Excavation log – Example	89
C1	Site-and-soil evaluation process for subdivisions	91
C2	Slope configuration and surface drainage.....	93
D1	Site plan – Individual lot – Example.....	100
D2	Site information sheet – Example.....	101
D3	Site-and-soil evaluation form – Individual lot – Example.....	102
E1	Example of pore charts with an areal percentage of 1.5%.....	110
G1	Permeameter assembly.....	115
G2	Anti-scouring device.....	116
G3	Soil permeability field record sheet – Example.....	120
L1	Conventional piped trench	151
L2	Self-supporting arch trench	151
L3	Boxed trench	152
L4	Discharge control trench.....	153
L5	Conventional bed	153
L6	ETA/ETS bed details	154
L7	ETA/ETS trenches	154
M1	Drip irrigation system – Example layout of components	167
M2	Spray irrigation system – Example layout of components	168
M3	Shallow subsurface LPED irrigation – Example system	169
N1	Wisconsin mound system	174
Q1	The natural water balance of land.....	180
R1	Example of design and compliance boundaries for application of setback distances for a soil absorption system	188
R2	Example of wastewater pathways and site constraints for application of setback distances for a soil absorption system	189
T1	The septic tank and land application system	199
T2	Traditional septic tank	200
U1	Monitoring form – Site information.....	204
U2	Monitoring form – On-site assessment.....	205
U3	Monitoring form – Soil investigation.....	206

NOTES

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
On-site domestic wastewater management

1 GENERAL**1.1 Purpose of Standard**

The purpose of this Standard is to provide the requirements for treatment units and their land application systems to achieve sustainable and effective on-site domestic wastewater management, to protect public health and the environment.

1.2 Scope

The Standard identifies the performance statements that cover the overall design and sustainable management of on-site domestic wastewater systems. These performance statements set performance objectives which are followed by performance requirements and then, when possible, with performance criteria.

1.2.1 Inclusions

This Standard deals with the systems for treating wastewater originating from household or personal activities including water closets, urinals, kitchens, bathrooms (including showers, washbasins, baths, spa baths but not spa pools or hot tubs) and laundries. Such domestic wastewater includes that from facilities serving staff/employees/residents in institutional, commercial, and industrial establishments.

1.2.1.1 Systems covered

The on-site systems covered by this Standard include primary, secondary, and disinfection wastewater treatment systems. The Standard gives specific details for septic tanks, other wastewater treatment units, and land application systems. Specific details are provided for conventional trenches, beds, evapotranspiration areas, mounds, drip and spray irrigation. These commonly used systems, while given as examples, are not intended to preclude the growing number of new or developing technologies in on-site wastewater management.

Likewise, guidelines and design manuals prepared by other agencies may be accepted as equally valid means of implementing the principles set out in this Standard. In particular, the management principles are appropriate for use in conjunction with the technical provisions of other design guidelines.

This Standard does not preclude the use of any material, system, design, or method of implementation provided the completed system and installation meet the performance requirements of this Standard. Details of such systems and installations and methods should be submitted to the relevant authority for approval. Systems not covered by this Standard require advice from a suitably qualified and experienced person.

1.2.1.2 System size

The systems covered in this Standard are normally designed for domestic wastewater flows up to 14 000 L/week, from a population equivalent of up to 10 persons.

Where the principles and practices outlined in this Standard are applied to systems exceeding this limit, the design shall be the responsibility of a suitably qualified and experienced person.

C1.2.1.2

The flow limit of 14 000 L/week represents an average daily flow for design sizing purposes of 2000 L from up to 10 persons in a single residence, or an institutional or commercial facility which may have a varying 7-day or 5-day operation averaged out over a full week. Larger systems often require additional features in light of the need for more centralised operation, maintenance, and monitoring.

1.2.2 Exclusions

This Standard does not cover systems for the treatment of wastewater from commercial and industrial sources, or stormwater.

Although this Standard covers the subsurface land application of greywater after primary or secondary treatment, it does not cover greywater reuse by the direct application onto land or by other means, nor does it provide details of greywater diversion systems.

C1.2.2

The use of untreated and treated greywater is complex due to its variable microbial and chemical characteristics. It is recognised, however, that recovery of greywater for treatment and reuse of the resulting reclaimed water is practised under regulatory control within several jurisdictions in Australia and New Zealand.

The Australian EPHC (Environment Protection and Heritage Council) (2002) has produced national guidelines for water recycling (November 2006) which use a risk management framework and provide specific guidance on the management of health and environmental risks associated with the use of recycled water.

1.3 Application**1.3.1 Users of this Standard**

This Standard is intended to be used primarily by regulatory authorities, system suppliers, design consultants, wastewater practitioners, and industry trainers. It should be read in conjunction with the regional and district plans, bylaws, rules, and regulations of relevant regulatory authorities of Australia and New Zealand.

1.3.2 Requirements for sustainable functioning of on-site systems

Successful on-site domestic wastewater management requires an understanding and control of all stages of the conception, design, implementation, and sustainable operation of the on-site system.

Management shall cover:

- (a) Design, including the evaluation of a site and its soil, the type, capacity and structure of the wastewater treatment unit or units, and the nature of the land application system;
- (b) Implementation, including the construction and installation of the total on-site system; and
- (c) The ongoing operation and maintenance requirements of the system.

On-site systems are usually sited within the property boundaries of the premises producing the wastewater. Therefore the occupier of the premises has a degree of responsibility for its sustainable operation. Different types of on-site system require different degrees of control as the complexity of the system changes. When ownership changes there shall be procedures for ensuring that information on the 'history' of the construction and installation of the system, occupancy, performance, operation, and maintenance is passed to the new owner (see 3.9). Otherwise, this can lead to neglect and possible failure of the on-site system with resulting risks to public health and the environment.

The constraints and capabilities of the site for accepting treated or partially treated wastewater shall be taken into account. These depend on the soil type, soil profile, depth of topsoil, topography, surface water flows, and groundwater depth. As well, the installed system needs to resist the effects of the weather, internal and external loads and pressures, including any ground movement, corrosion of materials by the wastewater, and by the environment.

There is now a better appreciation of the importance of achieving high levels of risk reduction by incorporating suitable factors of safety into the design while still achieving cost-effective systems. This has become increasingly feasible given the growing range of technologies and implementation techniques available.

1.4 Risk management framework

The principles of risk management have been incorporated into this Standard to ensure that the risks arising from the design and operation of on-site systems are identified and managed proactively to avoid adverse effects on public health and the environment.

The effective management of on-site domestic wastewater systems requires the overall control and integration of comprehensive site investigation and system design, followed by the corresponding system installation, operation, and maintenance. Support in the form of adequate training and information transfer and review is also critical at each stage.

The management framework for on-site systems is shown in Figure 1.1 and incorporates the following:

- (a) Performance objectives, in particular the objectives of managing on-site systems to ensure public health and the environment are protected;
- (b) Commitment to responsible on-site wastewater management, whereby all stakeholders (owners, operators, the community in general, designers, installers, and regulators) take responsibility for achieving these performance objectives;
- (c) Analysis and management of the on-site system, entailing an appreciation of the on-site wastewater problem, a formulation of the system, an assessment of the hazards and risks, the means of addressing these risks, and the procedures for operation, monitoring, and control;
- (d) Review, covering the long-term evaluation and auditing to ensure that performance objectives continue to be met, and providing a basis for continuous improvement.

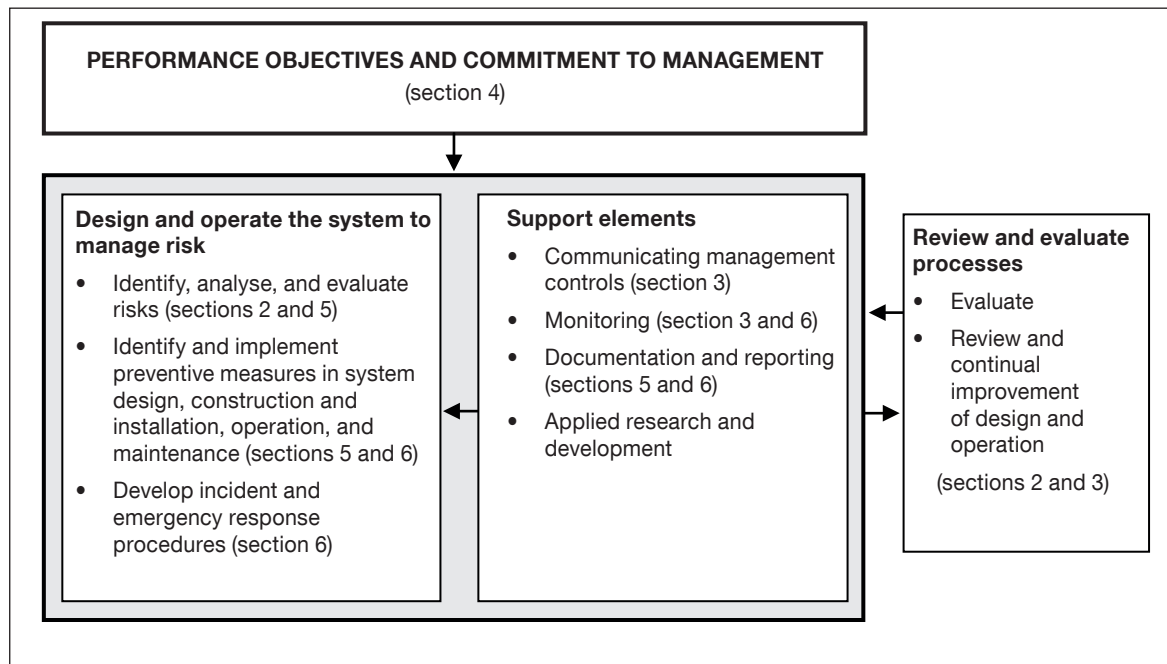


FIGURE 1.1
MANAGEMENT FRAMEWORK FOR ON-SITE SYSTEMS

1.5 Structure of this Standard

This revised Standard is presented in seven sections:

- Section 1: General covers the general objective, scope, and definitions relevant to the whole Standard.
- Section 2: The risk management process for on-site systems outlines a risk management approach to support achievement of the performance objectives of this Standard. Additional information on risk management is provided in Appendix A.
- Section 3: Roles and responsibilities provides clarification of the roles of the parties involved in designing, implementing, and managing on-site systems.
- Section 4: Performance statements contains the performance objectives that cover the overall design and sustainable management of on-site systems. The performance statements describe what is required to achieve sustainable management of on-site systems.
- Section 5: Design of on-site systems specifies the performance requirements and criteria for site-and-soil evaluation and system design.

This section covers:

- 5.2 Site-and-soil evaluation;
- 5.3 Design flow;
- 5.4 Wastewater treatment units; and
- 5.5 Land application system design.

The related Appendices for this section are:

- Appendix B Site-and-soil evaluation procedures;
- Appendix C Site-and-soil evaluation for planning, rezoning, and subdivision of land;
- Appendix D Site-and-soil evaluation for individual lots;
- Appendix E Site-and-soil properties;

Appendix F	Dispersive soil and sodicity;
Appendix G	Soil permeability measurement – Constant head test;
Appendix H	Typical domestic wastewater flow design allowances;
Appendix J	Recommended capacities for septic tanks;
Appendix K	Land application methods – Guidance on selection
Appendix L	Land application methods – Trenches and beds, and ETA/ETS systems;
Appendix M	Land application methods – Irrigation systems;
Appendix N	Land application methods – Mounds;
Appendix P	Disinfection;
Appendix Q	Water balance and land application systems;
Appendix R	Recommended setback distances for land application systems; and
Appendix S	Nutrients.

Section 6: Construction, installation, operation, and maintenance specifies the performance requirements for: construction, installation, operation, maintenance, and monitoring.

The related Appendices for this section are:

Appendix J	Recommended capacities for septic tanks;
Appendix T	Operation and maintenance guidelines;
Appendix U	Monitoring records for on-site systems;

Construction and installation requirements are contained in:

Appendix L	Land application methods – Trenches and beds, and ETA/ETS systems;
Appendix M	Land application methods – Irrigation systems;
Appendix N	Land application methods – Mounds.

Section 7: Administrative guidance identifies the requirements for good regulation of on-site systems.

Additional information comparing sections in this Standard with its previous version, AS/NZS 1547:2000, is set out in Appendix V.

1.6 Interpretation

The word 'shall' identifies a mandatory requirement for compliance with the Standard. The word 'should' refers to practices, which are advised or recommended.

Clauses prefixed by 'C' and printed in italic and shaded are comments, explanations, and summaries of technical background, or recommended practice. They may also suggest approaches that satisfy the intent of the Standard, but are not to be taken as the only or complete interpretation.

The terms 'Normative' and 'Informative' have been used in this Standard to define the application of the Appendices to which they apply. A 'Normative' Appendix is an integral part of the Standard, whereas an 'Informative' Appendix is for information and guidance only.

For the purposes of this Standard the term 'on-site system' will be used to cover all 'on-site domestic wastewater systems'.

Figures and tables in this Standard are used to describe specific issues referenced in the associated text. They are not to be construed as containing all design information that is required for that particular element or situation.

1.7 Referenced documents

The following documents are referred to in this Standard:

AUSTRALIAN

AS 1289.3.8.1:2006	Methods of testing soils for engineering purposes – Soil classification tests – Dispersion – Determination of Emerson class number of a soil
AS 1319:1994	Safety signs for the occupational environment
AS 2439.2:1983	Perforated plastics drainage and effluent pipe and fittings – Perforated effluent pipe and associated fittings for sewerage applications
AS 2698.2:1990	Plastics pipes and fittings for irrigation and rural applications – Mechanical joint fittings for use with polyethylene micro-irrigation pipes
AS 2758.1:1998	Aggregates and rock for engineering purposes – Concrete aggregates

JOINT AUSTRALIAN/NEW ZEALAND

AS/NZS 1477:2006	PVC pipes and fittings for pressure applications
AS/NZS 1546.1:2008	On-site domestic wastewater treatment units – Septic tanks
AS/NZS 1546.2:2008	On-site domestic wastewater treatment units – Waterless composting toilets
AS/NZS 1546.3:2008	On-site domestic wastewater treatment units – Aerated wastewater treatment systems
AS/NZS 2648.1:1995	Underground marking tape – Non-detectable tape
AS/NZS 3500.2:1996	Plumbing and drainage – Sanitary plumbing and drainage
AS/NZS 4129:2000	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130:2003	Polyethylene (PE) pipes for pressure applications
AS/NZS 6400:2005	Water efficient products – Rating and labelling
AS/NZS ISO 31000:2009	Risk management – Principles and guidelines
SAA/SNZ HB 203: ----	Environmental risk management – Principles and process (in preparation)
SAA/SNZ HB 436: ----	Risk management guidelines – A companion to AS/NZS ISO 31000 (in preparation)

NEW ZEALAND

NZS 3121:1986	Specification for water and aggregate for concrete
NZS/AS 1319:1994	Safety signs for the occupational environment

OTHER PUBLICATIONS

ANZECC and ARMCANZ. *National water quality management strategy – Australian and New Zealand guidelines for fresh and marine water quality*. Victoria: ANZECC and ARMCANZ, 2000.

ARC. *On-site wastewater systems: Design and management manual. Treatment and land disposal systems from domestic wastewater from households, commercial premises and similar facilities*. TP 58. 3rd ed. Auckland: Auckland Regional Council, 2004.

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EPA Victoria. *Guidelines for environmental management: Use of reclaimed water*. Victoria: EPA Victoria, 2003.

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U.S. Environmental Protection Agency. *Onsite wastewater treatment systems manual*. EPA/625/R-00/008. USEPA, 2002.

Venhuizen, D. *Analysis of the potential impacts on ground water quality of on-site watershed management using alternative management practices*. 1995. Retrieved from <http://www.venhuizen-ww.com/> (November 2011).

NEW ZEALAND LEGISLATION

Building Act 2004

Building Regulations 1992

Resource Management Act 1991

1.8 Legislation

This Standard shall be read in conjunction with the bylaws and regulations of the relevant authorities and, in New Zealand, with the New Zealand Building Code, and in Australia with the National Construction Code. While some legislation is identified, other legislation may also be applicable. It is the responsibility of all those involved with on-site domestic wastewater management to ensure that they are acting in accordance with all relevant legal requirements.

1.8.1 Australia

The relevant regulatory authority controls the collection and treatment of domestic wastewater. This authority may operate under the guidance of the State health department, or may be the State health department itself – working in conjunction with the department responsible for the environment or with split responsibility depending on the overall size of the system – or alternatively be the State environmental or local government agency.

The approval of treatment plant types and approval for the installation of individual wastewater treatment systems including the method of land application is the responsibility of the regulatory authority.

1.8.2 New Zealand

1.8.2.1 New Zealand Building Code

The performance requirements for the construction and operation of on-site systems are covered in the New Zealand Building Code (the First Schedule of the Building Regulations 1992).

The design and installation of on-site wastewater treatment and disposal systems has to comply with the New Zealand Building Code, specifically clauses G13 Foul Water and performance criteria G13.3.4, and be installed in accordance with a building consent. This Standard is intended as a means of compliance with the requirements of the New Zealand Building Code.

The New Zealand Building Code also requires compliance with public health and environmental standards. Public health requirements are controlled by the relevant local authority operating under the guidance of the Ministry of Health.

1.8.2.2 Resource Management Act

The Resource Management Act 1991 (RMA) is operated by local authorities (regional councils and territorial authorities) and, through regional plans, imposes environmental constraints on systems and the effluent produced.

Through the RMA, regional councils will have established regional plans which identify permitted, controlled, discretionary, and prohibited activities. Territorial authorities will give consent under the Building Act 2004 to install a system and will advise if resource consent under the RMA is required.

1.9 Definitions

Absorption	The uptake of effluent into the soil by infiltration and capillary action
Absorption trench or bed or area	A land application system which uses the principles of absorption
Adsorption	The physical or chemical attachment of substances to the surface of soil particles
Aerated wastewater treatment system (AWTS)	A system which uses the processes of aeration followed by clarification to achieve biological treatment of wastewater NOTE: AWTS units have been known as 'aerated septic tanks' in some jurisdictions of Australia and as 'aerobic treatment plants' (ATP), 'home aeration plants' or 'household package plants' in New Zealand.
Aggregate	Rock or stone media meeting the requirements of AS 2758.1 or NZS 3121
All-waste	The combined blackwater and greywater from a dwelling or premise that is generating domestic waste
Automatic sequencing valve	A distribution valve which under each pumping (or siphon dosing) cycle trips to a new outlet feeding an individual distribution line in a land application system, thus dosing each distribution line in sequence
Best practicable option (BPO)	The option for wastewater servicing, treatment, and land application that best meets public health, environmental and economic objectives
Blackwater	Wastes discharged from the human body either direct to a dry-vault toilet or through a water closet (flush toilet) or urinal
Boulder	A natural, geological entity with middle dimension greater than 600 mm
Constructed wetland	A system constructed for further treatment of effluent consisting of a bed of aggregate or other durable media in which wetland plants are grown

Design area	The horizontal plan area of a land application system to which effluent is distributed
Design irrigation rate (DIR)	The loading rate that applies to the distribution of effluent to the design area of an irrigation land application system, expressed in L/m ² /day or mm/day
Design loading rate (DLR)	The loading rate that applies to the distribution of effluent to the design area of an absorption trench or bed or mound land application system, expressed in L/m ² /day or mm/day, and equivalent to the LTAR of the land application system reduced by a factor of safety
Desludging	Removal of the accumulated sludge and scum from a treatment unit or holding tank
Disinfection	The method of treatment of wastewater which kills or inactivates microbial pathogens to an acceptable level, satisfactory for the intended use. Its effectiveness is typically measured by the reduction in faecal indicator bacteria <i>E. coli</i>
Dispersive soil	A soil that has the ability to pass rapidly into suspension in water
Displacement toilet	A toilet pedestal erected directly over a 'septic' tank or alternative primary treatment unit; sometimes referred to as a 'septic closet' NOTE: Displacement toilets are generally non-flushing type however; they might incorporate a low or micro-flush cistern with discharge through a flap valve or other water seal device.
Distribution device	A device such as a 'distribution box' or alternative device for distributing effluent by gravity or siphon evenly into each distribution line of a subsurface land application system
Distribution line or pipe	A slotted or drilled drainage line for gravity or siphon distribution of treated effluent throughout the design area of a land application system (see also Perforated line or pipe)
Divergent	The characteristic of a slope that spreads surface water out over an ever-widening area as it runs downhill
Domestic wastewater	Wastewater from a domestic source (see 1.2.1)
<i>E. coli</i> (Escherichia coli)	A member of the faecal coliform group of bacteria, and indicative of faecal contamination
Effluent	The liquid discharged from a wastewater treatment unit
Environment	Surroundings, including natural and physical resources, ecosystems, community, and neighbourhood
Environmental performance	The performance of on-site systems relative to both public health protection and protection of the natural and physical environment

Evapotranspiration-absorption (ETA) trench or bed (Australia)	A land application system that embodies the principles of evaporation, transpiration, and absorption
Evapotranspiration-seepage (ETS) trench or bed (New Zealand)	A land application system that embodies the principles of evaporation, transpiration, and absorption
Exclusion area	Areas such as building platforms, rocky outcrops, or poor soils that would not support an on-site system
Expected available area (EAA)	The area on a lot that can be expected to be favourable to a land application system and reserve area pending further information
Factor of safety	The proportionate increase in designed capacity or performance of a system aimed at reducing the risk of adverse impacts on public health or the environment
Favourable	Site or soil conditions, including all relevant environmental and other attributes, which are sufficient to meet or exceed the performance criteria of this Standard for the specified wastewater management system(s) under consideration
Filter cloth	Any durable, permeable textile material suitable for use with soil, aggregate, or earth
Food waste disposal unit	An appliance being an electrically operated mechanical device for reducing kitchen food waste into fragments small enough to be flushed into the drainage system (sometimes called a garbage grinder)
Greywater	The domestic wastes from a bath, shower, basin, laundry, and kitchen, but excluding toilet and urinal wastes. It may contain pathogens
Groundwater	The body of water in the soil, all the pores of which are saturated with water. If the body of water is present at all times it represents permanent or true groundwater
Holding tank	A tank used for holding wastewater prior to pumping out (sometimes called a collection well)
Impermeable layer	Soil layer with permeability less than 10% of that of the overlaying soil layer. The term 'impermeable' is not to be taken in a literal sense
Infiltration	Passage of water or effluent into soil
Irrigation	The distribution of effluent into the topsoil by a shallow subsurface or covered surface drip irrigation system, a shallow subsurface LPED irrigation system or an above ground spray irrigation system
Land application system	The system used to apply effluent from a wastewater treatment unit into or onto the soil for further in-soil treatment and absorption or evaporation

Linear	The shape of the land surface between two points, either up and down the slope or across the slope on the contour is a straight line
Loading certificate	A certificate that sets out the design criteria and the limitations associated with the use of the on-site system (see 7.4.2(d))
Long-term acceptance rate (LTAR)	The steady state rate that a land application system can absorb primary or secondary effluent for further treatment within the subsoil. It allows for loss to the soil by infiltration through the base and side walls of the system, and other losses to the atmosphere by evaporation and transpiration (see C5.5.5.1)
LPED irrigation	Shallow subsurface irrigation of effluent into topsoil through low pressure effluent distribution (LPED) lines
LPED line	A pressure line perforated with drilled squirt holes and nestled in a distribution line
Maintenance certificate	A document that certifies that an on-site system has been inspected by an accredited person and is judged to be properly operated and maintained
Map unit	(See Soil-terrain map unit)
Monitor	Check, supervise, observe critically or measure the progress of an activity, action, or system on a regular basis to identify change from the performance level required or expected
On-site system	An on-site domestic wastewater management system that receives, treats, and applies wastewater to a land application system or a holding tank
Outlet filter	A device fitted to, in place of, or immediately downstream of the outlet tee on a septic tank and which retains total suspended solids (TSS) greater than 3 mm size in the tank, so preventing their carry-over into the land-application area
Ped	A lump of soil that can be separated from others by hand, the void spaces between peds controlling the passage of water through the soil
Perched water table	Groundwater that has beneath it unsaturated soil material into which the groundwater drains NOTE: A perched water table is nearly always periodic or seasonal.
Perforated line or pipe	A pipe drilled with squirt holes for pressure distribution of treated effluent throughout the design area of a land application system by pump or siphon dosing (see also Distribution line or pipe)
Performance criteria	The qualitative or quantitative measures or limits which indicate attainment of the performance requirement
Performance objectives	The results required for a system to be acceptable

Performance requirements	The functions that a system has to perform so that it operates as defined
Permeability	(See Soil permeability)
Population equivalent	The ratio of the total quantity of waste produced to that defined as being produced from one person in a dwelling
Primary treatment	The separation of suspended material from wastewater in septic tanks, primary settling chambers, or other structures, before effluent discharge to either a secondary treatment process, or to a land application system
Regulatory authority	An authority or body that is empowered by statute to be responsible for managing or controlling an aspect of on-site systems
Reserve area	An area set aside for future use as a land application area to replace or extend the original land application system
Risk	An expression of the likelihood of identified hazards causing harm in exposed populations or receiving environments, and the severity of the consequence (risk = likelihood x consequence)
Risk assessment	The overall process of risk identification, risk analysis and risk evaluation using available information to predict how often hazards or specified events may occur (likelihood) and the magnitude of their consequences NOTE: See Appendix A for detail on risk identification, risk analysis, and risk evaluation.
Risk management	The systematic evaluation of the on-site system, the identification of hazards and hazardous events, the assessment of risks, and the development and implementation of preventive strategies to manage the risks
Risk management process	The systematic application of management policies, procedures, and practices to the tasks of identifying, analysing, evaluating, reducing, and monitoring risk
Risk reduction	The selection and implementation of appropriate options for dealing with risk
Scum	The floating mass of wastewater solids buoyed up by entrained gas, grease or other substances which form an accumulating layer on the liquid surface inside the treatment tank
Secondary treatment	Aerobic biological processing and settling or filtering of effluent received from a primary treatment unit

Septage	The pumpout contents of a septic tank (or primary compartment of an AWTS) removed during desludging operations, which includes scum, sludge, and tank liquid
Septic tank	A single or multiple chambered tank through which wastewater is allowed to flow slowly to permit suspended matter to settle and be retained, so that organic matter contained therein can be decomposed (digested) by anaerobic bacterial action in the liquid
Serviceable life	The period of time in which with only routine maintenance the system performs satisfactorily
Setback	The distance that an on-site system shall be situated from any facility, boundary or body of water
Sewerage	The network of collection drains carrying domestic wastewater or effluent away from properties for off-site treatment
Site-and-soil check (SSC)	An identification of potential constraints on an on-site system imposed by the environment and an assessment of the degree of detail required for assessing the soil profile
Site-and-soil evaluation (SSE)	An assessment of the legal constraints, financial consequences, and the risks to public health and the environment of an on-site system
Slickensides	The skin or coating formed on (usually) large units of soil, which will show striations or grooves resulting from the periodic rubbing together of the soil units due to shrinkage and swelling in response to moisture change
Sludge	The semi-liquid solids settled from wastewater
Sodic	A soil condition in which the percentage of exchangeable sodium is high enough to cause significantly increased clay dispersivity, decreased soil structure stability, and to potentially decrease soil permeability
Soil absorption zone	The depth of soil that is required to filter, isolate, and absorb wastewater microorganisms, nutrients and particles
Soil drainage	An indication of the duration and severity of local soil wetness conditions likely to occur in most years, strongly influenced by the characteristics of soil that permits the downward flow of excess water through it
Soil permeability	A calculated value derived from the rate at which a head of liquid infiltrates a particular soil, usually measured in m/d and often referred to as K_{sat}
Soil-terrain map unit	An individual mapped area (polygon) which contains a definable slope or group of soils which require individual soil evaluation prior to use as a land application area

Stones	Rock or stone material with middle dimension between 200 mm and 600 mm
Sustainable	Capable of continual operation with minimal long-term adverse effect on public health and the environment
Wastewater	The discharge from sanitary fixtures and sanitary appliances
Wastewater treatment unit	A primary or secondary treatment system
Watercourse	A stream that: (a) Has visible bed and banks, that is, an eroded channel no matter how small but not a defined non-eroded grassy course or drainage depression; and (b) Is partially fed with water from some source other than surface water run-off (for example, springs, snowfields, or spongy soil that absorbs rainfall and then releases it into the stream over a longer period)
Water table	The upper surface of groundwater below which the soil is permanently saturated with water

1.10 Abbreviations

The following abbreviations are used in this Standard:

AWTS	Aerated wastewater treatment system
BOD ₅	5-day biochemical oxygen demand
BPO	Best practicable option
cfu	Colony-forming unit
DIR	Design irrigation rate
DLR	Design loading rate
EAA	Expected available area
Eq.	Equation
ESP	Exchangeable sodium percentage
ET (or <i>Et</i>)	Evapotranspiration
ETA	Evapotranspiration absorption
ETS	Evapotranspiration seepage
FAC	Free available chlorine
GIS	Geographic information system
K_{sat}	Saturated permeability coefficient
kWh/day	Kilowatt hours per day
LPED	Low pressure effluent distribution
LTAR	Long-term acceptance rate
MPN	Most probable number
PRI	Phosphate retention index

PSI	Phosphate sorption index
SAR	Sodium adsorption ratio
SSC	Site-and-soil check
SSE	Site-and-soil evaluation
TSS	Total suspended solids

1.11 Conversion of per cent grade, slope, and gradient

This Standard refers to slopes as the 'per cent grade'. Table 1.1 provides conversions for typical 'per cent grade' into the equivalent 'slope angle' and 'slope ratio', with each defined as:

- (a) Per cent grade or grade (%) is the ratio of the vertical distance to the horizontal distance converted into per cent, (with 100% being a one to one ratio of equal horizontal and vertical distances, also equivalent to 45 degrees);
- (b) Slope angle or degrees (°) is the arctan of the vertical distance divided by the horizontal distance (that is tan of the slope angle is the vertical distance divided by the horizontal distance); and
- (c) Slope ratio (V:H) is the horizontal distance (H) that equates to a 1 m change in the vertical distance (V).

TABLE 1.1
SLOPE CONVERSION TABLE

PER CENT GRADE (%)	SLOPE ANGLE Degrees (°)	SLOPE RATIO (V:H) Approximate gradient
5	2.8	1:20.0
10	5.7	1:10.0
15	8.5	1:6.7
20	11.3	1:5.0
25	14.0	1:4.0
30	16.7	1:3.3
35	19.3	1:2.9
40	21.8	1:2.5

2 RISK MANAGEMENT PROCESS

2.1 Scope

The purpose of this section is to outline the requirements for ensuring a risk management process is adopted to support the attainment of the performance objectives of the Standard. Ideally on-site system management achieves overall control and integration of site investigation, conception, design, installation, operation, maintenance, and monitoring.

This section outlines a risk management approach to achieving the performance requirements of the Standard. This entails identifying and managing risks in a proactive way rather than simply reacting when problems arise.

Identifying the risks for each on-site system is important not only for developing appropriate designs and management procedures to reduce these risks, but also for ensuring that resources are not wasted in protecting against risks which are negligible.

Risk management is applicable to all stages of wastewater management, from the initial planning stages in determining the best practicable option, including full sewerage, through to the operation of the on-site wastewater system. As such, all stakeholders play an important role in implementing risk management including the regulatory authority, site evaluators and assessors, designers, installation contractors, equipment manufacturers and suppliers, maintenance contractors, and property owners. The roles and responsibilities of all persons involved are discussed in section 3.

Importantly, prior to assessing the best practicable option, robust institutional arrangements which enable the sustainable management of on-site wastewater systems should be in place.

An important component of the risk management framework is the need to continually review and evaluate the performance of on-site systems. Institutional arrangements need to ensure that these processes are in place.

The aim of the review and evaluation processes should be to:

- (a) Ensure that each stakeholder meets the obligations of their roles and responsibilities;
- (b) Address emerging problems and trends identified through monitoring activities, incidents, and emergencies;
- (c) Assess the overall performance against regulatory requirements; and
- (d) Identify priorities for improving on-site system management, and research and development opportunities.

2.2 Performance requirement

A risk management approach shall be adopted to ensure that risks associated with the on-site wastewater system are managed. This may include:

- (a) A risk assessment of the entire on-site wastewater system covering system inputs including quantity and quality of source wastewater, the treatment process, land application system, the receiving environment and potential exposure routes to the public and the environment; and
- (b) Implementing preventive controls or risk reduction measures to ensure that the performance objectives in section 4 are met.

To ensure the highest levels of competence, all persons involved in the design, installation, operation, maintenance, and performance monitoring procedures shall be adequately trained in the operational aspects of their work, and understand the potential impact of their actions on the on-site wastewater management system.

Design specifications and proposed maintenance programmes shall be reviewed to the satisfaction of the regulatory authority to ensure that the performance objectives of this Standard are met.

C2.2

In many cases the risk-based approach is inherent in good design and management processes.

The risk to public health and the environment can be reduced or eliminated by the implementation of:

- (a) *Investigation, design, and installation processes which incorporate appropriate factors of safety in dealing with site-and-soil constraints; and*
- (b) *Operation, maintenance, repairs, and performance monitoring measures which address potential adverse effects that can be reasonably foreseen.*

It is not intended to impose on practitioners an unrealistic burden in extra reporting in support of applications to regulatory authorities by requiring exhaustive procedures for quantifying risks and detailing of reduction measures. It is sufficient, but important, that designers and other practitioners formally infuse the risk management process into all decision-making associated with their role in on-site wastewater management.

Clause 2.4.1 and Appendix A are intended to provide assistance in achieving this requirement. Appendix A sets out guidance on the risk management process relating to implementation of on-site wastewater systems, and provides examples for assessing consequences and likelihoods and applying risk reduction measures. The list is not exhaustive.

See 2.4.2 on the importance of training and review in managing organisational risk.

2.3 The risk management process

Risk management is the culture, processes, and structures that are directed towards realising potential opportunities while managing adverse effects (AS/NZS ISO 31000 and SAA/SNZ HB 436). The risk management process entails iterative decision-making (SAA/SNZ HB 203) involving establishing the context, assessing risks (identifying, analysing, and evaluating) and formulating measures to manage risks (treat, eliminate, reduce, or modify risk). The process at each step involves communication and consultation with both internal parties (the property owner and the practitioners involved in delivering the on-site system) and external parties (the regulator and neighbouring property owners) where appropriate, and is subject to continuing monitoring and review to enhance the process over time.

C2.3

The generic process of risk management is outlined in AS/NZS ISO 31000 and SAA/SNZ HB 436 and illustrated in SAA/SNZ HB 203 (for health and environmental risk management).

In AS/NZS ISO 31000 the concept of 'risk treatment' incorporates a range of measures including risk reduction and risk sharing. In this Standard 'reduction' relates to dealing with potentially adverse effects and impacts related to providing and monitoring on-site system servicing.

2.4 Implementing risk management

2.4.1 *Protection of public health and the environment*

To a large extent risk management including developing and implementing measures to minimise the adverse effects of risk is an inherent part of the design process. The designer takes the site-and-soil assessment findings, designs the on-site system to address the risks associated with the site-and-soil constraints, and develops a management and monitoring programme to ensure sustainability.

The designer has the key role in incorporating risk reduction measures into the design and management of the on-site system. Risk reduction measures may include, but are not limited to:

- (a) Reducing wastewater output by installing water conservation fixtures;
- (b) Pre-treatment;
- (c) Installing holding/storage tanks to accommodate peak-loads;
- (d) Improving the quality of the final effluent;
- (e) Adopting conservative parameters for design;
- (f) Controlling the flow and sequencing of the dosing;
- (g) Providing a reserve area for the land application system;
- (h) Installing groundwater diversion trenches;
- (i) Installing surface water diversion upslope of the land application system;
- (j) Planting the land application area with high transpiration plant species;
- (k) Providing setbacks and barriers to property boundaries, watercourses and groundwater;
- (l) Ensuring proper and regular maintenance;
- (m) Ensuring regular monitoring; and
- (n) Formulating a contingency plan and troubleshooting guide.

2.4.2 *Organisational performance*

The quality of the on-site system depends on the quality of the services provided by the developer, site investigator, designer, installer, equipment supplier, servicing agent, performance monitoring inspector, regulator, property owner, and any other party involved in on-site system provision, use, and site supervision. This in turn depends on the skills and experience of those involved in delivering each element of the on-site management system.

Education and training is therefore essential for reducing risks of organisational failure, or poor decision-making and inadequate oversight of the design and management processes.

Although some practitioners may see professional indemnity insurance as the appropriate means of covering personal risk in decision-making, this is of little comfort to the property owner who has to deal with any consequences associated with the impact of a risk incident. Ensuring all practitioners are well trained or well supervised is the most effective means of reducing both organisational and end-user risk.

2.5 Review and evaluation

A process shall be implemented to verify that the management, design, operation, and administration of the on-site system continuously achieve the performance objectives in section 4.

3 ROLES AND RESPONSIBILITIES

The purpose of this section is to identify persons who may have a role to play in managing and implementing processes that lead to the effective and sustainable performance of on-site systems. It will identify some of the main aspects of the roles of these people. Table 3.1 lists the essential stages in the implementation process and suggests who should be involved in each stage.

Section 7 provides details on specific administrative requirements to ensure that the performance objectives are met.

3.1 The regulatory authority

The role of regulatory authorities is particularly significant in ensuring the performance objectives of this Standard are met. Management and implementation need central definition, instigation, and monitoring through a system of control, supported by an information management system, which could ultimately be regulatory, or private, or both. A sustainable system of on-site domestic wastewater management will need to have responsibilities clearly defined for each stage. Ideally the regulatory authority will:

- (a) Have key personnel who are competent and accredited through an appropriate training programme;
- (b) Review and assess all documents as part of any approval process including evaluation of on-site treatment versus sewerage (see 7.1(a));
- (c) Identify all risks in the on-site system and the mechanisms to address these;
- (d) Check that all plans, design, installation, and maintenance reports which form part of the application are certified;
- (e) Maintain records of on-site systems (both as-built and with subsequent modifications), their performance, and failures; and
- (f) Require the owner to enter into a servicing/monitoring agreement as appropriate.

Monitoring frequency is to be determined by the local regulatory authority to reflect the system type and the sensitivity of the receiving environment.

3.2 Planners/surveyors/land developers

Persons and organisations who plan, design, or develop subdivisions in unsewered areas should:

- (a) Undertake in the initial planning stage an assessment to determine the sustainable wastewater management practice for the site;
- (b) Evaluate the sustainability and environmental implications for public health, land use, and the continuing uses of energy, materials, and finances;
- (c) Have a suitably qualified and experienced person make an assessment of the risks to public health and environment, and the costs and benefits of on-site versus reticulated wastewater;
- (d) Ensure that key personnel from within their organisations are accredited through an appropriate training programme;
- (e) Take account of site-and-soil checks (SSC) prior to deciding the layout of a subdivision;
- (f) Reserve adequate areas of suitable soils for on-site land application systems;
- (g) Evaluate potential cumulative environmental and public health effects arising from long-term use of on-site systems;
- (h) Ensure that the on-site systems can achieve the performance requirements of this Standard;
- (i) Provide design reports and plans to local authorities, property owners, and property purchasers;

- (j) Protect potential land application areas during subdivision construction, trafficking with heavy equipment, and removal of topsoil; and
- (k) Provide details on on-site operation, maintenance, and monitoring in applications and plans for subdivision.

TABLE 3.1
IMPLEMENTATION PROCESSES AND PERSONS INVOLVED – ESSENTIAL STAGES

A: PLANNING FOR UNSEWERED AREAS		
Implementation stage	Implementation processes	Implemented by
1. Planning study (See 5.2)	Site-and-soil evaluation to determine areas which are most favourable for new developments	– Planning authorities – Site evaluator – Environmental authorities
	Identifying constraints to new development	– Resource management authorities
	Evaluating environmental and public health effects	– Public health authorities
B: UNSEWERED SUBDIVISION PROPOSALS		
Implementation stage	Implementation processes	Implemented by
1. Feasibility study (See 5.2)	Review of sewered versus unsewered option for wastewater servicing of particular land(s) under study	– Designer – Planner/surveyor – Public health authority – Environmental authority – Planning authority – Sewerage authority – Developer
	Site-and-soil evaluation to check areas are suitable for subdivision	– Planner/surveyor – Site evaluator – Local government – Environmental authority
	Evaluating environmental and public health effects	– Site evaluator – Environmental authority – Public health authority
2. Subdivision design (See 5.2)	Site-and-soil check	– Site evaluator
	Site-and-soil evaluation	– Site evaluator/soil assessor
	Lot size and layout design	– Surveyor
	Design reporting	– Designer

TABLE 3.1
IMPLEMENTATION PROCESSES AND PERSONS INVOLVED – ESSENTIAL STAGES (continued)

B: UNSEWERED SUBDIVISION PROPOSALS		
Implementation stage	Implementation processes	Implemented by
3. Systems design (See 5.3 and 5.5)	Selecting and sizing land application system Determining capacity of wastewater treatment unit	– Designer – Regulatory authority
4. System installation (See 6.2)	Constructing and installing wastewater treatment unit and land application system	– Installer/contractor – Designer – Regulatory authority
5. System use (See 6.3)	Operation and maintenance	– Home owner/occupier – Regulatory authority – Pumpout contractor – Treatment plant service agent or maintenance service agent
	Monitoring	– Home owner/occupier – Regulatory authority – Treatment plant service agent or maintenance service agent

Table 3.1 continued on next page ➤

TABLE 3.1
IMPLEMENTATION PROCESSES AND PERSONS INVOLVED – ESSENTIAL STAGES (continued)

C: INDIVIDUAL LOT IN EXISTING SUBDIVISION		
Implementation stage	Implementation processes	Implemented by
1. Feasibility (See 5.2)	Review whether off-site or on-site servicing is the best practicable option	– Developer/owner/builder – Regulatory authority
2. Site investigation (See 5.2)	Site-and-soil check Site-and-soil evaluation Design reporting	– Site evaluator – Site evaluator/soil assessor – Designer
3. Systems design (See 5.3 and 5.5)	Selecting and sizing land application system Determination of the capacity of the wastewater treatment unit	– Designer – Regulatory authority
4. System installation (See 6.2)	Constructing and installing wastewater treatment unit and land application system	– Installer/contractor – Designer – Regulatory authority
5. System use (See 6.3)	Operation and maintenance	– Home owner/occupier – Regulatory authority – Desludging/pumpout contractor – Treatment plant service agent or maintenance service agent
	Monitoring	– Home owner/occupier – Regulatory authority – Treatment plant service agent or maintenance service agent

3.3 Site evaluators and soil assessors

Site evaluators and soil assessors may include professional engineers, soil scientists, drainage contractors or plumbers with appropriate training, competence, and experience in design and installation practice. Site evaluators and soil assessors should ensure that they:

- (a) Have attended an appropriate accredited training programme;
- (b) Are familiar with any regulatory requirements for site evaluation;
- (c) Are responsible for all work to evaluate the capacity of a site and its soil for accepting treated wastewater;
- (d) Certify that the evaluation procedures have been undertaken in accordance with this Standard and any requirements of the relevant regulatory authority; and
- (e) Identify cultural concerns or constraints.

3.4 Designers

Designers may include professional engineers, soil scientists, drainage contractors or plumbers with appropriate training, competence, and experience in design and installation practice. Designers should ensure they:

- (a) Have attended an appropriate accredited training programme;
- (b) Complete and certify a design report (including a loading certificate) to accompany any application for installing or operating on-site systems, as set out in 7.4.2;
- (c) Are familiar with information on current installation trade practices, the range of materials and methods employed, the types of machinery available to the installer and the level of operator competence required for their use;
- (d) Are familiar with any community and environmental constraints;
- (e) Certify on completion of the installation, that the on-site system has been constructed, installed, and commissioned in accordance with its design including any additional requirements of the relevant regulatory authority;
- (f) Lodge a set of 'as-built' plans and details, as set out in 6.2.5.4, with the owner or occupier of the facility being serviced by the on-site system and with the relevant regulatory authority if required;
- (g) Prepare a set of operation and maintenance guidelines (see 6.3) specific to the on-site system as designed and installed or constructed. The guidelines should be lodged with the property owner or occupier and if required, with the regulatory authority or their agent.

C3.4

Certification could be required by regulatory authorities to be by independent technical experts such as independent professional engineers with appropriate experience and competence in the relevant discipline.

The operation and maintenance guidelines should include the designer's loading certificate setting out specific detail on the capacity of the system, the wastewater producing fixtures for which it has been designed, and the risks of overloading if additional fixtures are added beyond the capacity of the system (see 7.4.2(d)).

3.5 Installation contractors

Installation contractors may include licensed drainlayers and plumbers, technical or professional engineering people or any other persons with appropriate competence and experience in construction and installation. Contractors should ensure that they:

- (a) Have attended an appropriate accredited training programme which should include training in the theory of current and contemporary design approaches and in installing on-site systems;
- (b) Consult with the designer on the intention of the design, and the installation/construction methods and procedures essential to achieving design integrity;
- (c) Liaise with the designer during installation/construction so that a certificate of compliance with design can be completed, particularly when unusual or innovative design approaches are being used that are beyond their current experience; and
- (d) Certify with the designer that all equipment incorporated as part of the on-site system has been installed in accordance with the manufacturer's or supplier's instructions and in accordance with any other conditions established by the regulatory authority.

C3.5

Regulatory authority requirements could at times override the designer's or manufacturer's instructions.

3.6 Equipment manufacturers and suppliers

Equipment manufacturers and suppliers should ensure that:

- (a) Key personnel from within their organisation have attended the appropriate accredited training programme;
- (b) Any required product certification is obtained from an accredited certification body;
- (c) Assembly and installation instructions are provided for every wastewater treatment unit;
- (d) Quality control processes are in place to capture and incorporate relevant feedback from designers, installers, and constructors of on-site systems;
- (e) Operation, maintenance, and monitoring instructions (where relevant) are provided; and
- (f) An appropriate on-call operation, maintenance, and monitoring back-up service is available for users.

3.7 Maintenance and desludging/pumpout contractors

Such contractors should ensure that:

- (a) All field personnel have undertaken an appropriate training programme;
- (b) A service report covering all maintenance carried out is completed by the servicing contractor;
- (c) Full records are kept for at least 10 years of maintenance operations (desludging/pumpout operations of wastewater treatment units), and that they notify in writing the owner or occupier and the regulatory authority of unusual circumstances and wastewater treatment unit defects discovered during servicing;
- (d) Scum/sludge and all septage material taken from the site during desludging/pumpout are disposed of or used by an approved facility or agency in accordance with the regulatory authority requirements; and
- (e) Appropriate measures are in place during desludging/pumpout operations to protect staff and any other individuals who could be exposed to health risks during the activity.

3.8 Property owners

Property owners should fully inform themselves about the on-site wastewater management system on their property and its operation and maintenance. They should have available a copy of the operation, maintenance, and monitoring guidelines and the loading certificate for the system.

The property owner should ensure that maintenance carried out on the system is certified by the contractor. The maintenance should be in accordance with the schedules in the operation, maintenance, and monitoring guidelines prepared for the system by the designer and with the regulatory authority requirements. The property owners should keep records of the maintenance carried out for the past 10 years.

Property owners should also ensure that details and requirements for operation, maintenance, and monitoring (including plans, design reports, loading certificate, equipment brochures, and so on) are retained on the property and are readily accessible to the occupier.

Absentee property owners should ensure that occupiers are similarly informed.

3.9 Estate agents and property transfer agents

Estate agents and property transfer agents handling the sale, purchase, or letting of properties and facilities serviced by on-site systems should ensure that:

- (a) They are aware of the type and location of the wastewater management system for each property and facility;
- (b) They arrange for an operation, maintenance, and performance monitoring check to be undertaken prior to finalising a sale, organise completion of any maintenance and remedial actions identified by the check, and ensure that a maintenance certificate (see 6.3.5.6) is provided to the purchaser;
- (c) Prospective purchasers and occupiers are made aware of the details of the wastewater management system, including operation and maintenance requirements;
- (d) They supply each purchaser and occupier with a copy of the current operation, maintenance, and monitoring guidelines and the loading certificate for the particular system;
- (e) Any consent is transferred into the purchaser's name;
- (f) Purchasers and occupiers certify that they have received information on the working details of the system and are aware of its type, maintenance requirements, and location, and any consent, approval or permit requirements (where applicable);
- (g) Prospective purchasers of land in a new subdivision development are aware of the requirements of this Standard; and
- (h) Appropriate site and effluent management requirements and constraints are entered onto individual property titles (for example, exclusion areas such as building platforms, rocky outcrops, poor soil areas; land application areas; reserve areas).

C3.9

In New Zealand and a number of Australian States, information on site and effluent management requirements and construction might be recorded onto individual property titles. Some local authorities require a formal acknowledgement by the property owner of their legal responsibilities before completing the transfer of ownership.

4 PERFORMANCE STATEMENTS

This section of the Standard contains performance objectives that cover the overall design and sustainable management of on-site systems. From these performance objectives performance requirements are identified and then, when possible, performance criteria are specified. The performance statements describe what is required to achieve sustainable management of on-site systems.

The key performance objectives for any on-site domestic wastewater management systems are:

- (a) To protect public health;
- (b) To maintain and enhance the quality of the environment;
- (c) To maintain and enhance community amenity; and
- (d) To protect resources.

4.1 Primary performance objectives

4.1.1 *Public health*

To protect public health, the on-site system shall be designed and managed to:

- (a) Minimise the health risks associated with the assimilation of human waste and domestic wastewater in the environment;
- (b) Avoid the potential for public health nuisances;
- (c) Avoid the potential for disease, including those that can be transmitted by ingestion, direct contact, vectors, and airborne droplets;
- (d) Sustainably assimilate pathogens;
- (e) Avoid transmission of pathogens and deleterious chemicals to surface and groundwaters; and
- (f) Monitor risks to public health.

4.1.2 *Environment*

To protect the environment the on-site system shall be designed and managed to:

- (a) Avoid soil instability, and sustainably assimilate nutrients and other dissolved salts;
- (b) Maintain soil productivity and sustainable use of soils;
- (c) Contain any adverse effects within the property boundaries;
- (d) Avoid adverse effects on surface and groundwater flows;
- (e) Avoid pollution of groundwater and surface water such that subsequent use of the water is not compromised;
- (f) Avoid foul odours;
- (g) Minimise the cumulative adverse effects; and
- (h) Monitor risks to the environment.

4.1.3 *Community amenity*

To protect community amenity, the on-site system shall be designed and managed to:

- (a) Avoid detracting from property and neighbourhood community values; and
- (b) Be designed to take account of social and cultural values of stakeholders.

4.1.4 *Resource utilisation*

The on-site system shall be designed and managed to use materials and energy efficiently during construction, installation, and operation.

4.2 **Secondary performance objectives**

These secondary objectives restate the primary objectives relating them to specific elements of the system and the procedures for its design and operation. They are not of any lesser importance than the primary objectives.

4.2.1 *Site-and-soil evaluation*

The objective of the site-and-soil evaluation shall be to collect sufficient information on site characteristics and local environmental constraints to enable the best practicable option(s) to be employed for the design, installation and operation of the on-site system.

See 5.2.1 for the performance requirements related to this objective.

4.2.2 *Wastewater treatment systems*

The objective of wastewater treatment system design and operation shall be to treat wastewater to a standard that is suitable for applying to land.

See 5.4.1 for the performance requirements and 5.4.2 for the performance criteria related to this objective.

4.2.3 *Land application systems*

The performance objectives for any on-site land application systems shall be:

- (a) To assimilate the treated wastewater into the soil on the site with a low probability of soil saturation, wastewater breakout, ponding, channelling, and run-off from the site;
- (b) To have a low probability of becoming unstable or collapsing, or of causing loss of amenity, through undue deformation, slope, stormwater flow, response to vibration, degradation, or other physical characteristics during construction or alteration and throughout the life of the system when in use (see 5.5.4.2.1);
- (c) To provide reasonable access for maintenance, cleaning, and clearing blockages; and
- (d) To provide measures to restrict unauthorised access.

See 5.5.1 for performance requirements for land application system design, and 5.5.3 for the design criteria related to these objectives.

4.2.4 *Construction and installation*

The objectives in the construction and installation of on-site systems shall be to:

- (a) Ensure that the stability of other structures is not compromised;
- (b) Avoid soil saturation and soil instability;
- (c) Satisfy the design requirements; and
- (d) Ensure ease of access for maintenance and operation.

See 6.2.1 for the performance requirements for achieving these objectives.

4.2.5 *Operation and maintenance*

The objective of operating, maintaining, and monitoring an on-site system shall be to ensure that, throughout its serviceable life, the on-site system:

- (a) Protects and enhances public health;
- (b) Achieves environmental management objectives for air, land, and water resources; and
- (c) Is checked regularly that it is operating as intended.

See 6.3.2 for the performance requirements for achieving these objectives.

4.3 Primary performance requirements

4.3.1 *Public health and environment*

Site investigation and design procedures shall include the evaluation of potential public health and environmental effects. The option of full sewerage shall be included in the comparison of on-site systems when choosing the best practicable option (BPO). The assessment shall ensure that the on-site system will produce effluent that complies with the public health and environmental quality requirements of the regulatory authority.

The choice of system shall incorporate:

- (a) Measures to control potential public health nuisances;
- (b) Measures to maintain soil stability and achieve sustainable use of soils and their capacity to assimilate nutrients, other dissolved salts, and pathogens including bacteria, protozoan, enteric viruses, and helminths;
- (c) Measures to ensure that the effects are contained within the property boundaries including, if necessary, the use of setbacks;
- (d) Measures to control the effects on surface water and groundwater flows and the quality of natural waters such that subsequent use of those waters is not impaired or compromised;
- (e) Measures for control of odours during normal operation and routine maintenance (see 6.3);
- (f) Measures for protecting public health from diseases, including those that can be transmitted by direct contact, vectors, or airborne droplets; and
- (g) Measures to identify, analyse, evaluate, reduce, and monitor risks to public health and environmental quality.

4.3.2 *Community amenity*

The design of an on-site system shall include the evaluation of potential effects on community values. The final choice of system shall incorporate:

- (a) Controls on the siting, installation, and operation so that nuisance is avoided;
- (b) Measures so that the installed system shall not detract from, nor lower, property and neighbourhood community values;
- (c) Appropriate consideration of social and cultural values through consultation with the community groups and individuals that have an interest; and
- (d) Ongoing measurement and remedial action so that risk management processes secure high levels of amenity from on-site wastewater management systems.

4.3.3 Resource utilisation

When there is a community (for example, a subdivision) wastewater reuse programme, or when wastewater reuse is to be part of an individual site design, the provision of the on-site system shall be undertaken so that:

- (a) Public health considerations take priority over any resource utilisation criteria in cases where any potential conflict exists;
- (b) Materials and energy are used efficiently during construction, installation, and ongoing operation; and
- (c) Water is conserved or reused and the residual sludge and scum are used beneficially, whenever practicable.

C4.3.3

The concept of integrated water management can be directed to conserve water. Water use and thereby wastewater production can be minimised. Water usage is minimised through use of in-house water conservation measures, fittings, and techniques. For further guidance on water recycling refer to the Australian EPHC, National water quality management strategy – Australian guidelines for water recycling: Managing health and environmental risks (Phase 1).

The designer needs to incorporate safety factors to account for prolonged wet weather conditions and inability to control use of water conservation measures, particularly in areas where water shortages are not the driving factor for water conservation.

The manufacturer should state the energy consumption to operate the on-site system in kWh/day for the rated capacity under normal operating conditions.

5 DESIGN OF ON-SITE SYSTEMS

5.1 Scope

This section details the requirements and criteria for:

- (a) Site-and-soil evaluation to identify site specific risks and inform appropriate system design including treatment and land application; and
- (b) Selection of wastewater treatment units and design of land application systems.

5.1.1 Overview

Clause 5.2 sets out site-and-soil evaluation (SSE) procedures for development areas, subdivisions, and individual lots to meet the performance objectives given in 4.2.1. Clause 5.2 provides a methodology and a set of procedures for determining the nature of a site and of its soil. The section also provides methodologies and techniques for determining soil categories that are used for the design of land application systems.

Clause 5.3 establishes the most appropriate flows to be used in sizing the land application system.

Clause 5.4 identifies the performance requirements, capacity, and structural requirements for wastewater treatment units to meet the performance objectives of section 4. Alternative wastewater treatment units constitute adaptations of the basic septic tank.

Clause 5.5 establishes requirements for land application system design, siting, and sizing to meet the performance requirements for on-site systems given in section 4 of this Standard.

Land application systems featured in this Standard are based on those which are commonly used.

C5.1.1

In light of the variability of soil and climatic environments in Australia and New Zealand, an SSE needs to consider the local performance of land application systems in conjunction with best estimates of loading rates. Soils with highly dispersive and often heavy clay subsoils of great age are common in Australia, whereas New Zealand is characterised by generally younger soils, and in the North Island, volcanic ash soils of high structural stability and permeability.

Soil assessment evaluates the reaction of the soil to constant inputs of effluent with relatively high concentrations of salts, especially the reduction of permeability by sodium and potassium ions. Previous Standards have related soil assessment procedures in terms of permeability (or percolation) testing to effluent design loading rates. This Standard follows a different approach. Soil profile inspections, which consider several important soil properties, are used as the main tool to determine soil categories. Important soil properties include soil texture, sodicity and dispersiveness, soil structure, and soil structural stability (AS 1289.3.8.1), presence, density, and sizes of biological pores – ‘areal porosity’ (see E8) – as well as soil bulk density, and soil permeability (hydraulic conductivity). Of these predictors, areal porosity has proved to be the most useful one. These predictors need to be correlated with measured permeability values in any given soil environment. The predicted permeabilities are then matched to a best estimate of effluent infiltration capacity known as the long-term acceptance rate (LTAR) from which recommended design loading rates (DLR) and design irrigation rates (DIR) are assigned for each soil category. Soil permeability testing is a useful tool to help confirm the soil category for design purposes, particularly if there is any doubt or caution required, or if the design is not to be conservative. Permeability test results, however, are not to be used as the sole determinant of soil category.

C5.1.1 – continued

Even if all these predictors are used, only a coarse level prediction is feasible. Hence, reliable local information on performance is valuable. So far, there are few documented correlations between measured permeability and LTAR, and none between visually assessed soil properties and LTAR. This requires a greater emphasis on monitoring, which is being addressed in this Standard.

5.2 Site-and-soil evaluation

Additional information of site-and-soil evaluation can be found in the following Appendices:

Appendix B	Site-and-soil evaluation procedures;
Appendix C	Site-and-soil evaluation for planning, rezoning, and subdivision of land;
Appendix D	Site-and-soil evaluation for individual lots;
Appendix E	Site-and-soil properties;
Appendix F	Dispersive soil and sodicity;
Appendix G	Soil permeability measurement – Constant head test; and
Appendix S	Nutrients.

5.2.1 Performance requirements for site-and-soil evaluation

To meet the performance objective (see 4.2.1), processes for site-and-soil evaluation (SSE) shall:

- Provide sufficient information for deciding whether or not a development area, subdivision, or lot is suitable for on-site system(s);
- Provide detailed site-specific information identifying the site-and-soil characteristics to be taken into account when selecting and designing an on-site system;
- Identify, analyse, and evaluate any risks posed by site-and-soil characteristics which might compromise the long-term effectiveness of the on-site system(s);
- Identify, analyse, and evaluate any risks of contamination of groundwater or surface water and of associated health risks; and
- Specify measures required to reduce and monitor such risks.

5.2.2 Site-and-soil evaluation**5.2.2.1 General methodology**

The SSE procedure shall:

- Assess the public health, environmental, cultural, risk management, legal, and economic factors which are likely to impinge on the siting and design of a land application system;
- Evaluate the site-and-soil characteristics to determine feasible options for the design and sizing of land application systems;
- Compile all information collected during the SSE on appropriate plans and forms and in reports so that the information is then available to the system designer for inclusion in a design report; and
- Recommend risk reduction measures to be addressed in the design report.

C5.2.2.1

Alternative SSE procedures may be adopted where the regulatory authority is satisfied that a less rigorous procedure can satisfy the performance objectives of 4.2.1, whether through past performance, experience, or new knowledge. Justification for the adoption of a less rigorous procedure is to be lodged with the regulatory authority for assessment and prior approval.

5.2.2.2 *Types of site-and-soil evaluation*

The main types of SSE are:

- (a) SSE surveys of land prior to zoning or rezoning the land use;
- (b) SSE surveys for multiple adjacent sites such as subdivisions; and
- (c) SSE for individual lots.

C5.2.2.2

Land use surveys are usually carried out either over one or more local government areas for regional long-term planning purposes, or when potential development areas within a local government jurisdiction are being assessed.

SSE surveys for multiple adjacent sites such as subdivisions are to evaluate if the area is favourable for land application systems and to determine those areas requiring further evaluation. Such surveys are more efficient than a series of individual lot inspections.

SSE for an individual lot is to identify potential land application and reserve areas and to gather sufficient site-and-soil information for the selection and design of the on-site system.

5.2.2.3 *Site-and-soil evaluation procedure – Summary*

The SSE shall consist of a staged process, undertaken by a suitably qualified and experienced person.

The process shall consist of:

- (a) A desktop study (see Appendix B)
An initial evaluation of the development area, subdivision or lot shall be made to collate relevant site information (including legal description, site plans, setback requirements, soil maps, bore logs, depth to groundwater, depth to limiting horizons, nearby wells, groundwater direction, and environmental factors) prior to the site-and-soil check;
- (b) A comprehensive site-and-soil check (SSC) (see Appendix B)
An on-site inspection involving traverses by foot shall be made to record the land surface features such as topography, slope, buildings, vegetation cover, surface water, and services and to identify potential environmental and other constraints. This inspection shall define the expected available area for a land application system and delineate the exclusion area. This aspect of the SSC shall also be used to determine the extent of any soil assessment required;
- (c) A detailed site-and-soil assessment (see Appendices B to E)
A detailed subsoil investigation shall examine and record the soil profile and soil features within the expected available area. This leads to the testing of soil permeability when appropriate and the allocation of soil categories. The investigation determines soil characteristics and potential soil limitations, provides an evaluation of the long-term acceptance rate (LTAR), and enables the determination of a design loading rate (DLR) or a design irrigation rate (DIR). A standard procedure and a modified procedure are available (see D3);
- (d) Evaluation of results and preparation of a SSE report (see 5.2.4).

C5.2.2.3

This procedure covers most site-and-soil investigations. It is not exhaustive. Other factors may need to be considered and other techniques may need to be employed. Individuals undertaking each step or procedure in the process of carrying out the evaluation should be suitably trained, experienced and qualified, and not work outside their area of competence.

For situations outside the scope of this Standard, a suitably qualified and experienced person should be used.

Modified individual SSEs are possible where sufficient information is available for local authorities to be confident that cumulative environmental risks, both on site and off site, are expected to be low. In some cases, this will be where the existing surveys indicate little risk; the proposed site is surrounded by adequately functioning systems; or the development is sufficiently sparse for impacts to be insignificant.

Where cumulative environmental risks are deemed to be high, a conservative approach to the site evaluation and design should be adopted and the standard procedure used. Consideration should also be given to off-site wastewater servicing and, if practicable, full sewerage.

The relevant regulatory authority, land developer, or on-site system consultant will usually produce the SSE report depending on the size, nature, and interest in the land involved (development area, subdivision, or individual lot). The SSE report is to be available to the on-site system designer for use and inclusion (in whole or in part), in the design report (see 5.2.4).

5.2.2.4 Extent and intensity of site-and-soil evaluation

The initial desktop study helps determine the extent of the evaluation necessary for a particular development area, subdivision, or individual site. The intensity of site evaluation shall be matched against the size of the development and the likely nature and extent of potential health and environmental impacts as determined by the SSC. This includes the impact of construction activity on the ability of each site to function as a land application area.

The intensity of a SSE may be varied according to:

- (a) The volume, usage pattern or scale of the proposed on-site wastewater application (for example, an isolated lot or subdivision; a large lot size; a small lot size; size of expected available area; likely volume of wastewater flow);
- (b) The cumulative risk to health and the environment of the on-site wastewater application;
- (c) The previous land uses and the anticipated variability and complexity of site-and-soil parameters in the expected available area;
- (d) The availability and nature of data from previous investigations (such as for adjacent or nearby sites where the existing data records can be readily confirmed as comparable to, or representative of, the new areas under investigation); and
- (e) The performance record of local on-site systems (for example, if the performance record is poor there may be a need for higher than normal levels of site-and-soil evaluation).

The likely flow path of applied effluent and the probable fate of its contaminants shall be explicitly addressed in the report with particular reference to the worst case scenarios and the most sensitive activity within the catchment concerned.

C5.2.2.4

It should be borne in mind that existing system failure might be because of under-design or lack of maintenance. External consultation and other checks should address these issues (see A3.2.1).

The analysis of the likely flow path of applied effluent and the probable fate of its contaminants is an essential element in all site-and-soil investigations.

It is expected that in areas where health and environmental impacts are minimal, such as isolated rural properties, the extent of site evaluation can be scaled down. This would also apply where cumulative impacts are not expected to be significant, such as with large 'lifestyle' blocks in areas where water quality problems are not an issue, or in the use of vacant lots within existing subdivisions for which a range of good site information is available about on-site systems on neighbouring properties.

For greenfield subdivision, the site evaluation will need to assess, as appropriate, whether every lot/property is favourable. Indeed, this may be the determining factor in the sizing and layout of individual lots or properties. The option of individual on-site systems should be evaluated and compared with off-site alternatives such as common effluent drainage (or septic tank effluent collection) systems or modified or conventional sewerage (see 4.3.1). Applications for subdivision consent should provide sufficient information to regulatory authorities to demonstrate that each lot will be capable of accommodating the on-site systems proposed.

5.2.2.5 Timing of site-and-soil evaluation

The SSE shall take account of construction or landscaping activity on site and on the state of the soil.

When major earthworks are required, the evaluation process shall be staged to include evaluations at the time of subdivision design; after the subdivision has been constructed; and before the on-site systems are designed in detail.

For individual sites in existing subdivisions, the evaluation shall consider the timing and the impacts of proposed building and landscaping works on the on-site system's location, design, and construction.

The timing of the evaluation shall also consider the effects of seasonal (winter/summer) and episodic variations on likely site conditions.

C5.2.2.5

Many site-and-soil assessment procedures are not relevant or valid when soils are saturated. Furthermore, the results of site-and-soil assessments can be invalidated following landscaping adjustments or construction disturbance of the site, when soils are compacted by construction/excavation equipment.

5.2.3 Results of site-and-soil evaluation**5.2.3.1 Determination of soil category**

The evaluation process shall result in the collection of all relevant information on soil drainage, structure, texture, and indicative soil permeability of the soil that is required to filter, isolate, and absorb wastewater microorganisms, nutrients, and particles, in the soil absorption zone (see Appendix S). This information is then reviewed in accordance with Table 5.1 and is used to determine the soil category to be assigned for design purposes.

TABLE 5.1
DETERMINATION OF SOIL CATEGORY

Soil category (see Notes 1 and 2)	Soil texture	Structure	Indicative permeability (K_{sat}) (m/d) (see Note 2)
1	Gravels and sands	Structureless (Massive)	> 3.0
2	Sandy loams	Weakly structured Massive	> 3.0 1.4 – 3.0
3	Loams	High/moderate structured Weakly structured or massive	1.5 – 3.0 0.5 – 1.5
4	Clay loams	High/moderate structured Weakly structured Massive	0.5 – 1.5 0.12 – 0.5 0.06 – 0.12
5 (Note 3)	Light clays	Strongly structured Moderately structured Weakly structured or massive	0.12 – 0.5 0.06 – 0.12 < 0.06
6 (Note 3)	Medium to heavy clays	Strongly structured Moderately structured Weakly structured or massive	0.06 – 0.5 < 0.06 < 0.06

NOTES:

- 1 Soil category determination shall take into account the soil horizons within the depth range into which effluent is absorbed (see 5.2.3). Figure B1 may be used to report on the overall soil category determined from the inspection of the individual soil layers. Table E1 should be used to assist in determining soil category from soil texture assessment.
- 2 The values of indicative permeability K_{sat} are based on the movement of water, not effluent, through the soil. They are estimates only and shall be used with caution in assisting the determination of the soil category. In the field, soil permeability is strongly influenced by the presence of biological channels such as old root holes, termite, ant and worm passages, as well as shrinkage cracks, and not merely by soil texture. A virgin clay-based soil under native bush could easily be ten times as permeable as the same soil under frequent cultivation or compacted by heavy traffic. More accurate estimates for effluent K_{sat} values may be obtained by modifying the characteristics of the test water to better match that of effluent, particularly the salt composition. See Appendices F and G.
- 3 For clay-dominated soils having dispersive (sodic) or shrink/swell behaviour, specialist soil advice and special design techniques will be required to enable their use for land application systems. Generally these soils will have very poor soil drainage.

C5.2.3.1

The soil category, along with any specific site-and-soil limitations that have significance, will determine whether on-site land application systems are feasible and will lead to the selection and design of the overall on-site system.

The soil category should be based on the assessment of physical and chemical soil properties including texture, structure and porosity, structural stability and dispersiveness, soil colour, and soil drainage status for the most restrictive soil layer within the clearance depth set by the regulatory authority, and not the shallower soils within which the land application system is installed (see Note 1 of Table 5.1). Indicative soil permeability may be derived from these properties but where an unacceptable level of uncertainty exists the actual soil permeability is measured according to the method in Appendix G. The visual and manual assessment is often satisfactory with the younger soils of New Zealand but this method can produce significantly faulty results with the older soils of Australia.

This assessment should take account of maps and information on soil types in the local area where such data are available. Soil maps and land system maps as well as interpretative maps (land capability surveys) are available at various scales and levels of detail for many areas in Australia and New Zealand from government agencies such as Departments of Primary Industries and ought to be consulted. Specialist soils science advice on important soil properties is also often available from these bodies.

One of the most relevant and helpful texts for such soil assessments is McKenzie, Coughlan, Cresswell 2002.

5.2.3.2 Design loading/irrigation rate

The design loading/irrigation rate (DLR/DIR) shall be either selected from the tables in this Standard appropriate to the preferred land application system and determined soil category (see 5.5.5 and Appendices L to N), or determined and justified by other techniques allowed by this Standard.

C5.2.3.2

Tables L1, M1, and N1 assign DLR/DIR values to soil categories for the current most commonly used land application systems. Table 5.2 (see 5.5.5.1) summarises the DLR/DIR values as set out in Tables L1, M1, and N1.

In this Standard a conservative approach has been adopted in the determination of DLR/DIR. The DLR/DIR for each soil category is set lower than the corresponding estimated LTAR value.

5.2.4 Reporting

All information collected during the site evaluation process detailed in Appendix B shall be fully reported in a site-and-soil evaluation report and shall be available to the designer for inclusion in a design report (see 7.4.2).

C5.2.4

Example data report sheets for use in compiling the SSE report are:

- (a) *Soil-profile information and data sheet (Figure B1);*
- (b) *Site plan – Individual lot (Figure D1);*
- (c) *Site information sheet (Figure D2);*
- (d) *Site-and-soil evaluation form – Individual lot (Figure D3); and*
- (e) *Soil permeability field record sheet – Example (Figure G3).*

5.3 Design flow

The design flow used for sizing the wastewater treatment unit and land application area shall be based on Appendices H and J (which incorporate an allowance for peak water usage) and on peak occupancy numbers, unless otherwise determined by the relevant authority.

Land application systems shall be designed to suit the design wastewater flow from the premises concerned. This flow shall be determined from the equivalent population or number of bedrooms being served. The system shall also be able to store individual and cumulative peak daily flows, particularly when the weekly flow is being discharged over less than 7 days. Typical design flow allowances from premises producing domestic wastewater are given in Appendix H.

C5.3

Those factors which need to be considered in arriving at the design flow for sizing a land application area include:

- (a) *The number of bedrooms;*
- (b) *Average and peak occupancy;*
- (c) *Average and peak per capita wastewater volume;*
- (d) *Type of water supply and nature of water supply restrictions;*
- (e) *Type of water fixtures in the dwelling (such as water saving, or high water use);*
- (f) *Type of wastewater treatment system and land application system and the resilience of each to variable hydraulic loads;*
- (g) *Treated effluent quality as discharged to the land application area; and*
- (h) *The conditions of consent that can be applied by the regulatory authority, particularly for the operation, maintenance, and monitoring of the on-site system.*

5.4 Wastewater treatment units**5.4.1 Performance requirements for wastewater treatment units**

To meet the performance objectives for on-site systems, wastewater treatment units shall:

- (a) Be of sufficient capacity to receive and treat all wastewater outputs from premises on the property;
- (b) Produce effluent suitable for the land application system;
- (c) Avoid the likelihood of creating unpleasant odours, or the accumulation of offensive matter; and
- (d) Use minimal energy resources.

C5.4.1

Septic tank treatment units may be modified. For example, totally new components or systems may be devised for inclusion in the tank, or extra treatment stages added to further treat the tank effluent provided they are approved for use by the relevant authority.

In general, the modifications are made to:

- (a) *Reduce the amount of total suspended solids in the septic tank effluent being forwarded to the land application system, so that the system is more sustainable; and*
- (b) *Improve the overall quality of the effluent to reduce potential health and environmental effects.*

Wastewater treatment units may be based on or incorporate:

- (c) *As additions or modifications to septic tanks:*
 - (i) *Outlet filters*
 - (ii) *Two-stage or multiple-tank configurations*
 - (iii) *Gas-baffled outlet tees, and*
 - (iv) *Siphon or pump-dosing chamber(s) within the tank or within one of its stages (or chambers);*

The use of outlet filters is recommended for control of total suspended solids in effluent from septic tanks. Outlet filters may be retrofitted to existing septic tanks to improve their performance, provided the tank has sufficient capacity to retain additional solids and to avoid re-suspension of settled solids from influent plug flows. Where the tanks are under-sized for the daily flow, the filter may block more frequently. This is a strong indication that the tank is not performing as it is designed to retain solids, and, without a filter, it is likely the overflow of solids from the tank will lead to premature failure of the land application system. In such situations, a larger or additional tank should be installed.

- (d) *As an additional treatment stage (or stages) following the septic tank, or as stand-alone units:*
 - (i) *Aeration, clarification, and disinfection, for example, aerated wastewater treatment systems (AWTS)*
 - (ii) *Sand filters*
 - (iii) *Textile packed bed reactors*
 - (iv) *Submerged aerated filters*
 - (v) *Membrane bioreactors, and*
 - (vi) *Constructed wetlands (reed beds).*

System performance and design integrity of such additional treatment should be verified by an independent assessment, in accordance with the performance and design evaluation regimes in AS/NZS 1546.1 and AS/NZS 1546.3.

5.4.1.1 Capacity

On-site systems shall have adequate capacity for treating the flow of wastewater and have sufficient storage for the solids that build up before removal. Wastewater treatment units shall be able to:

- (a) Hold the normal flow of domestic wastes from design population equivalents up to a maximum of 10 persons, as specified for that treatment unit;
- (b) Allow for normal peak flows;
- (c) Allow for short-term unusual/overload production of wastes; and
- (d) Allow for sludge and scum to build up.

C5.4.1.1

The principles and practices outlined in this Standard can be applied to the design, installation, and management of systems exceeding the size limit expressed in 1.2.1.2. Implementation of such design, installation, and management requires advice from a suitably qualified and experienced person.

5.4.1.2 Structural design

Wastewater treatment units shall satisfy the structural performance requirements and criteria for wastewater treatment units in AS/NZS 1546.1.

5.4.1.3 Solids management

A risk management plan shall be drawn up when it is possible for untreated or partially treated solids to come into contact with people or animals.

5.4.1.4 Effluent quality and land application

The regulatory authorities shall be consulted for the environmental and land application criteria and effluent quality requirements relevant to the areas within their jurisdiction.

Systems that produce secondary or disinfected effluent shall be subject to specific design and sizing appropriate to their intended application. They shall be installed, constructed, operated, and maintained in accordance with the principles of AS/NZS 1546.3, and with the designer's and manufacturer's instructions, to meet the performance requirements of this Standard.

NOTE: See 5.4.2.5 for information on disinfected effluent quality.

C5.4.1.4

The ability of any particular environment to absorb effluent depends on many of the factors referred to in this Standard. Some areas will be able to accept a lower quality of effluent than others, the difference being based on constraints such as the proximity of the land application system to groundwater and surface water and the sensitivity of native vegetation to high levels of nutrients (particularly in Australia). Such constraints will be assessed through the risk management process. The resulting knowledge is local and so the setting of the criteria for the allowable quality of effluent to a land application system, clearances to groundwater and property boundaries and to control transport to groundwater is primarily the role of the local regulatory authority, through a consultation process with its community.

5.4.1.5 Alternative toilet systems

Any effluent or waste liquid such as urine or other drainage from an alternative toilet system shall be treated as blackwater and applied to land either separately, or in combination with greywater in accordance with this Standard. Any other treatment of waste liquid shall be in a manner that has the approval of public health authorities.

C5.4.1.5

Alternative toilet systems may include or incorporate dry-vault units using natural processes for the decomposition of the waste, or may treat the wastewater using physical, chemical, or biological means. Examples are the pit privy ('long drop' into sealed tank), displacement toilets ('septic closets'), waterless composting toilets, dehydrating toilets, incineration toilets, and chemical toilets. These may be the subject of separate Standards.

5.4.2 Performance criteria for wastewater treatment units

5.4.2.1 Design flow

Wastewater treatment units shall be of sufficient capacity to treat the peak wastewater flow generated by the facility being served (see 1.2.1.2 and Appendix J).

C5.4.2.1

The flow limit of up to 14 000 L/week in 1.2.1.2 represents a maximum flow for design purposes. This represents a flow of approximately 2000 L/day from up to 10 persons in a single residence, or for an institutional or commercial facility, which may have a varying 7-day or 5-day operation, the daily flow averaged over a full week. The criteria outlined in this clause may be applied to systems exceeding this flow limit, in which case a suitably qualified and experienced person needs to undertake the design.

5.4.2.2 Capacity of septic tanks

The capacity of primary treatment tanks shall be determined taking into consideration the recommended minimum capacities for all-waste, greywater and blackwater septic tanks shown in Appendix J, unless otherwise determined by the relevant authority.

C5.4.2.2

These minimum capacities are based on settling volumes of:

- (a) 200 L/person for all-waste tanks;
- (b) 60 L/person for blackwater tanks; and
- (c) 120 L/person for greywater tanks (to which is added a 33% flow buffer volume).

The 200 L/person for all-waste tanks represents the settling/treatment volume allowance within that unit. This is conservative to ensure that the unit has capacity to cope with peak discharge rates or for temporary or unusual overloads and includes no allowance for food waste disposal units (see 5.4.2.2.3).

5.4.2.2.1 Capacity requirements

The septic tanks shall be designed with sufficient capacity to:

- (a) Retain the average daily flow for at least 24 hours to settle the solids and float the scum effectively, so there is a clear zone at the level of the discharge outlet;
- (b) Store the accumulating sludge and scum (systems with food waste disposal units are not included – see 5.4.2.2.3) as follows:
 - (i) All-waste 80 L/person/year
 - (ii) Greywater 40 L/person/year
 - (iii) Blackwater 50 L/person/year;
- (b) Require sludge removal when sludge accumulation reduces settling volume below 24 hours retention, at no less than 3 – 5-year intervals; and
- (c) Maintain at least a 24-hour emergency storage volume above the high-water-level alarm sensor if the system has a pumped discharge to a land application area.

C5.4.2.2.1

This Standard adopts a conservative approach to sizing based on consideration of the current availability of improved community water supply, the use of modern appliances and facilities and on the assumption that water-conservation devices are not being used. The minimum recommended capacities for septic tanks based on the above criteria are given in Appendix J. However, in situations where there is a limited water supply or water-conserving devices are likely to be fully used, see 5.4.2.2.2.

Small septic tanks (less than 4500 litres) have reduced capacity for storage of solids and scum and require more frequent pumpouts to provide capacity to achieve an effective clear zone. The higher cost of installing a larger septic tank may be offset by a reduced pumpout frequency.

Pumpout frequency depends on the reliability of the accumulation rates set out in 5.4.2.2.1. Too frequent pumpout removes the microorganisms needed for degradation of wastewater solids. Where outlet filters are fitted to larger all-waste septic tanks, then pumpout intervals of up to 10 to 12 years can be acceptable (Bounds 1994), but this needs to be verified by annual monitoring of sludge and scum. The longer pumpout interval has beneficial implications for conservation of resources in that the volume of septage requiring treatment and disposal can be reduced significantly.

Where research results or monitoring experience provide reliable information on different accumulation rates to those cited above, such rates may be used in design subject to approval of the regulatory authority.

In cold climate conditions stabilisation and consolidation processes within the scum and sludge of a septic tank will be less active, and sludge accumulation rates may be such that more frequent pumpout is required. More frequent pumpout may also be required if food waste disposal units are installed, see C5.4.2.2.3.

5.4.2.2.2 Capacity of septic tanks – Restricted water supply

Minimum design capacities for septic tanks for use in areas with limited water supply such as remote area recreational facilities, mobile homes, and pensioner cottages shall be determined by:

- (a) Providing for 24-hours settling volume plus 8-hours hydraulic buffering volume for the daily flows from the design population equivalent;
- (b) Providing for scum and sludge accumulation over a 5-year period using the rates set out in 5.4.2.2.1; and
- (c) Monitoring of flows.

C5.4.2.2.2

A conservative approach is necessary if water supply is augmented or improved. Septic tank capacities may need to be increased or water reduction facilities installed.

5.4.2.2.3 Food waste disposal units

If food waste disposal units are to be used then the septic tank capacity and the land application system shall be subject to design by a suitably qualified and experienced person that takes into account the additional flows and loads generated.

C5.4.2.2.3

The installation and use of a food waste disposal unit will result in an increased accumulation of solids, organic materials, oils, and grease in the septic tank and higher concentrations of some contaminants in the effluent discharged to the land application system. Consequently, additional allowances need to be made for the design of the on-site system. See AS/NZS 1546.1 for further guidance.

5.4.2.3 Holding tanks

Holding tanks used to store domestic wastewater prior to pumpout and removal off-site are not covered by this Standard. Their sizing requirements shall be in accordance with local regulatory requirements. In all other ways, they shall comply with AS/NZS 1546.1.

5.4.2.4 Wastewater treatment units other than septic tanks

Performance criteria for wastewater treatment units other than septic tanks shall be based on relevant criteria from other appropriate Standards including AS/NZS 1546.1 for septic tanks and AS/NZS 1546.3 for secondary treatment units.

C5.4.2.4

AS/NZS 1546.1 specifies test methods for demonstrating compliance with watertightness, structural integrity, and resistance to loads. AS/NZS 1546.3 specifies test methods for demonstrating compliance with effluent quality criteria for secondary treatment by an AWTs. Test methods for other types of wastewater treatment units should conform to the principles underlying these.

5.4.2.5 Disinfection

Disinfection may be by addition of chlorine, ultra-violet light (UV), ozone, or other means.

Disinfection systems for secondary treated wastewater shall be designed to kill or inactivate pathogenic microorganisms to mitigate public health risks from direct or indirect human contact.

The disinfection system shall be used in accordance with local regulatory requirements wherever there is such a risk.

5.4.2.5.1 Performance criteria for disinfection

Performance criteria for disinfection shall be based on the criteria for disinfection treatment in AS/NZS 1546.3.

Details of apparatus, monitoring, and maintenance requirements of chlorination and UV systems are given in Appendix P. Ozone disinfection is not common and the details of the apparatus operation and maintenance need to be considered to ensure the *E. coli* criteria are consistently met.