



On-site domestic wastewater treatment units

Part 3: Secondary treatment systems



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 - Association of Rotational Moulders Australasia
 - Australian Building Codes Board
 - Australian Chamber of Commerce and Industry
 - Australian Industry Group
 - Australian Local Government Association
 - Australian Wastewater Treatment Association
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 - Independent Expert
 - Master Plumbers Australia
 - National Precast Concrete Association Australia
 - National Recycled Water Regulators Forum
 - NSW Ministry of Health
 - SA Health
 - University of Technology, Sydney
 - Victoria University
 - Waste Management Association of Australia
 - Water Services Association of Australia
-

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Australian Standard[®]

On-site domestic wastewater treatment units

Part 3: Secondary treatment systems

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PREFACE

This Standard was prepared by the Standards Australia Committee WS-040, On-site Domestic Wastewater Treatment, to supersede AS/NZS 1546.3:2008, *On-site domestic wastewater treatment units, Part 3: Aerated wastewater treatment systems*.

This Standard incorporates Amendment No. 1 (December 2018). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to set out requirements for the design, commissioning, performance and compliance testing of secondary treatment systems and advanced secondary treatment systems (STS) designed to treat domestic wastewater. The design hydraulic treatment capacities that may be tested in accordance with this Standard range from a minimum of 1200 L/d to a maximum of 5000 L/d. Guidance on installation, operation and maintenance is also provided.

This Standard is part of the AS/(NZS) 1546 series for on-site domestic wastewater treatment units, as follows:

AS

- 1546 On-site domestic wastewater treatment units
- 1546.3 Part 3: Secondary treatment systems (this Standard)
- 1546.4 Part 4: Domestic greywater treatment systems

AS/NZS

- 1546.1 Part 1: Septic tanks
- 1546.2 Part 2: Waterless composting toilets

In this revision, the scope of the standard has been broadened to include all types of secondary treatment systems; the design requirements have been reviewed for clarity; terms and definitions have been updated to reflect current practice; and the testing regime has been made more stringent and specified in greater detail to ensure uniformity and reproducibility in testing, and to be in alignment with international best practice.

This Standard includes Commentary on some of the Clauses. The Commentary directly follows the relevant Clause, is designated by 'C' preceding the Clause number and is printed in italics in a box. The Commentary is for information and guidance and does not form part of the Standard.

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 a mandatory part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in Notes to Figures and Tables are deemed to be requirements of this Standard.

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STANDARDS AUSTRALIA

Australian Standard

On-site domestic wastewater treatment units

Part 3: Secondary treatment systems

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE OF STANDARD

This Standard sets out requirements for the design, commissioning, performance and conformity testing of secondary treatment systems (STS) and advanced secondary treatment systems (see Note 1) designed to treat domestic wastewater. The design hydraulic treatment capacities that may be tested in accordance with this Standard range from a minimum of 1200 L/d to a maximum of 5000 L/d. Guidance on installation, operation and maintenance is also provided.

NOTES:

- 1 Secondary treatment systems and advanced secondary treatment systems are collectively abbreviated to 'STS'.
- 2 State regulators may set a minimum or maximum daily hydraulic capacity for treatment systems.

1.2 INCLUSIONS

STSs covered by this Standard are those designed to treat maximum domestic wastewater flows of between 1200 L/d and 5000 L/d to secondary or advanced secondary water quality standard (see Tables 2.1 and 2.2).

Treatment may be by physical, chemical and/or biological processes and technologies, and typically includes primary settlement, aeration, filtration, clarification and disinfection. Treatment processes may also use extended aeration-activated sludge, biofiltration, rotating biological contact, sand filtration, reed bed, trickling filters and any other treatment technologies.

This Standard provides testing requirements for all types of STSs. All models of STS that claim to conform with this Standard are to be tested using the testing requirements in this Standard. STSs that are tested on the basis of alternative test protocols, or use theoretical calculations or modelling of larger or smaller sized systems cannot claim to conform with this Standard.

STSs that meet the product conformity requirements in this Standard shall be available, for retail sale, as a standardized manufactured unit assembled either in a factory or in the field.

1.3 EXCLUSIONS

This Standard does not cover the following:

- (a) Sanitary plumbing and drainage systems conveying domestic wastewater to or from the STS.
- (b) Treatment systems for toilet amenity blocks, single toilets (with or without hand basins) or urinals.

- (c) Treatment systems for non-domestic wastewater (e.g. commercial wastewater, industrial wastewater or trade waste).
- (d) Greywater treatment systems (refer to AS 1546.4 for performance evaluation protocol for greywater treatment systems).
- (e) Treatment of spa pool and swimming pool water.
- (f) Indoor reuse of treated wastewater (e.g. for toilet flushing, clothes washing machines).

1.4 OBJECTIVES

The objectives of this Standard are to provide:

- (a) Performance requirements to be met by an STS.
- (b) Performance evaluation tests against which any conventional or innovative STS may be assessed.
- (c) Basic design criteria for an STS that will enable it to be tested for conformity to this Standard.
- (d) For purchasers of an STS, a basis for confidence that the system will perform in accordance with the product specifications.

1.5 INTERPRETATION

The word 'shall' indicates that a statement is mandatory.

The word 'should' indicates a recommendation.

1.6 APPLICATION

1.6.1 General

This Standard is intended for use by testing bodies, conformity assessment bodies, designers, manufacturers, suppliers, consultants, regulators, installers and service technicians.

1.6.2 Nutrients

An STS may not significantly reduce nutrients such as nitrogen and phosphorus unless specifically designed for that purpose. An STS that is specifically designed to reduce the concentration of nitrogen and/or phosphorus in the final effluent, shall comply with Tables 2.2 and 2.6 in Section 2 and Appendix A.

1.6.3 Legislation

This Standard is to be read in conjunction with the legislative instruments, by-laws, regulations, and policies of the regulatory authorities in the jurisdictions of Australia. The approval of a secondary treatment plant type and model, and approval for the installation of an individual secondary treatment system, including the method of treated effluent end use, is the responsibility of the relevant regulatory authorities.

1.7 NORMATIVE REFERENCES

The following are normative documents referenced in this Standard.

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

1546 On-site domestic wastewater treatment units

1546.4 Part 4: Domestic greywater treatment systems

AS/NZS

1546 On-site domestic wastewater treatment units

1546.1 Part 1: Septic tanks

1547 On-site domestic wastewater management

3500 Plumbing and drainage

3500.0 Part 0: Glossary of terms

3500.1 Part 1: Water services

3500.2 Part 2: Sanitary plumbing and drainage

American Public Health Association (APHA), *Standard Methods for Examination of Water and Wastewater*, 22nd edition, 2012

Australian Building Codes Board, National Construction Code (including Plumbing Code of Australia)

1.8 DEFINITIONS

For the purpose of this Standard the definitions given in AS/NZS 1547, AS/NZS 3500.0 and those below apply.

1.8.1 Advanced secondary treatment system

A wastewater treatment system which produces treated effluent of advanced secondary standard, i.e. ≤ 10 mg/L of BOD₅, ≤ 10 mg/L of TSS and ≤ 10 cfu/100 mL of *E. coli* (as specified in Table 2.1).

1.8.2 Aerobic action

A biological process undertaken by the action of bacteria in the presence of dissolved oxygen.

1.8.3 Biochemical oxygen demand (BOD₅)

The amount of dissolved oxygen consumed by microbiological action and chemical processes when a sample of liquid is incubated over five days at 20°C. The result is expressed in milligrams per litre (mg/L).

1.8.4 Commercial wastewater

Wastewater generated by shops, restaurants, cafés, hotels, motels, bed and breakfast accommodation, medical centres and similar premises, but excluding industrial wastewater.

1.8.5 Desludging

Removal of sludge and scum, known as septage, typically from a primary treatment tank or chamber, but may also be removed from secondary treatment chambers.

1.8.6 Disinfection

The treatment of wastewater to reduce pathogen concentrations through die-off or inactivation.

1.8.7 Domestic wastewater

Wastewater originating from household fixtures such as toilets, urinals, kitchens, bathrooms (including shower, washbasins, baths, spa baths, but excluding spa pools) and laundries; and wastewater flows from facilities serving staff, employees and residents in institutional, commercial, and industrial establishments, but excluding commercial and industrial wastewaters, large-scale laundry activities, and stormwater flows.

1.8.8 Domestic-scale treatment system

A system designed to treat ≤ 3000 L/d of wastewater generated by a domestic premises.

1.8.9 Effluent

Liquid discharged from or flowing out of a chamber, tank or vessel, generally after undergoing treatment.

1.8.10 *Escherichia coli* (*E. coli*)

A gram-negative, facultative-anaerobic, rod-shaped bacterium, measured in colony forming units (cfu)/100 mL. Commonly found in the lower intestine of warm-blooded animals, it is a member of the faecal coliform group of bacteria. Its presence in water is indicative of recent faecal contamination and is a crude measure of the effectiveness of disinfection.

1.8.11 Free available chlorine (FAC)

The concentration of free residual chlorine present as dissolved gas, hypochlorous acid or hypochlorite in water, and not combined with ammonium or organic material in other less readily available forms.

1.8.12 Greywater

Domestic wastewater from a bath, shower, hand basin, kitchen sink, spa bath, dishwasher, clothes washing machine, and/or laundry tub (excluding spa pool, toilet and urinal wastewater).

1.8.13 Gross solids

Solids in wastewater captured by a 6 mm mesh screen (i.e. solids >6 mm in two dimensions).

1.8.14 Hydraulic retention time (HRT)

The average time that a specified volume of fresh wastewater is retained within the influent collection tank, measured in hours.

1.8.15 Influent

Influent in this Standard refers to wastewater that flows into a chamber, tank or vessel of a wastewater treatment system before treatment.

1.8.16 Laboratory

A facility that carries out analytical testing and fulfils the requirements of AS ISO/IEC 17025—2005.

1.8.17 Land application system

An area of land used for the application of final effluent from an STS (refer to AS/NZS 1547).

1.8.18 Large-scale treatment system

A large onsite domestic wastewater treatment system designed to treat a greater volume of wastewater (i.e. >3000 L/d) than is typically generated by a single domestic household.

1.8.19 Manufacturer

Any person, company or firm and any nominated representative of the company or firm that manufactures or assembles an STS.

1.8.20 Nephelometric turbidity unit (NTU)

Turbidity (or clarity) of water assessed by passing a beam of light through the sample and measuring the scatter of that light.

1.8.21 On-site (treatment) system

A wastewater treatment system located on the premises where the wastewater is generated. An onsite wastewater treatment system may be small or large.

1.8.22 Pathogen

A microorganism capable of causing or likely to cause disease.

1.8.23 Performance criteria

Qualitative or quantitative measures or limits which indicate attainment of the performance requirements (see Tables 2.1 and 2.2).

1.8.24 Performance objectives

The design requirements, performance and effluent quality results required for the STS to be acceptable.

1.8.25 Performance requirements

The functions that an STS has to perform and tests that it has to undergo to verify that the STS can operate as defined by performance criteria.

1.8.26 pH

A number expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acidic and higher values more alkaline. The pH is equal to $-\log_{10}[\text{H}^+]$, where $[\text{H}^+]$ is the hydrogen ion concentration in moles per litre.

1.8.27 Premises

An allotment of land including any building situated on it.

1.8.28 Primary treatment

The separation of suspended material from wastewater by settlement and/or flotation in septic tanks, primary settling chambers, or other structures. In addition to physical separation of solids from liquid, the solids may be decomposed by aerobic or anaerobic microbiological processes and digestion (e.g. anaerobic sludge digestion).

1.8.29 Reedbeds

A sub-surface flow, trickling-filter secondary wastewater treatment system consisting of horizontal layers of particulate material, such as sand and gravel, with macrophytes (generally reeds) planted in the surface layer, following a primary treatment system. Primary treated wastewater is intermittently dosed into pipes in the reedbed which distribute the flows through the media layers before the wastewater is disinfected and flows into the effluent storage chamber.

1.8.30 Regulatory authority

A state, territory or local government department, agency, body, entity or council empowered by statute to control the installation, operation and/or acceptance of STS.

1.8.31 Sand filter

A sub-surface flow, trickling-filter secondary wastewater treatment system consisting of horizontal layers sand, gravel and/or other particulate media, following a primary treatment system. After primary treatment, wastewater is intermittently disbursed through pipes and flows through the filter layers once (i.e. a 'single pass') or is recirculated, before being disinfected and flowing into an effluent storage chamber.

1.8.32 Scum

Floating mass of wastewater solids buoyed by gas, grease and other matter less dense than water which forms a layer on the surface of the wastewater in the primary treatment tank or chamber.

1.8.33 Secondary treatment

Microbiological digestion and physical settling and filtering processes and decomposition of wastewater constituents following primary treatment.

1.8.34 Secondary treatment system (STS)

A wastewater treatment system which produces treated effluent of secondary standard, i.e. ≤ 20 mg/L of BOD₅, ≤ 30 mg/L of TSS and ≤ 10 cfu/100 mL of *E. coli* (as specified in Table 2.1).

1.8.35 Service life

The period of time during which an STS performs satisfactorily when routinely maintained. The service life expires when routine maintenance no longer facilitates satisfactory performance and the effluent is deemed non-compliant.

1.8.36 Shall

Indicates that a statement is mandatory.

1.8.37 Should

Indicates a recommendation.

1.8.38 Sludge

The semi-liquid solids settled from wastewater.

1.8.39 Spa bath

A domestic bath complying with AS 2023—1995, *Baths for ablutionary purposes*, fitted with air jets to aerate the bath water.

1.8.40 Spa pool

A public or private pool complying with AS 2610.1—2007, *Spa pools*, Part 1: *Public spas* or AS 2610.2—2007, *Spa pools*, Part 2: *Private spas*, and fitted with air jets to aerate the water.

1.8.41 Specification

Technical documentation that provides critical defining information about an STS, disinfection unit and nutrient reduction facilities including material specifications, system process design, design drawings, installation, operation and servicing manuals and component data sheets (also known as 'spec. sheets').

NOTE: The manufacturer usually produces the specifications for an STS.

1.8.42 Steady-state

Condition where the STS is producing effluent quality that consistently meets effluent compliance criteria and is not subject to any loading from a stress test, as detailed in this Standard.

1.8.43 Supplier

The party that provides a treatment system for testing to determine whether it meets and, if applicable, continues to meet, the requirements of this Standard.

NOTE: A supplier may be the manufacturer of the treatment system.

1.8.44 Test STS

A representative example of a specific model of STS, including all associated fittings, selected to undergo type testing in accordance with Appendix A in order to demonstrate conformity to this Standard.

1.8.45 Testing facility

Premises with a source of fresh domestic wastewater (i.e. maximum transport time ≤ 6 h), personnel and operational equipment for performance evaluation testing in accordance with this Standard.

1.8.46 Total suspended solids (TSS)

The concentration of solids suspended in water, expressed in mg/L.

1.8.47 Trade waste

Industrial wastewater including commercial-scale laundries.

1.8.48 Transmissivity

The degree to which water allows UV light radiation to pass through it.

1.8.49 Type test

A test, conducted in accordance with all the requirements of a product standard, intended to demonstrate the performance of the design, configuration or modification of a product.

1.8.50 Ultraviolet light intensity (UVI)

The light energy exposure per unit area perpendicular to the direction of flow of water through the ultraviolet disinfection system, measured in millijoules per square centimetre (mJ/cm^2).

1.8.51 Ultraviolet light (UV)

Electro-magnetic radiation with a wavelength shorter than that of visible light, but longer than X-rays, i.e. in the range between 100 nm and 400 nm.

1.8.52 Ultraviolet light transmittance (UVT)

The fraction of incident light at wavelength 254 nm remaining after passage through a 1.0 cm path length of a sample of water, reported as a percentage.

1.8.53 Wastewater

See 'domestic wastewater'.

1.8.54 Water meter

A device used to measure and record the rate of flow of water through a pipe or channel in L/min, L/hr and L/d.

1.8.55 Watertight

Condition which will not allow liquid to leak from or into a tank, chamber or component of an STS.

1.9 TEST REQUIREMENTS**1.9.1 General**

The test requirements included in this Standard are for new and modified STSs.

1.9.2 Test STS for assessment of compliance with this Standard

To demonstrate conformity with the performance requirements of this Standard, one example of each model and size (rated capacity) of STS, including all associated fittings, shall be tested according to the requirements of Appendix A. The model of STS is referred to throughout this document as the test STS. The test STS shall be a representative example of the design model.

1.10 ABBREVIATIONS

The following abbreviations are used in this Standard:

AWTS	Aerated wastewater treatment system
BOD ₅	Biochemical oxygen demand (five days)
CAB	Conformity assessment body
cfu	Colony forming unit
FAC	Free available chlorine
HRT	Hydraulic retention time
JAS-ANZ	Joint Accreditation System of Australia and New Zealand
L	Litre
L _{eq}	Equivalent continuous A-weighted sound pressure level
mg	Milligram
NATA	National Association of Testing Authorities, Australia
NCC	National Construction Code
nm	Nanometre
NTU	Nephelometric turbidity unit
STP	Sewage treatment plant
STS	Secondary treatment system or an advanced secondary treatment system
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
UV	Ultraviolet light
UVI	Ultraviolet intensity
UVT	Ultraviolet transmissivity

SECTION 2 PERFORMANCE CRITERIA AND DESIGN REQUIREMENTS

2.1 SCOPE OF SECTION

This Section specifies the function, performance criteria, design requirements and installation, operation and maintenance requirements for secondary and advanced secondary treatment systems.

2.2 PERFORMANCE CRITERIA

2.2.1 General

The function of an STS is to treat domestic wastewater using specific processes to produce effluent to a quality specified in Clause 2.2.2. To conform to this Standard, the STS shall meet the performance and effluent compliance criteria for one of the following wastewater treatment levels:

- (a) Secondary quality.
- (b) Secondary quality with nutrient reduction capability.
- (c) Advanced secondary quality.
- (d) Advanced secondary quality with nutrient reduction capability.

C2.2.1 *Advanced secondary quality effluent may be required by the regulatory authority for land application systems where the risk to public health and/or the environment is considered high by the regulator. An STS with nutrient reduction capability may be required by the regulatory authority in areas where there are ecosystems sensitive to high concentrations of nutrients.*

2.2.2 Effluent compliance criteria

The following tables detail the performance compliance criteria to be tested in accordance with Paragraphs A5.6, A5.7, A5.8 and A5.9:

Table 2.1: Secondary or advanced secondary effluent quality criteria for an STS with no nutrient reduction facilities.

Table 2.2: Secondary or advanced secondary effluent quality criteria for an STS with nutrient reduction facilities.

Table 2.3: Parameters for assessing secondary or advanced secondary effluent quality.

Table 2.4: Optional water quality parameters for assessing membrane treatment systems and UV disinfection units.

Table 2.5: Operating parameters to be measured and reported on.

Table 2.6: Parameters for assessing nutrient reduction capability.

Where the supplier has decided to have an STS assessed for nutrient reduction capability, the influent and effluent shall be sampled and tested for the effluent compliance criteria in Table 2.2 and the nutrient parameters in Table 2.6, concurrently with the testing regime in Tables A5 and A6.

A1

TABLE 2.1
EFFLUENT COMPLIANCE CRITERIA FOR AN STS WITH NO NUTRIENT REDUCTION FACILITIES

Parameter	Secondary effluent		Advanced secondary effluent	
	90% of samples	Maximum	90% of samples	Maximum
BOD ₅	≤ 20 mg/L	30 mg/L	≤ 10 mg/L	20 mg/L
TSS	≤ 30 mg/L	45 mg/L	≤ 10 mg/L	20 mg/L
<i>E. coli</i> *	≤ 10 cfu/100 mL	30 cfu/100 mL	≤ 10 cfu/100 mL	30 cfu/100 mL
FAC †	Minimum 0.5 mg/L ‡	N/A	Minimum 0.5 mg/L ‡	N/A
Turbidity §	N/A	N/A	N/A	10 NTU

* Where disinfection is required.

† Where chlorine disinfection is used.

‡ Minimum level, not 90% of samples.

§ Where UV light is used for disinfection (see Paragraph B3.1).

TABLE 2.2
EFFLUENT COMPLIANCE CRITERIA FOR AN STS WITH NUTRIENT REDUCTION FACILITIES

Parameter	Secondary effluent with reduced nutrients		Advanced secondary effluent with reduced nutrients	
	90% of samples	Maximum	90% of samples	Maximum
BOD ₅	≤ 20 mg/L	30 mg/L	≤ 10 mg/L	20 mg/L
TSS	≤ 30 mg/L	45 mg/L	≤ 10 mg/L	20 mg/L
<i>E. coli</i> *	≤ 10 cfu/100 mL	30 cfu/100 mL	≤ 10 cfu/100 mL	30 cfu/100 mL
FAC †	Minimum 0.5 mg/L ‡	N/A	Minimum 0.5 mg/L ‡	N/A
Turbidity §	N/A	N/A	N/A	10 NTU
Total N	N/A	15 mg/L	N/A	15 mg/L
Total P	N/A	2 mg/L	N/A	2 mg/L

* Where disinfection is required.

† Where chlorine disinfection is used.

‡ Minimum level, not 90% of samples.

§ Where UV light is used for disinfection (see Paragraph B3.1).

|| In alignment with NZ OSET NTP 'A grade' nutrient reduction capabilities.

C2.2.2 Free available chlorine (FAC) is used as the measure of disinfection in preference to total chlorine. Consider the following equation:

$$\text{Total chlorine} = \text{combined chlorine} + \text{FAC}$$

FAC is the active disinfectant and can be measured directly. However, combined chlorine disinfects about 60 times less effectively and cannot be measured directly. While total chlorine can be measured directly, it contains combined chlorine and its measurement does not reflect disinfection effectiveness accurately.

The chlorine disinfection device should be capable of producing at least 0.5 mg/L FAC in secondary treated effluent before the water flows into the effluent storage chamber. The timing of sampling for FAC should correlate with inflow of wastewater into the STS, i.e. the FAC sample should be collected within the number of minutes specified by the supplier which correlates with liquid flowing through the STS.

TABLE 2.3
WATER QUALITY PARAMETERS TO BE TESTED
AND MEASURED (see Paragraph A5)

Parameter to be tested	Sample type	Number of samples	
		Influent	Effluent
BOD ₅	24 h composite	41	41
<i>E. coli</i>	Grab	—	41
Free available chlorine (FAC) or turbidity (where applicable)	Grab	—	41
pH	Grab	41	41
TSS	24 h composite	41	41
Total = 328		123	205

TABLE 2.4
OPTIONAL WATER QUALITY PARAMETERS
TO BE TESTED (see Paragraph A5)

Parameter to be tested	Sample type	Number of samples	
		Influent	Effluent
Fats, oils and grease	24 h composite	41	—
Surface film—oil/foam (observation)	Grab	—	41
Dissolved oxygen (DO)	Hand-held probe	41*	

* Where the STS incorporates an aeration tank, the DO in the wastewater in the aeration chamber is to be measured with a hand-held probe within five minutes of the blower being switched off (not the final effluent chamber).

TABLE 2.5
OPERATING PARAMETERS TO BE MEASURED
OR LOGGED AND REPORTED

Parameter	Test type and frequency of measurement
Air temperature	Daily minimum and maximum on-site temperatures
Electricity	kWh/d and kWh/1000 L
Flow rate	L/min, L/h and L/day
Water temperature	Test the temperature of the influent and the liquid in the middle of the aeration tank or main treatment tank/reactor with a thermometer when the effluent is sampled

2.2.3 Nutrient reduction testing (where specified by the supplier)

Where an STS is specifically designed to reduce the concentration of nitrogen and/or phosphorus in the final effluent, the supplier shall select the nutrients to be tested from the parameters in Table 2.6. The specified nutrient(s) tests shall be sampled via 24-hour composite sampling for each of the steady-state and stress tests in conjunction with the BOD and TSS sampling in accordance with Appendix A. The nutrient test results and reporting shall include the minimum, maximum and median results, and shall not include an average of the nutrient results.

TABLE 2.6
NUTRIENT PARAMETERS TO BE TESTED

Parameter	Sample type	Number of samples	
		Influent	Effluent
Total nitrogen	24 h composite	41	41
Total phosphorus	24 h composite	41	41
Free ammonia NH ₄ -N	24 h composite	0	41

2.3 DESIGN REQUIREMENTS

2.3.1 Design parameters

The STS shall be designed to perform on premises under the following parameters when the premises are occupied:

- (a) A minimum daily flow of 150 L per person.
- (b) Average daily BOD₅—70 g per person (460 mg/L).
- (c) Daily BOD₅ range—150 mg/L to 750 mg/L.
- (d) Average daily total suspended solids (TSS)—70 g per person (460 mg/L).
- (e) Daily TSS range—150 mg/L to 750 mg/L.
- (f) Average daily total nitrogen—15 g per person (100 mg/L).
- (g) Daily total nitrogen range—20 mg/L to 150 mg/L.
- (h) Average daily total phosphorus—2.5 g per person (17 mg/L).
- (i) Daily total phosphorous range—4 mg/L to 25 mg/L.
- (j) An average annual sludge and scum loading rate of 80 L/person.

NOTE: Refer to Metcalf and Eddy (Ed.), Wastewater Engineering, 2014.

2.3.2 Design considerations

The STS shall be designed to—

- (a) provide adequate tank, vessel and chamber capacity for the design wastewater flow, storage of solids and frequency of discharge to a land application system;
 - (b) where primary treatment is one of the treatment processes, provide a minimum capacity within the primary treatment chamber(s) or tank(s) equal to the daily design hydraulic capacity of the STS, and any additional hydraulic, sludge and scum capacity where required by a State or Territory regulatory authority;
 - (c) operate effectively during normal, intermittent and peak flow and load conditions;
 - (d) ensure there is no cross-contamination or short-circuiting of wastewater between the primary treatment chambers and the effluent storage chamber or tank;
 - (e) ensure there is no ponding on the surface of an STS contained in a basin or open box structure and not contained in a tank;
 - (f) provide, where required, a disinfection unit designed in accordance with Clause 2.3.12 and Appendix B;
 - (g) avoid foul air and explosive gases (e.g. hydrogen from electrolysis equipment) accumulating within the system or entering buildings;
 - (h) provide easy and safe access to all tanks, vessels and chambers for maintenance, sludge measurement, desludging, pumping out, clearing of blockages and pipes, sampling wastewater and where applicable, membrane replacement and maintenance of effluent filters, reedbed vegetation and treatment filters;
 - (i) prevent children from gaining access into tanks;
 - (j) perform for the specified service life if maintained in accordance with the manufacturer's operation and maintenance procedures;
- NOTE: See Appendix D.
- (k) provide an effluent storage chamber that permits an effluent pump to be easily installed, maintained and replaced;
 - (l) ensure that the entire structure and its associated inspection and access covers and/or extensions, are integrally sound in accordance with AS/NZS 1546.1;
 - (m) prevent the entry of roots, stormwater and groundwater into the STS;
 - (n) prevent vermin and insects, such as mosquitoes, which may carry disease from entering the STS;
 - (o) prevent damage from superimposed loads or normal ground movement, in accordance with AS/NZS 1546.1;
 - (p) provide insulation against high and/or low temperatures of water and ambient air appropriate for the local climate; and
 - (q) be installed and operated in a manner that is safe and efficient for the installer, the owner, the operator and the environment, such as is set out in AS/NZS 1547 and Appendices C and D.

In addition to Items (a) to (p) above:

- (i) Aerated wastewater treatment systems shall be designed to—
 - (A) aerate wastewater, ensure the air is evenly distributed throughout the water and that the contents of the chamber are well mixed; and

- (B) minimize the deposition of sludge in the aeration chamber, so that sludge does not impede the working of the diffuser.
- (ii) Reedbed, sand filter, bio-filter and multi-media treatment systems shall be designed to ensure—
 - (A) the base, sides and lid of the wastewater distribution box are solid and wastewater can only be discharged from the box via the distribution pipes inserted and sealed into the sides of the box;
 - (B) there is no possibility of wastewater short-circuiting between the sand and liner;
 - (C) there is no possibility of water ponding on the surface of the media; and
 - (D) the liner cannot be punctured by any media layer or equipment.

2.3.3 Temperature range

The STS specification shall nominate the range of ambient air temperatures, influent and wastewater treatment temperatures for which the STS is designed to operate when it is fully buried, partially buried and installed above-ground.

C2.3.3 *Temperature affects all biological processes in wastewater treatment systems. Biological oxidation rates in water peak at around 35°C for most treatment systems whilst temperatures below 15°C adversely affect the performance of biological processes, in particular, nitrification (Crites and Tchobanoglous, 1998).*

Although ambient temperature does not have a direct influence in the design and performance of wastewater treatment systems it may have an influence on the temperature of the water in the treatment chamber(s) due to the system configuration and water storage capacity. Therefore, in the development process of the STS design, including engineering of mechanical systems for the STS, the design process should evaluate the influence of temperature variations and climatic conditions on the influent and the water in the main treatment chamber and mechanical systems for their possible effect on the biological system. This evaluation should use data from different seasons of the year taking into account local weather data, the storage volume of the tanks, materials of construction for the STS, as well as the energy (heat) input to the overall process through aeration or mixing.

Recording the ambient air, influent and main treatment chamber water temperatures during testing in winter will assist in verifying whether the ambient air temperature has any detrimental influence on the performance of the STS due to heat loss resulting from the system's design and configuration.

Where the temperature of the liquid in the aeration tank or main treatment chamber is below 15°C or above 35°C and the system is not achieving secondary effluent quality during testing, the sides and/or lid of the tank(s) should be insulated.

2.3.4 Tanks and fittings

The tank(s) and associated fittings, partitions and baffle walls and riser extensions comprising the STS shall be constructed of durable materials, be structurally sound, corrosion resistant and be fit-for-purpose to achieve the minimum service life of 15 years in accordance with AS/NZS 1546.1. The tank(s), including access risers, shall be watertight and capable of withstanding loads and stresses imposed on the roof and walls during handling, installation, maintenance, desludging and daily use.

Internal walls and baffles shall be constructed of durable materials, be structurally sound, securely fastened together and shall not deform or crack under a load. Materials used in the construction of the tanks and internal walls shall be minimally reactive to wastewater, chlorine and ozone residuals.