Code of Practice for Wastewater Management

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Disclaimer

The information provided in the Code of Practice for Wastewater Management (the Code) is general only and is based upon requirements for the design, installation and management of wastewater management systems in the Northern Territory.

The Code and the information herein does not in any part act as an approval to install a wastewater management system.

The Northern Territory Government accepts no liability for costs or damages to any person or property resulting from the application of the Code.

Contents

Acronyms

Acronyms	Full form
AEP	Annual exceedance probability
AS/NZS	Australia/New Zealand Standards
AWTS	Aerated wastewater treatment system
BOD	Biochemical oxygen demand
CEDS	Common effluent drainage system
CFU	Colony forming unit
COD	Chemical oxygen demand
CWMS	Community wastewater management system
DCMC	Department of Chief Minister and Cabinet*
DEPWS	Department of Environment, Parks and Water Security*
DGTS	Domestic greywater treatment system
DIPL-BAS	Department of Infrastructure, Planning and Logistics – Building Advisory Services*
DIR	Design irrigation rate
DLR	Design loading rate
DoH	Department of Health*
DRP	Dissolved reactive phosphorous
EP	Equivalent persons
ETA	Evapotranspiration-absorption
FOG	Fats, oils and grease
GDD	Greywater diverter device
Ksat	Saturated soil permeability measure (expressed in mm/day)
LPED	Low pressure effluent distribution
MBBR	Moving bed biofilm bioreactor
MBR	Membrane bioreactor
N	Nitrogen
NH_4	Ammonia
NH_4-N	Ammoniacal nitrogen
Nitrate	NO_3

Acronyms	Full form
NT	Northern Territory
NTU	Nephelometric turbidity unit
OWMS	On-site wastewater management system
P	Phosphorous
PCA	Plumbing Code of Australia
PWC	Power and Water Corporation*
RV	Recreational Vehicle
STEDS	Septic tank effluent drainage scheme
STS	Secondary treatment system
SSE	Site-and-soil evaluation
TDS	Total dissolved solids
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TSS	Total suspended solids
UV	Ultraviolet
VIP	Ventilated improvement pit
WC	Water closet
WELS	Water Efficiency Labelling Scheme
WPZ	Wellhead protection zone (managed by PWC)
WMS	Wastewater management system

* These titles may change from time to time

Definitions

Definitions	Full form
Absorption	Uptake of sewage effluent or sullage or both into the soil by infiltration or capillary action.
Absorption trench/area	A system that uses the principle of absorption, which is limited to soil with good but not excessive permeability, i.e. between 2 mm/hour to 100 mm/hr or 0.05 metres/day (m/d) and 0.6 m/d.
Activated sludge process	A biological wastewater treatment process by which biologically active sludge (concentrated biomass) is agitated and aerated with incoming wastewater. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by settlement, and most of it is returned to the process. The treated effluent is then discharged to a land application area.
Adsorption	Physical or chemical attachment of substances to the surface of soil particles.
Advanced secondary treatment	Aerobic biological treatment process, including settling and/or filtering of wastewater. Advanced secondary treated wastewater is expected to be equal to or better than 15 g/m^3 5-day biochemical oxygen demand and 15 g/m^3 suspended solids. Higher quality (such as 10 g/m^3 and 10 g/m^3 respectively or better), may be required as a risk reduction measure in situations where a higher level of environmental protection is required. Wastewater treatment units that can provide advanced secondary treatment are predominantly sand filters, advanced textile filters and packed bed reactors. Some high performing, stabilised and closely monitored aerobic treatment plants (refer AWTS) can also achieve the same discharge quality.
Advanced tertiary treatment	Further treatment of secondary effluent by nutrient reduction and disinfection.
Aerated wastewater treatment system (AWTS)	A wastewater system that uses the processes of aeration following clarification to achieve secondary (biological) treatment of wastewater.
Aerobic	Having molecular oxygen as part of the environment, or growing/occurring only in the presence of molecular oxygen (as in “aerobic organisms”).
Anaerobic	Characterised by the absence of molecular oxygen, or growing in the absence of molecular oxygen (as in “anaerobic bacteria”).
Backflow	The undesirable reversal of water flow from private plumbing back into the public water supply system.
Biomass	A film of biological matter on the contact surface of the soil in a soakage system.
Blackwater	Liquid or solid human body waste and the carriage waters generated through toilet usage.
Biochemical Oxygen Demand	The Biochemical Oxygen Demand of sewage and other polluted waters which is a measure of the organic content in terms of oxygen required for bacterial oxidation. The standard test measures oxygen used in 5 days at 20°C (BOD_5)

Definitions	Full form
Chlorination	The addition of chlorine releasing compounds to the treated effluent for the purpose of disinfection.
Combined chlorine	Chlorine that is combined with ammonia and other organic compounds containing nitrogen to form chloramines thus reducing its effectiveness as a disinfectant.
Community wastewater management system	A decentralised system for the collection and management of wastewater generated in a town, regional area or other community, but does not include Power and Water Corporation sewerage infrastructure. CWMS may include common effluent drainage system (Refer AS3500.2) or septic tank effluent disposal scheme.
Composting toilet	A treatment unit that employs the process of biological degradation in which organic material is converted into humus like material through the action of microorganisms and invertebrates.
Contaminated land	Land with hazardous substances in or on it that are reasonably likely to have significant adverse effects on the environment and potentially, human health. Hazardous substances can seep through the soil and contaminate the groundwater, which can affect nearby land or waterways.
Daily flow/daily inflow	The volume in litres of sewage and liquid wastes flowing into a septic tank during a 24 hour period. Also refer to 'hydraulic loading'.
Design irrigation rate	The loading rate that applies to the irrigation of a land application area with effluent of a secondary quality. It is expressed in L/m2/day or mm/day.
Design loading rate (DLR)	The long term acceptance rate (LTAR) reduced by a factor of safety as detailed in AS/NZS 1547:2012.
Desludging	Removal of accumulated sludge and scum from the septic tank.
Disinfection	A process which destroys, inactivates or removes pathogenic microorganisms.
Dispersive soil	Soil that has the ability in water to form a cloudy suspension that will not settle.
Distribution box	A device which is designed to distribute filtered effluent evenly to separate land application areas. These devices are typically sized to accommodate the expected hydraulic load and should be mounted on a concrete plinth (min 100 mm thickness) to maintain the device level so as to ensure even distribution to irrigation fields. There should be no vehicle or animal stock traffic over the device.
DN100	The nominal pipe diameter in millimetres.
Domestic greywater treatment system (DGTS)	System or device that collects, treats and disinfects domestic greywater for reuse.
Domestic residential premises	A Class 1 building as specified under the classification of the Building Standard of Australia and includes single domestic dwellings, town houses and villa units.
Domestic wastewater	Wastewater originating from households or personal activities including water closets, urinals, kitchens, bathrooms and laundries. Includes wastewater flows from facilities serving staff/employees/residents in institutional, commercial and industrial establishments, but excluding commercial and industrial wastes, large-scale laundry activities and any stormwater flows.

Definitions	Full form
Domestic water supply	The source and infrastructure that provides water to households. A domestic water supply may include a stream, a spring, a bore, a rainwater collection system, or water vendors. It excludes a public water supply.
Drain	An underground pipe for conveying sewage and liquid wastes to the septic tank.
Durable aggregate	Aggregate, metal or stones which are graded to AS 2758.1 for single size coarse aggregate for nominal sizes, usually ranging from 20mm to 50mm.
Effluent	Sewage, water, or other liquid, partially or completely treated or in its natural state, flowing out of a wastewater treatment unit, or out of a component of a WMS.
E.coli	*Escherichia coli* which is a member of the faecal coliform group of bacteria, and indicative of faecal contamination.
Effluent disposal system	A constructed system utilising various methods and materials to effectively dispose of effluent.
Evaporation	The transfer of water from a liquid to a gas.
Evapotranspiration	Sum of evaporation and plant transpiration from the land and water surface to the atmosphere. Evaporation accounts for the movement of water to the air from sources such as soil, canopy interception and water bodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapour through stomata in its leaves.
Evapotranspiration -Absorption (ETA) trench or bed	A land application area that uses the principles of evaporation, transpiration and absorption.
Faecal coliforms	Thermo-tolerant coliform organisms that indicate faecal pollution. *Escherichia coli* are generally the dominant species.
Filtration	Process of removing particulate matter from water by passing it through a porous medium, such as sand.
Free residual chlorine	Chlorine that is not combined with ammonia and is available for disinfection (Also known as free available chlorine).
Friable soil	Soil that is easily crumbled and consists predominantly of sand and loam.
Geotextile	A non-woven needle punched continuous filament polyester fabric 1.4 mm nominal thickness with a flow rate capacity of 500 litres/m^2/sec to AS 3705.
Greywater	Domestic wastewater drained from sinks, tubs, showers, baths, dishwashers, clothes washers and other non-toilet sources. (Greywater does not include waste from garbage grinders.)
Groundwater flow	The movement of water through the saturated zone below the water table and is a function of permeability. Groundwater flow encompasses the flow of water underground or the flow of water from saturated zones into a body of water.
Holding tank	A tank used for holding effluent or domestic wastewater prior to removal or direct discharge to a land application system or sewer. Also referred to as a collection well.
Hydraulic conductivity	Saturated hydraulic conductivity (Ksat) in m/day is the measure of soil permeability used in onsite wastewater management.
Hydraulic consultant	For wastewater management systems installed outside a building control area: Certifying Engineer (Hydraulic) or Certifying Plumber and Drainer (Design) with experience in wastewater management.

Definitions	Full form
Hydraulic loading	Liquid flow required to be handled by the treatment process. Also refer to 'daily flow'.
Indexing valve	Allows for a number of separate land application areas to be irrigated.
Infiltration rate	Rate at which water (or treated effluent) enters into the soil expressed as mm/day or $L/m^2/day$. The infiltration rate depends on soil texture (the size of the soil particles) and soil structure (the arrangement of the soil particles).
Land application system	The type of land application (dripper irrigation, trench, bed, mound etc.) sized to the daily wastewater flow and wastewater loading rate for discharge/distribution of treated wastewater into the ground for final treatment.
Land application area	The area of land used to disperse/dispose of treated wastewater. Provides further treatment within the soils and through plant uptake.
Long term acceptance rate (LTAR)	The long-term acceptance rate (LTAR) at which effluent can be absorbed into the soil of a disposal system, expressed in litres per square metre per day. The LTAR is dependent on the effluent quality, method of effluent dosing and soil permeability.
Low pressure effluent distribution (LPED)	Subsurface irrigation of secondary treated effluent into topsoil through low pressure effluent distribution (LPED) lines.
Non-potable water	Water which is not considered to be safe to drink.
Nutrients	The foods of microbial and plant life; mainly compounds of nitrogen and phosphorous.
On-site wastewater management system	The entire on-site management system including treatment and discharge of effluent, typically with a maximum hydraulic flow less than 2,000 L/day.
Outlet filter	An effluent filter placed in the outlet inspection opening of a septic tank to reduce the level of solids entering the land application system. Outlet filters do not provide secondary treatment.
Pan evaporation	The loss of water by evaporation measured in a Class A pan under controlled conditions.
Pathogens	Micro-organisms that are potentially disease causing; these include, but are not limited to bacteria, protozoa and viruses.
Percolation	The process by which water travels, primarily downwards, through an unsaturated soil matrix in a land application area.
Perforated pipe	A subsurface soakage system using perforated pipes to disperse effluent along a trench.
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 saturated hydraulic conductivity (Ksat).
Plastic tunnel trench	A subsurface absorption system using sections of slotted plastic tunnel to disperse effluent. Self-supporting durable arching, 500 mm wide, shall have a perforated water opening area of not less than 10,000 mm^2/m length and conform to AS 2041 and AS 2042.

Definitions	Full form
Potable water	Water which is considered safe for drinking purposes. This is usually provided by a public water supply, but can be sourced from rainwater tanks in areas where there is no public water supply available.
Primary treatment	The separation of suspended material from wastewater by settlement and/or flotation in septic tanks, primary settlement chambers etc. prior to effluent discharge to either secondary treatment process or to a land application system.
Process water	Process water is derived from industrial plants, industrial processes and production facilities.
Public water supply	A reticulated supply of potable water operated by the water utility.
Reserve area	An area set aside for future use as a land application area to replace or extend the original land application area.
Runoff	The movement of water above the ground (overland flow processes) and may include stormwater, but also water from exfiltration (such as seepage or groundwater surfacing).
Sand	Shall be obtained from naturally occurring deposits or be washed quarry material and shall be free from clay lumps, organic material or other debris. It shall have an effective size between 0.4 mm and 1.0 mm and contain no more than 5% by volume of clay and fine silt.
Sanitary fixtures	The plumbing fixtures connected to the system including a bath, basin, clothes and dishwashing machines, food waste disposal unit, kitchen sink, laundry trough, spa bath, toilet and other sanitary fixtures as permitted by AS 3500.2.
Scum	Material floating on the surface of the septic tank. Scum usually contains fats, oils and greases.
Secondary treatment	Aerobic biological treatment process, including settlement and/or filtering of wastewater. Secondary treated wastewater is expected to be equal to or better than 20 g/m^3 5-day biochemical oxygen demand and 30 g/m^3 suspended solids. Wastewater units that can provide secondary treatment include well designed and operated stabilised aerated treatment plants.
Septic tank	A single or multiple chambered tank through which wastewater is allowed to flow slowly to allow suspended matter to settle and be retained, so that organic matter contained therein can decomposed (digested) by anaerobic bacterial action in the liquid. The term covers the tanks that are used to treat all wastewaters, greywater and blackwater.
Setback	The separation distance that a wastewater management system must be situated from any facility boundary, water body or other limiting factor.
Sewer	Pipe used to transfer sewage from location to another.
Sewered area	Land where sewer pipes have been laid adjacent to allotments.
Sewerage	The pipework and ancillary equipment associated with the collection and transport of sewage, and the equipment and processes involved in treating and discharging the effluent.
Site-and-soil evaluator	A soil scientist or environmental engineer with appropriate training, competence and experience with site-and-soil evaluation for the design and installation of WMS. Also known as a land capability assessor.

Definitions	Full form
Slope	Slope is the rise or fall of the land surface. In this document, slope is expressed in degrees accompanied by the equivalent % grade (see slope conversion table in AS/NZS 1547:2012
Sludge	The semi-liquid solids settled from wastewater.
Soil permeability	A calculated value derived from the rate at which a head of liquid infiltrates a particular soil, usually measured in m/day and often referred to as Ksat.
Subsurface	This is the depth from 100 mm to 150 mm below surface level.
Subsurface irrigation	Pressurised irrigation system requiring secondary treated effluent. Irrigation lines are situated approximately 150 mm below the ground surface.
Sullage	Domestic wastes from baths, showers, laundries and kitchens, including floor wastes from these sources.
Surface irrigation disposal area	A dedicated area of land suitably landscaped for the disposal of reclaimed water by means of surface irrigation onto a suitable medium and plants capable of affecting a high rate of evapotranspiration.
Suspended solids	Solid particles held in suspension including both settleable and non-filterable residues.
Tertiary treatment	Further treatment of secondary effluent by disinfection.
Transpiration	Transfer of liquid through plants to the atmosphere.
Treated effluent	Effluent that has undergone (wholly or partly) secondary treatment including aeration and or clarification but has not been subject to disinfection.
Water table	This is the level below which the ground is saturated with water. It is the surface where water pressure head is equal to atmospheric pressure.
Wastewater	The contaminated water produced from domestic activities in dwellings, institutions or commercial or public facilities, consisting of all waste, greywater or blackwater.
Wastewater management system	A wastewater management system (WMS) is a physical collection of pipes and chambers that receives, treats, and applies domestic wastewater to a land application system or a holding tank. A WMS may comprise an on-site wastewater management system (OWMS) or a community wastewater management system (CWMS).
Wastewater treatment unit	The unit that provides treatment of the effluent prior to discharge/distribution to land application area/s.
Waterway	Refer Part 1, section 4 Interpretation of *Water Act 1992*.
Wetted areas	The areas assumed for calculation purposes are as follows: • Absorption trenches and beds – basal width of trench or bed. • Surface Irrigation – the designated subsurface area to which effluent is applied.

1. Introduction

1.1. Background

The Department for Health (DoH) Code of Practice for Wastewater Management (the Code) has been developed pursuant to the provisions of the *Public and Environmental Health Act 2011* and the regulations made under that Act dealing with wastewater (Public and Environmental Health Regulations).

This Code replaces the 'Code of Practice for On-site Wastewater Management – July 2014'. The Public and Environmental Health Regulations (P&EH Regulations) and the DoH wastewater codes have been formulated to reflect changes associated with current trends in wastewater management practices.

The Code provides information about applying 'AS/NZS 1547:2012 On-site domestic wastewater management' in the Northern Territory, including additional Northern Territory requirements for:

- Site-and-soil evaluation.
- Setback distances.
- Determining hydraulic flows and load inputs.

It should be noted that this document is a prescribed code under the P&EH Regulations and an adopted code under the Building Regulations. It needs to be read in conjunction with the P&EH Regulations, the Plumbing Code of Australia, the 'Guidance notes for wastewater management', the relevant Australian and New Zealand Standards and other DoH wastewater codes.

1.2. Purpose

The Code provides technical requirements and guidance for the selection, design, installation, and management of wastewater management systems (WMS) in the Northern Territory. The Code provides best practice for effective wastewater management based upon current standards and guidelines, while safeguarding public health and minimising possible adverse environmental effects.

1.3. Performance statements

The Code has been developed to establish and achieve the following performance statements for any WMS:

- To protect public health.
- To maintain and enhance the quality of the environment.
- To maintain and enhance community amenity.
- To protect resources.

1.4. Goals

To achieve the purpose, the goals of the Code and associated Guidance Notes are to:

- Ensure the protection of the environment including groundwater, drinking water catchments, waterways, estuaries, stormwater, surface water, land and vegetation.
- Protect public health by minimising the risk of human contact with wastewater and effluent.
- Restrict vector access into WMS, i.e. mosquitos, flies and rodents.

- Ensure that specific site constraints and locations are considered to ensure suitable WMS are installed.
- Maintain and enhance community amenity in regard to installation and operation of WMS, i.e. visual, noise and odour.
- Ensure that all notification/applications to install WMS comply with appropriate Acts, Regulations, Australian Standards, and guidelines.
- Promote ecologically sustainable development, i.e. efficient use of resources, water and energy in the design and operation of WMS.
- Ensure that resources are provided for the development of communication and homeowner education programs.
- Ensure the efficient and effective use of Northern Territory Government resources.
- Promote the safe reuse of treated effluent, when suitable.
- Ensure that only suitably qualified and experienced persons design, install and service WMS systems.

1.5. Scope and application

A WMS is a physical collection of pipes and chambers that receives, treats, and applies domestic wastewater to a land application system or a holding tank.

A WMS may comprise an on-site wastewater management system (OWMS) or a community wastewater management system (CWMS).

Commercial and multi-dwelling premises include, but are not limited to schools, camping areas, food premises, wineries, government buildings, reception centres, housing complexes, conference centres, businesses and public facilities which typically generate wastewater containing blackwater and/or greywater of human origin.

While the content of the Code provides for commonly used WMS, this should not be seen as precluding any new, or developing, technologies for wastewater management, provided it can be demonstrated that the device can achieve the wastewater performance (both wastewater treatment unit and land application system) requirements.

The scope and application of the Code excludes:

- Treatment, or disposal of stormwater or process wastewater derived from industrial plants, industrial processes and production facilities.
- Power and Water Corporation sewage treatment plants utilising waste stabilisation ponds.

The Code is not retrospective and only applies to upgraded and new WMS installed upon the commencement of this Code.

2. Regulatory requirements

2.1. Public and Environmental Health Act 2011 and Regulations

The *Public and Environmental Health Act 2011* provides a head of power enabling administration of the Public and Environmental Health Regulations 2020. The operation and management of any WMS installed in the Northern Territory must not cause a public health nuisance in terms of the *Public and Environmental Health Act 2011*.

The Public and Environmental Health Regulations 2020 – Part 6 Wastewater Management, detail the legislative requirements with regard to the manufacture, installation, operation and maintenance of WMS outside building control areas. The Code is prescribed code and must be read in conjunction with the Public and Environmental Health Regulations.

The Department of Health (DoH) has developed 'Administrative procedures for the installation of wastewater management systems outside building control areas' which are available on Northern Territory Government website.

2.2. Building Act 1993 and Regulations

The design, installation, operation and maintenance of WMS inside building control areas must comply with the codes adopted under Building Regulation 4. The requirements in the *Building Act 1993* and Regulations apply inside declared building control areas.

The codes referred to in Building Regulation 4 include the Building Code, the Plumbing Code (PCA) and the Code of Practice for Wastewater Management published by Department of Health (this code). These codes also refer to Australian Standards which are therefore also technical requirements

For all drainage works being undertaken, including installation of a WMS, the plumber or drainer carrying out drainage works must notify the Director of Building Control (by contacting BAS) of the completion of drainage work prior to covering up those works; and stop carrying out those works if required by the Director of Building Control.

Inside declared building control areas if a WMS is being installed with other building works a building permit is required (e.g. new WMS for a new dwelling). The WMS must be included in the building permit and the building certifier will be responsible for the approval and occupancy certification of the building works. Generally, the building certifier will require the installation of the WMS to be certified by a certifying plumber and drainer or a certifying engineer (hydraulic) and a section 40 certificate of compliance submitted.

Where the WMS or plumbing and drainage works are undertaken without other building work (e.g. replacement or upgrades to an existing disposal area) a building permit may not be required. For all drainage works being undertaken, including installation of a WMS, the plumber or drainer carrying out drainage works must notify the Director of Building Control (by contacting Building Advisory Services) of the completion of drainage work prior to covering up those works; and stop carrying out those works if required by the Director of Building Control. This notification will facilitate the creation of a 'Plumbing only permit' associated with the building record. In these circumstances the WMS installation or plumbing and drainage works must be certified by a certifying plumber and drainer, a certifying plumber or drainer (design) or a certifying engineer (hydraulic) and a section 40 certificate of compliance must be submitted to BAS within 7 days after completion of the works to be included on the building record.

2.2.1. Deemed to satisfy solutions

WMS installed inside building control areas that comply with PCA 'Deemed-to-Satisfy' solutions can be designed and certified by the following building practitioner categories:

- Certifying plumber and drainer.
- Certifying plumber and drainer (design).
- Certifying engineer (hydraulic).

These systems can be installed by plumbers and drainers licenced under *the Plumbers and Drainers Licensing Act 1983*

2.2.2. Performance solutions

All WMS installed inside and outside Building Control Areas that do not comply with the PCA 'Deemed-to-Satisfy' solutions must be installed as a performance solution.

Inside building control areas performance solutions must be designed and certified by a certifying engineer (hydraulic).

Outside building control areas performance solutions must be designed and certified by a hydraulic consultant.

Examples of systems requiring performance solutions include:

- Systems to service flow capacity greater than the flow capacity covered by AS/NZS 1547:2012.
- Systems that do not comply with the PCA or Australian Standards.
- Systems that require a number of product approved systems to be used in the design.
- Community wastewater management systems.

Definition: Performance Solution: as per the definition in the PCA and includes alternative solutions as referred to in the *Building Act 1993* and Regulations.

2.3. Waste Management and Pollution Control Act

The *Waste Management and Pollution Control Act 1998* (WMPC Act) provides for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices for related purposes. The legislation establishes the duties of end users of wastewater.

The WMPC Act requires all users of wastewater to comply with the general environmental duty, meaning that they have a responsibility for the actions taken that affect the environment. Activities must not be carried out where they may cause or likely to cause environmental harm, unless all reasonable and practicable measures are taken to prevent or minimise the harm.

For example, a person must take all reasonable measures to ensure that odours from a WMS offensive to the sense of human beings are not being discharged beyond the boundaries of the premises. A person must also take all reasonable measures to ensure that contaminants from a WMS, including nutrients and sediment-laden runoff from a land application system, are not discharged directly or indirectly into drains or watercourses.

2.3.1. Duty to notify of environmental incidents

In addition to the general environmental duty, the WMPC Act also imposes the obligation to notify the Northern Territory Environment Protection Authority (NT EPA) where incidents occur that may have caused or threaten to cause serious or material environmental harm.

A person must notify the NT EPA if they are undertaking an activity and an incident occurs which causes, or threatens to cause, pollution resulting in material or serious environmental harm.

2.3.2. Environment protection licences and approvals

The NT EPA grants environment protection approvals and licences for activities listed in Schedule 2 of the WMPC Act. These activities are associated with the:

- Disposal of waste by burial.
- Listed Waste collecting, transporting, storing, re-cycling, treating or disposing.
- Processing hydrocarbons so as to produce, store and/or despatch liquefied natural gas or methanol.

Environment protection approvals are granted for works associated with the construction phase of these activities and environment protection licences are granted for the operational phase of the activity.

2.4. Water Act

The *Water Act 1992* requires a person conducting an activity which has the potential to prejudice a declared beneficial use, or which may cause waste to come into contact with water, or water to become polluted, to have a waste discharge licence. The Controller of Water Resources has the statutory power to grant waste discharge licenses under section 74 of the *Water Act 1992*.

Waste discharge licences are regulatory instruments used to regulate the quality and quantity of waste discharged to water in the Northern Territory.

With respect to wastewater management, waste discharge licences are most commonly granted for waste discharges associated with sewage treatment or large WMS.

2.5. Australian/New Zealand Standards

The Code must be read in conjunction with the AS/NZS 1547:2012 which takes a risk management approach to on-site domestic wastewater management for systems normally designed for domestic wastewater flows up to 2,000 litres/day, from a population equivalent of up to 10 persons.

The scope of AS/NZS 1547:2012 applies to all WMS installed in the NT.

Table 1: Referenced Australian/New Zealand Standards

Standard	Title
AS/NZS 1546.1:2008	On-site domestic wastewater treatment units Part 1: Septic tanks
AS/NZS 1546.2:2008	On-site domestic wastewater treatment units Part 2: Waterless composting toilets
AS 1546.3:2017	On-site domestic wastewater treatment units Part 3: Secondary treatment systems
AS 1546.4:2016	On-site domestic wastewater treatment units Part 4: Domestic greywater treatment systems
AS/NZS 1547:2012	On-site domestic wastewater management
AS/NZS 3000:2018	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3500.1:2018	Plumbing and drainage Part 1: Water services
AS/NZS 3500.2:2018	Plumbing and drainage Part 2: Sanitary plumbing and drainage

2.6. Guidance Notes for Wastewater Management

The Guidance Notes for Wastewater Management provides additional supporting information to the Code.

2.7. Terminology

The terms 'must' and 'shall' in the Code are mandatory requirements. The term 'should' refers to desirable or recommended procedures and methods.

3. Wastewater management options for sewered and unsewered areas

3.1. Sewered areas

Water-based primary treatment systems (e.g. septic tank systems) are not permitted to be installed or used in sewered areas because the lower-quality primary treated effluent cannot be recycled. Therefore, the systems must be decommissioned when sewerage becomes available.

The only WMS permitted to be installed or used by premises owners in sewered areas are:

- Greywater treatment systems for single domestic households.
- Greywater treatment systems for commercial and multi-dwellings establishments.
- Greywater diverter devices.
- Dry composting toilets (with all residual liquid discharged to sewer).

The above list will be reviewed by DoH pending available technologies.

Site-and-soil evaluations are not required for WMS in sewered areas because any water that is excess to plant requirements must be discharged to sewer.

3.2. Unsewered areas

WMS may be installed in an unsewered area for:

- A new development.
- Upgrading an existing failed WMS.
- Converting an offsite discharge to an on-site treatment and recycling/dispersal system.
- Upgrading to a larger WMS where a premises is being extended to accommodate more people.

Table 2: Wastewater management options for sewered and unsewered areas

<table>
<tr><th colspan="2">WMS</th><th>For sewered or unsewered areas</th><th>Effluent recycling options</th><th>Effluent disposal options</th></tr>
<tr><td>Dry</td><td>Primary treatment
Dry composting toilets</td><td>All areas</td><td>N/A
N/A</td><td>Excess liquid discharged to sewer, or to an absorption trench/bed in unsewered areas</td></tr>
<tr><td rowspan="3">Water-based</td><td>Primary treatment anaerobic (septic tank),
Aerobic biological filter (wet composting, vermiculture)</td><td>Unsewered areas only</td><td>N/A</td><td rowspan="3">Absorption trenches/beds
Evapotranspiration beds
Low pressure effluent distribution (LPED)
Mounds
Non-discharge systems</td></tr>
<tr><td rowspan="2">WMS:
Septic tank systems
Secondary treatment systems (STS)
Methods of greywater use</td><td>All waste WMS in unsewered areas only</td><td>Subsurface irrigation
Surface irrigation</td></tr>
<tr><td>Greywater systems in all areas</td><td>DGTS
Refer to AS1546:4:2016:
• Level 1 end-use
• Level 2 end-use
• Level 3 end-use

GDD:
• Subsurface irrigation</td></tr>
</table>

4. Site-and-soil evaluation

Mandatory requirement: Site-and-soil evaluation (SSE) for wastewater management must be carried out in general accordance with Section 5 of AS/NZS 1547:2012.

4.1. Introduction

Land application of wastewater provides additional treatment before it enters the receiving environment beyond the land application system. This additional treatment is the result of the soakage of treated wastewater through unsaturated soils, and depends on:

- Characteristics of the site (such as proximity to surface and groundwater).
- Capacity of soils to absorb or attenuate residuals, provide biological stabilisation of organic matter and inactivate bacteria and viruses.

Soils and hydrology must be well understood so that effective subsoil treatment and effluent distribution occurs.

The aim of an SSE is to identify all site and subsurface constraints and any necessary mitigations. This process should result in determining the most appropriate type of wastewater treatment unit and land application system.

4.2. Objectives

The key objectives of an SSE are to:

- Characterise the site, soil and hydrology and identify constraints that will influence design decisions and determine the site's suitability for a particular type of WMS.
- Identify surrounding land uses and how these could affect or influence the design requirements.

The characteristics of the site, its soil, hydrology and receiving environment will:

- Determine the effluent quality required.
- Identify the most suitable locations for the land application area.
- Determine appropriate hydraulic loading rates.
- Provide the designer with the information needed to develop appropriate mitigation measures to manage any potential environmental risks.

4.3. Process

An SSE must be carried out by a site-and-soil evaluator defined as a soil scientist or environmental engineer with appropriate training, competence and experience with site-and-soil evaluation for the design and installation of WMS. Also known as a land capability assessor.

4.4. Soil categories

Soil categories referenced in this Code refer to those detailed in AS/NZS 1547:2012 - Table 5.1 Determination of soil category and Appendix E – Site-and-soil properties.

5. Primary treatment systems

5.1. Primary treatment units

Primary treatment of effluent is most commonly provided by septic tanks (Figure 1) prior to discharge into the ground via a land application system. Septic tanks can also be used to provide primary treatment prior to a secondary treatment stage. A septic tank collects greywater (kitchen, bathroom and laundry) and blackwater (toilet waste) and provides a simple retention unit for settling of solids and floatation of oils, grease and fat (scum).

The septic tank operates as a passive, low rate digester, with wastewater passing through as plug flow. A stratification process separates solids depending on the density of the particles relative to water. Separation and biodegradation are natural processes that do not depend on additives. Stratification allows a clear zone, free of solids, to develop in the middle of the tank before being discharged.

The total capacity of a septic tank is divided into:

- Air space at the top and above the scum layer, which in the case of a pumped unit, includes capacity for 24-hours emergency storage volume above the high-water level alarm sensor
- The scum layer.
- The clear zone or settling zone.
- The sludge layer at the base.

The accumulated sludge in the base of the tank biodegrades and consolidates slowly under the action of facultative and anaerobic microorganisms.

5.2. Septic tank configurations

Conventional septic tank

A conventional septic tank is usually a single rectangular or cylindrical chamber.

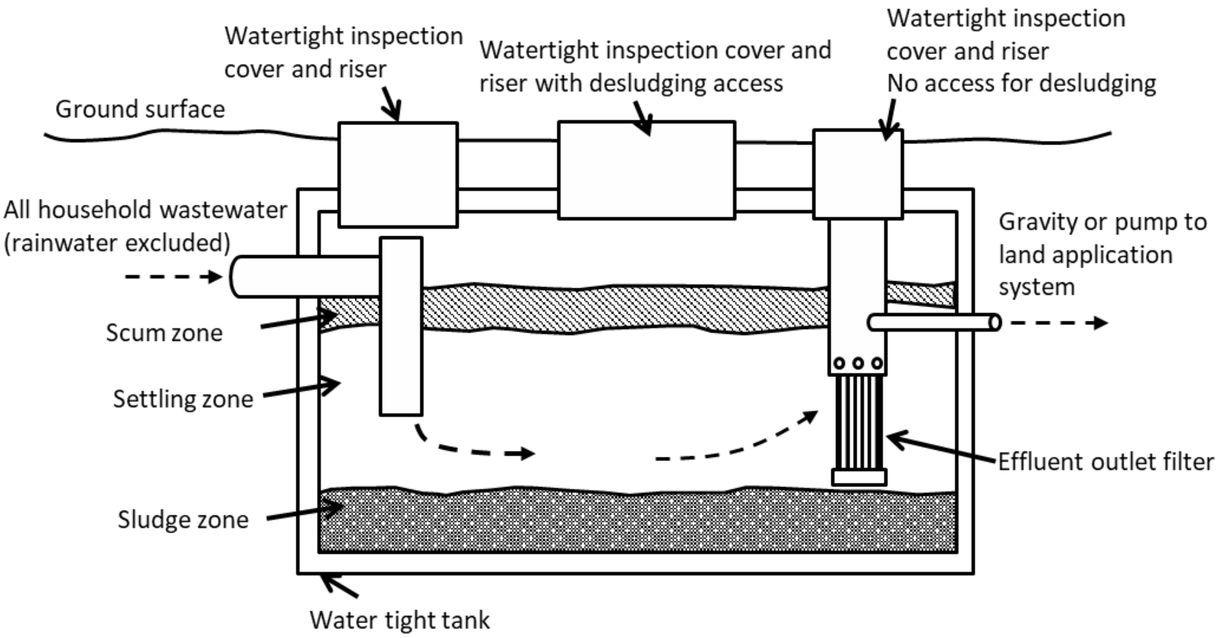

Figure 1: Illustration of a conventional septic tank

Compartmented septic tank

Compartments separated by a partition wall are an optional configuration for the conventional septic tank (Figure 1). Partition walls divide the tank into two compartments in the ratio by volume of 2:1. In theory, the hydraulic buffering provided by the first compartment stabilises the flow through the second compartment and reduces the potential carryover of solids into any later treatment stages and/or into the land application system.

Tanks with compartments (Figure 2) may need to be desludged more frequently than conventional tanks of equal size because the bulk of sludge settles in the first compartment. While compartmented tanks may increase the volume of retained solids, those solids can still be re-suspended and discharged and may require an outlet filter.

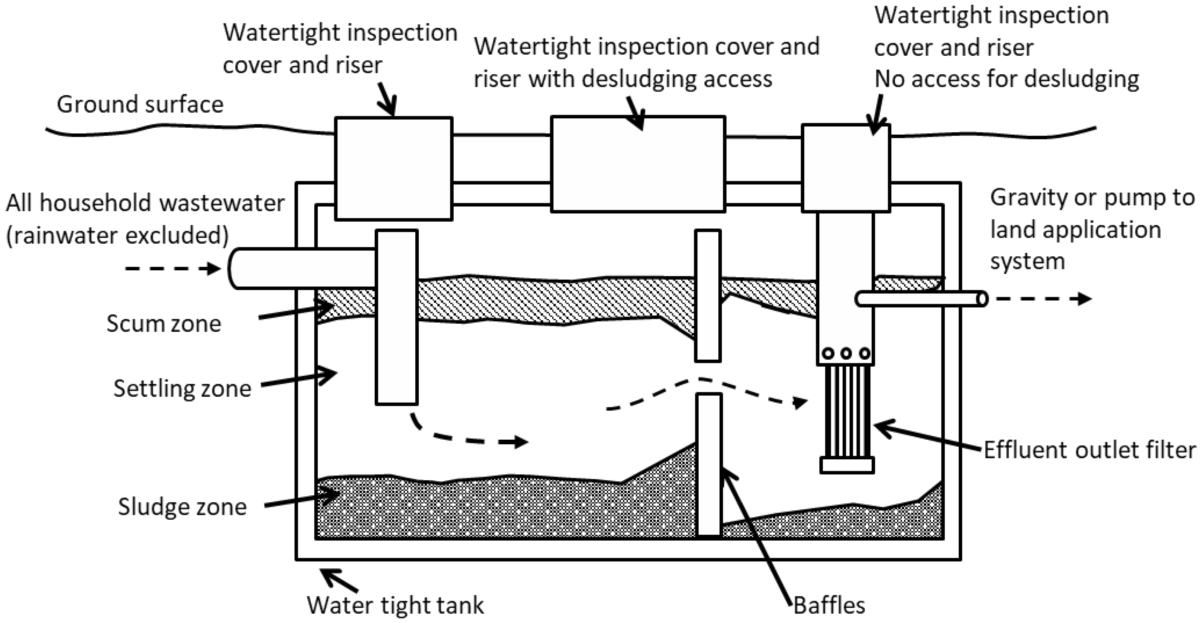

Figure 2: Illustration of a compartmented septic tank

5.3. Primary treatment unit performance

The larger the primary treatment chamber, the better the bulk solids removal. The following performance requirements apply:

- As per Clause 5.4.2.2.1 of AS/NZS 1547:2012:
  - 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.
  - Store the accumulating sludge and scum.
  - Require sludge removal when sludge accumulation reduces settling volume below 24-hours retention, at no less than 3 to 5 year intervals.
- No potential for overflows or cross-contamination from the primary chamber to any secondary chamber (e.g. where the primary chamber is within the whole treatment plant unit, the walls of the primary chamber must be of full height and sealed).

Performance of primary treatment units is affected by:

- Retention time and tank capacity: Essential to ensure settling of solids and scum floatation.
- Influent composition and concentration: Different facilities will have differing influent composition e.g. households with in-sink grinders produce higher organic loads which can negatively impact the effectiveness of the septic tank.
- Age of unit: A septic tank can take up to six months to become fully operative. The microbial biomass of the wastewater treatment unit should be allowed to reach equilibrium in this time with consistent, regular inflows.
- Microbial health: Facultative and anaerobic bacteria provide the majority of biological treatment processes and must be protected from inputs of chemicals and anti-microbial agents.
- Climatic conditions: In warmer climates, the microbial breakdown of solids and scum can almost be completed in the septic tank.

6. Secondary treatment systems

Secondary treatment refers to an aerobic biological process in which microorganisms absorb suspended and dissolved organic matter while growing under aerobic conditions, the resulting biological sludge solids being removed by settlement and/or filtering processes.

Secondary treatment systems commonly used in the Northern Territory include:

- Compact activated sludge unit (typically Aerated Wastewater Treatment System or AWTS).
- Membrane bioreactor (MBR).
- Moving bed biofilm bioreactor (MBBR).
- Attached growth textile filter.
- Recirculating evapotranspiration system.

6.1. Selection of secondary treatment process

6.1.1. Key factors of consideration

Key factors include:

- Performance in terms of effluent quality (including consistency and available data).
- Frequency and cost of operation and maintenance (including power costs).
- Aesthetics (including noise and odour).
- Site-specific constraints (e.g. intermittent wastewater loading).

6.1.1.1. Operational and maintenance considerations

All secondary treatment systems require inspection on a regular basis by trained maintenance contractor. Quarterly inspections are recommended as the minimum necessary to achieve consistent performance. Operation and maintenance servicing contract arrangements are vital and must be maintained for the life of the WMS. Servicing will include, for example, checks on the dissolved oxygen level in the effluent as well as periodic analysis of BOD_5 and TSS levels.

Removal of scum/sludge via pump-out of the septic tank/primary treatment compartment will also be required at intervals based on operating observations and experience.

6.1.2. Key performance requirements for secondary treatment systems

Key performance requirements are presented in Table 3. Actual performance depends on correct operation and maintenance. Some key criteria may be adjusted if other components of the unit are sized or designed to compensate for any variance.

Table 3: Key performance requirements for secondary treatment systems

Treatment system (components)		Performance requirements
Secondary treatment system	Secondary	• See Table 2.1 of AS 1546.3:2017 On-site domestic wastewater treatment units – Part 3: Secondary treatment systems.
	Advanced secondary	• See Table 2.1 of AS 1546.3:2017 On-site domestic wastewater treatment units – Part 3: Secondary treatment systems.
	Secondary with nutrient reduction	• See Table 2.2 of AS 1546.3:2017 On-site domestic wastewater treatment units – Part 3: Secondary treatment systems. • Required levels of total nitrogen and total phosphorus determined on a case-by-case basis based on nutrient loading constraints or limitations identified during the site and soil evaluation stage.
	Advanced secondary with nutrient reduction	• See Table 2.2 of AS 1546.3:2017 On-site domestic wastewater treatment units – Part 3: Secondary treatment systems. • Required levels of total nitrogen and total phosphorus determined on a case-by-case basis based on nutrient loading constraints or limitations identified during the site and soil evaluation stage.
Other components	Outlet filter	• If a drip irrigation system is designed for land application of the treated effluent, an effective effluent disc filter (or a screen or a mesh filter with constant backflush) must be: o Fitted in the discharge pipe, between the discharge point from the treatment process and the irrigation lines. o Designed to retain all solids greater than 120-130 µm within the wastewater treatment unit. • The supplier is required to verify that the wastewater treatment unit itself will consistently achieve the specified treated wastewater quality parameters. • The cleaning frequency of outlet disc filters should be less than the routine three-monthly contracted maintenance frequencies. • Refer to Guidance Notes for more information about outlet filters.
	Alarm system	• A malfunction alarm system must be installed to activate in the event of aeration system equipment failure or other electrical/mechanical malfunction, and/or in the event of a high water level in any of chamber within the wastewater treatment unit and/or in the pump chamber. • An audible alarm unit, as well as a visual alarm unit, must be located in a prominent place on the property.
	Safety components	• There must be a leak-proof and durable lid on the top or side of the whole WMS that prevents ingress of surface water runoff and is secured to prevent access by unauthorised personnel and yet is readily accessible for maintenance or replacement. • All risers must be sealed.
	Emergency storage	• A minimum emergency storage volume of at least 24-hours capacity above the alarm trigger level is required in the pump chamber. Otherwise, a combination of the equivalent emergency

Treatment system (components)		Performance requirements
		storage must be provided within the whole WMS, with automatic overflow between sections. • Excess wastewater must not have access to the clarifier chamber, or otherwise lead to cross contamination of other sections.
	Electrical equipment	• All electrical connections and components in the WMS must be in equipment accordance with the AS/NZS Standards for Electrical Installations.
	Service life	• The design life of a secondary treatment system and associated fittings should be a minimum of 15 years and installed and maintained in accordance with the manufacturer's instructions.
	Other relevant design standards for WMS	• WMS utilising secondary treatment must be manufactured to the Standards in AS 1546:3 2017, particularly in terms of the design requirements and must also be in accordance with the other relevant design criteria specified in this document, whichever is the more stringent. • The key criteria that must be noted within AS 1546.3:2017 are design flows and loads (the average influent quality the plant must be designed to handle), and design considerations (a variety of additional design provisions that must be included within the wastewater treatment unit). • AS 1546.3:2017 also provides provisions for the design of tanks and fittings, tank construction, emergency storage capacity, materials selection, mechanical equipment, electrical equipment, effluent pumps, alarm systems, and disinfection criteria.

6.1.3. Disinfection

6.1.3.1. Overview

Disinfection of treated wastewater usually refers to pathogen deactivation following secondary treatment. Unlike sterilisation, disinfection does not kill all microorganisms within the wastewater. Disinfection results in damage to the microorganism cell (cell wall or the cell's nucleic acids) resulting in death or prevention of replication. Disinfection consists of the selective reduction of disease-causing bacteria, parasites and viruses and is typically achieved by chlorination, UV or ozone dosing.

The characteristics of the wastewater (including TSS, turbidity, organic content measured by BOD_5 and COD, pH, and hardness) can impact on the effectiveness of disinfection. Other factors include contact time, concentration of the disinfectant, temperature and concentration of the microorganisms.

For disinfection to be effective, the wastewater must first be secondary treated to a consistently high quality. Wastewater high in BOD_5 and TSS requires a greater level of disinfectant dosage (i.e. higher doses of chlorine as chlorine demand) or reduces the performance of UV disinfection due to the low UV transmissivity.

For further information about disinfection refer to AS/NZS 1547:2012: Appendix P – Disinfection.

6.1.3.2. Chlorine disinfection

General information

Chlorine is the most commonly used disinfectant as it is efficient, easily monitored for the effective chlorine residual, and relatively easily maintained.

However, chlorine treatment of treated wastewater may result in the formation of disinfection by-products as the chlorine interacts with organic matter in the wastewater. Some of these disinfection by-products may have adverse effects on the receiving environment or have potential human health impact if public contact occurs. In addition, excess residual chlorine can have a toxic effect on microorganisms in the receiving soils or waterbodies. These risks decrease if the disinfected wastewater is sufficiently de-chlorinated prior to discharge.

The required degree of chlorination will depend on the intended reuse of the wastewater, as well as the sensitivity of the environment and the volume and the quality of the wastewater to be disinfected.

Chlorination performance requirements

The design criteria for treated wastewater chlorination should follow the specifications within AS1546.3:2017.

Chlorination systems require regular addition of chlorine and on-going monitoring, to ensure the necessary chlorine residual is maintained. A design minimum Ct value (concentration x contact time) to achieve the required chlorination will need to be specified in design. To be effective, a final chlorine residual in the disinfected wastewater should be at least 0.5 g/m^3 free available chlorine, with a minimum contact time of 30 minutes. Monitoring should ensure that the chlorine residual is maintained.

Effective chlorination prior to wastewater reuse should achieve a median *E. coli* level of ≤10 MPN/100mL, with 80% of samples containing fewer than 20 MPN/100 mL and maximum *E. coli* level of 100 MPN/100mL.

Achieving turbidity requirements for effective disinfection (i.e. <1 NTU for UV and <5 NTU for chlorination) can be difficult for domestic STS and is dependent on system performance.

6.1.4. Ultraviolet (UV) disinfection

6.1.4.1. Overview

UV disinfection uses UV radiation to penetrate the walls of cells and disrupt nucleic acids. Its effectiveness depends on the characteristics of the wastewater, the UV light intensity, the length of time the micro-organisms are exposed to the UV light, and the reactor configuration.

UV is most effective where there is low colloidal and particulate material in the wastewater. Wastewater should have very low turbidity otherwise bacteria can be shielded and not receive an effective dose. It is for this reason that untreated greywater, with its often-high suspended solids and high turbidity levels, is unsuitable for UV disinfection. Consequently, all wastewater subject to UV treatment should be secondary treated. UV units require regular maintenance to ensure the tube surfaces are clean and UV transmission intensity is not reduced.

7. Trade waste management

Trade waste management utilising conventional grease traps (Figure 3) is crucial for assisting with the removal of grease, oil and fat from wastewater generated by commercial premises. The principles of trade waste management for commercial premises connected to sewer also applies to commercial premises connected to a WMS.

Grease traps are typically used in restaurants, cafes, health care facilities and institutions producing wastewater with a high fat, oil and grease content.

For individual houses, the septic tank generally provides adequate control of grease, although it is important that grease from utensils and cooking are not discharged to the WMS.

Grease traps are similar in design to a septic tank. Typically, the grease (dissolved in the hot influent water) cools and solidifies and traps oils by flotation. Clearer water is then removed from the central zone. To be effective, the grease trap must retain the fluid for sufficient time to allow grease cooling and flotation, or for at least 30 minutes, at the instantaneous peak flow. Increasing grease trap size (and retention time) improves grease and fat removal.

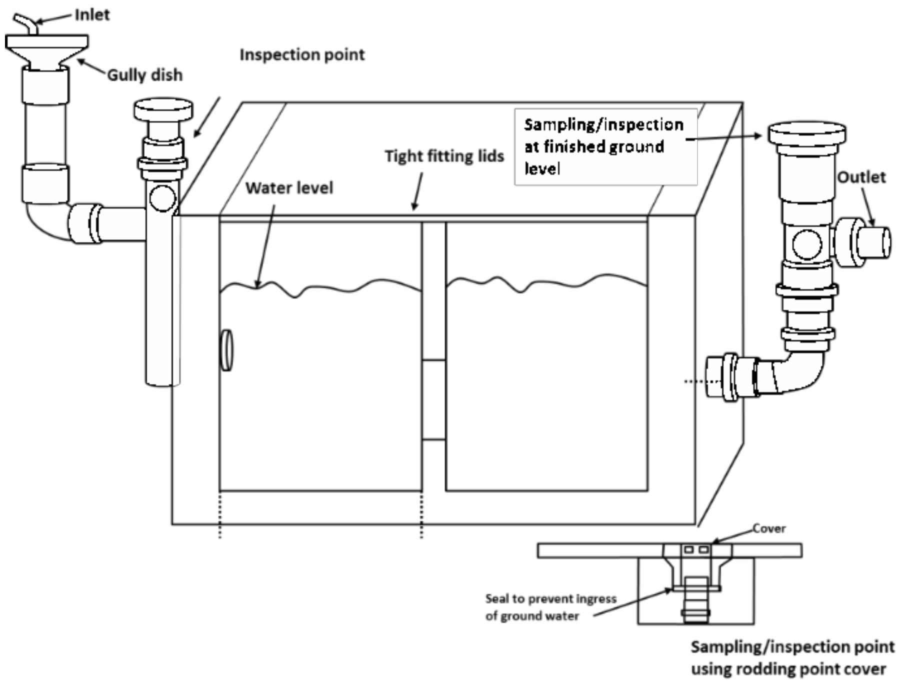

Figure 3: Illustration of a typical conventional grease trap

Table 4: Grease trap key design and operational considerations

Grease trap key design and operational considerations	
Sizing	Grease trap storage capacity should be between two to three times the kitchen average daily design flow volume, with at least one-day's retention for the peak wastewater flow discharging to it. Minimum grease trap storage capacity for commercial kitchens is 1000 L.
Location	Grease traps should be located outside the building and be accessible for maintenance or cleaning.
Influent	Grease traps do not perform well with high solids content in the wastewater; this leads to increased pump-out frequency. Discharges containing high BOD (such as wine, milk, oils and grease) should be avoided.
	High intermittent flows from commercial kitchens should discharge into a buffer tank prior to the WMS.
Filters	Commercially available outlet filters designed for grease interceptor tanks can improve effluent quality.
Additional design options	In commercial kitchens, under-sink grease trimmers, prior to the grease trap, can provide additional oil and fat removal, with further treatment in the subsequent grease trap.
	Under-sink grease converters with chemical addition for emulsification of grease components in the wastewater are never appropriate in the WMS.
Maintenance	Cleaning frequency is dependent on the facility's kitchen practices and must be based on observed accumulation. The depth of scum and sludge build-up requires regular monitoring.
	Cleaning is needed when the grease is accumulated to 75% of the grease retention capacity. For restaurants, depending on the capacity of the grease traps, pump-out frequency can vary between once a week and once every 2 to 3 months.

7.1.1. Power and Water Corporation (PWC) – Trade Waste Management System

The principles of PWC's Trade Waste Management System also apply to the installation of grease traps to WMS. For more information on PWC's Trade Waste Management System, refer to the PWC website.

7.1.2. Commercial kitchens & commercial laundries

Commercial kitchens and commercial laundries generating more 2000 L/day of wastewater require a WMS performance solution that may involve installation of a buffer tank and/or a WMS that provides secondary treatment with appropriate organic and hydraulic load capacity.

The WMS must also include associated trade waste management that shall at the minimum comply with the requirements of the PWC – Trade Waste Management System.

All WMS installed inside and outside Building Control Areas that do not comply with the PCA 'Deemed-to-Satisfy' solutions must be installed as a performance solution. Inside building control areas performance solutions must be designed and certified by a certifying engineer (hydraulic). Outside building control areas performance solutions must be designed and certified by a hydraulic consultant.

8. Permanent greywater systems

8.1. Greywater diversion device

A greywater diversion device (GDD) diverts greywater to a small holding tank and then to an irrigation system that's below the soil surface. These systems should be self-draining so that greywater isn't stored for more than a day. They also have a valve to make it is easy to divert greywater directly to the sewer when it’s raining or when the soil is saturated.

The requirements of the PCA and AS/NZS 3500.2 apply to GDDs.

GDDs do not require DoH product approval.

GDD’s must meet the following criteria:

- Each system installed is for a single house only.
- Greywater must not be stored for more than a day.
- Kitchen wastewater must not be used.
- Greywater must not be used for spray irrigation - the system must release it below the surface of the ground.
- Must be connected to overflow to a sewer or septic tank.
- Must be installed by a licensed plumber in accordance with AS/NZS 3500.2.

8.2. Domestic greywater treatment system

A domestic greywater treatment system (DGTS) provides a permanent supply of treated effluent. The use of treated greywater inside the house requires more stringent conditions for the installation and performance of the treatment system than is required for garden irrigation only.

AS 1546.4:2016 On-site domestic wastewater treatment units – Part 4: Domestic greywater treatment systems (DGTS) sets out the requirements for the design, commissioning, performance, installation and conformity testing of DGTS and associated fittings for single domestic premises where backflow prevention is provided in accordance with AS/NZS 3500.2. DGTS require DoH product approval.

The greywater treatment and storage system must be designed so the volume of greywater collected matches the household recycled water needs (e.g. for toilet flushing, washing machine use and garden irrigation). Large effluent storage tanks may be installed to ensure a ready supply of water for indoor uses, garden irrigation and/or firefighting.

The requirement for 24-hour maximum storage time only applies to untreated greywater (e.g. via a GDD), and not to treated, disinfected greywater. Where there may be insufficient effluent for continuous supply to the toilets and/or washing machine, the system can be supplemented with potable quality water.

Due to the difficulty of treating fats, oils, grease and high loads of organic matter in kitchen wastewater, most greywater treatment systems exclude kitchen water from the waste stream. Kitchen wastewater must be diverted to sewer (or to a septic tank in unsewered areas) unless the DGTS is specifically designed for treating kitchen wastewater. Most DGTS manufacturers instruct householders to exclude greywater from the laundry trough when it is polluted with contaminants such as dirty nappies, soiled clothing or cleaning chemicals. A DGTS’s ability to treat kitchen or laundry trough wastewater is detailed in the owner’s manual.

8.3. Indoor use of treated greywater in single domestic households

The indoor use of treated greywater is only permitted in single domestic households, not in any commercial business, community, school, child care, hospital or multi-dwelling residential premises.

The internal plumbing of pipes to the toilet cistern and/or clothes washing machine for greywater recycling must be undertaken by the licensed plumber in accordance with the PCA and AS/NZ 3500.2.

Greywater recycling systems for indoor use must include:

- Purple colour-coded pipework for internal recycled water plumbing.
- An appropriate back-up supply of potable water in the event that the supply of recycled greywater fails.
- An automatic valve to divert effluent to sewer if the system fails as a result of a malfunction or power failure or if the effluent storage tank is full.
- A manual valve to divert wastewater contaminated with chemicals, dyes or faecal matter from any sink, bath or shower to the sewer.

Treated greywater pipes must not be cross-connected to the potable water supply pipes. Appropriate back-flow prevention devices must be installed on any potable water backup to the treated greywater supply in accordance with AS/NZS 3500, after consultation with the relevant Water Utility where reticulated drinking water is supplied.

Flow estimates for the proportion of greywater that can be used for designing household greywater recycling systems are provided in Table 5.

Table 5: Recommended estimates from greywater flows

Household flow estimates	
Source	**% of total household wastewater**
Showers, baths, basins	40%
Laundry	30%
Toilet wastewater	30%

8.4. Outdoor use of treated greywater

Greywater recycling for garden irrigation must be designed, installed and maintained in accordance with this Code and AS/NZS 1547:2012: On-site domestic wastewater management, AS/NZS 1319: Safety Signs for the Occupational Environment and ensure that:

- Greywater is treated to the required effluent quality for the intended uses.
- New irrigation systems use purple coloured pipes and fittings, or if an existing irrigation system is being used, the external connection to the greywater supply is retro-fitted with purple coloured tape or painted purple [Note: lilac (purple) is the international colour code for secondary effluent quality recycling]. AS/NZS 3500.1 requires all plumbing outlets, and in most cases pipes, to be marked with the colour lilac/light purple and the words: “RECYCLED WATER — CAUTION NOT FOR DRINKING”.
- Disc or mesh filters are installed to protect the irrigation system from solids being carried over from the treatment system.

- Flush/scour valves or an equivalent system are installed to enable periodic flushing to clean the pipes in the irrigation system.
- Vacuum breakers are installed to stop soil and other particles being sucking into and clogging the drippers.
- Failsafe diversion valves divert greywater to sewer (or to blackwater systems in unsewered areas):
    - during wet weather.
    - in the event of a power outage or system malfunction.
    - when greywater production exceeds demand and the storage capacity limit is reached.
- Prohibition and safety signs with the symbols and/or words indicating ‘Recycled Water — Do Not Drink’ are clearly displayed on the treatment unit and adjacent to any dedicated recycled greywater hose tap in accordance with the AS/NZS 1319.
- Recycled water hose tap outlets:
    - are coloured purple.
    - are located at least 300 mm from any drinking water tap.
    - have a removable ‘child-proof’ handle.
- Recycled water hoses are purple and have a non-standard left-hand thread which screws into the recycled water taps (the opposite of drinking water taps).
- The effluent is contained within allotment boundaries and not discharged to drains, waterways and does not negatively impact the beneficial uses of groundwater.
- The effluent is dispersed throughout the land application area via a pressure-compensating drip irrigation system in accordance with the Design Irrigation Rates in AS/NZS 1547:2012 after the irrigation designer has determined the soil type on the property.
- The irrigation rate and volume of effluent applied to the irrigation area does not exceed the plant or soil requirements.
- The irrigation area contains good quality loamy topsoil (native or imported soil) with substantial organic matter to support the growth of healthy plants and soil microbes.
- Soil moisture sensors and/or rain sensors are integrated into the irrigation system to automatically divert treated effluent to sewer before the soil becomes saturated in sewered areas (consult the soil moisture or rain sensor manufacturer for advice on installation to ensure the location is representative).
- Treated effluent does not come in contact with the edible parts of herbs, fruit or vegetables.
- Any evidence of effluent pooling, odours or increase in noise receives the attention of the service technician.
- Householders monitor their gardens and use information about plant type, soil type and soil profile to ensure the irrigation rate meets the plants’ water requirements and is at a level suitable for the hydraulic capacity of the soil.

9. Alternative treatment options

9.1. Alternative treatment systems

Alternatives are available for both wastewater treatment units and toilet systems. They include some waterless toilet systems such as composting toilets, and other alternative wastewater treatment units such as vermiculture (worm) systems. Other alternative systems are briefly summarised below but are not discussed in detail in this document.

Some alternative treatment systems are product approved in accordance with the Code of practice for product approval of on-site wastewater management systems, providing there is a corresponding Australian/New Zealand Standard. Alternative treatment systems not covered by the PCA and referenced Australian standards require a performance solution, see section 2.2.2.

9.2. Alternative toilet systems

There are other methods for reducing pollutant mass loading to a single WMS, by segregating toilet waste flows (blackwater) from sink, shower, washing machine, and other waste flows (greywater). Some alternative types of toilet systems can provide separate handling of human faecal material and associated products such as toilet paper.

Significant quantities of suspended solids, BOD_5, nitrogen, and pathogenic organisms can be eliminated from wastewater flows by segregating human effluent from the wastewater stream using composting or incinerator toilets.

Waterless toilets can reduce a household's wastewater volume by 20% to 40% depending on toilet system flush volumes and water reduction fixtures. In instances where blackwater is treated separately, all greywater must be collected and treated according to its intended end use.

Table 6: Examples of alternative toilet systems commonly used in the NT

Examples of alternative toilet systems	
Composting toilets	
Description	Composting toilets are designed to store and compost, by aerobic bacterial digestions, only the toilet waste (but may also include kitchen food scraps, depending on the design). Other carbon sources may be required to enhance the digestion (such as grass clippings, wood chips, coarse saw dust, etc.). The greywater from bathing facilities, sinks and washing machines must be collected and treated separately. The main components of a composting toilet include: • A composting chamber connected to one or more toilets. • An exhaust system (often fan-forced). • Ventilation (aeration) system. • Drainage/collection of excess liquid and leachate. • Mixers (automatic or manual). • Access for mixing and removal of end-product. The design, testing, selection and sizing of waterless composting toilets shall be in accordance with the requirements given in AS/NZS 1546.2 Waterless Composting Toilets and DoH Product Approval. The composted material must be disposed of in accordance with AS/NZS 1546.2 and have completed a 12 month composting period in the composting toilet system before disposal. The composted material must be buried if disposal is to be on-site.
Design considerations	Composting toilets need to be located and operated in such a way that no public health hazard or odour nuisance arises. Home owners should not remove the composted residual wastes; these should be handled by licensed waste transporters only. • Factors that need to be considered: o Number of individuals who use the composting toilet. o Kind of use (residential, day-use, public facility, etc.). o Designed environmental factors (temperature, aeration control, etc.). • Important sizing assumptions may include: o Daily waste production rate: Urine: 1.3 L/person/day; faeces: 0.6 L/person/day or 200 g/person/day. o Population equivalent definition: 1.2 faecal event and 4 urine events/person/day. o Ratio of urine to faeces: 3:1 – 4:1 (residential); 10:1 (public facility). • The solid end-product should not produce any objectionable odour immediately after removal from the composting toilet. • The moisture content of the solid end-product should be less or equal to 65%. • Faecal coliform level should be less than, or equal to 200 MPN/gram. • Vector management consideration are required. The process relies on both worms and soil microbes for the decomposition process (rather than heat tolerant microbes present in regular composting).
Hybrid toilets	
Description	The 'Hybrid Toilet System' which incorporates parts of the various other technologies to provide a high quality effluent, with no mains power usage and low maintenance.

Examples of alternative toilet systems	
Design considerations	• The system involves a drop toilet (no flush) into a primary tank where solids are retained and broken down into a liquid form. • The effluent passes to a second tank for treatment before being disposed of in an absorption bed disposal area. The system is closed and is not influenced by rainwater other than in the disposal area. • The only power is a solar powered exhaust fan. Sludge must be pumped out every 5 years. Both the primary and secondary tank are filled with water at the time of installation. • The tanks are sized to provide 43 days storage in the primary tank and 25 days in the secondary tank. The secondary tank contains media with a high void space ratio and incorporates upflow and downflow water features. This intricate flow path ensures maximum contact with the biomass at all times.
Chemical toilets	
Description	Chemical toilets generally include a toilet seat located above a vault, which contains chemicals to disinfect and control odours from the wastewater. Recirculating toilets apply chemicals with the toilet flushes. Usually the waste is separated from the liquid phase and stored in an internal holding tank. The chemical liquid may be reused for additional toilet flushing. Because of the incomplete disinfection of the waste and presence of chemicals in the liquid, the residual waste or spent chemical liquid in these toilets needs to be periodically removed by a licensed hazardous waste transporter.
Design considerations	• Only proprietary devices available, therefore no specific design parameters are available. • Chemical toilets are only a portable, temporary solution for wastewater management.
Pit toilets	
Description	A pit toilet consists of a toilet structure on top of an excavation where human waste is deposited permanently.
Design considerations	• Pit depth should be at least 3 m deep. • Complete separation (or isolation) is required to prevent accidental human, animal, or vector access. • Pit toilets should not be installed in areas prone to shallow permanent water table, flooding or surface water ponding.

9.3. Pump-out tanks

Pump-out tanks are large septic holding tanks designed to contain effluent from premises usually for 1 week to 3 months. The tanks must be certified in accordance with AS/NZS 1546.1 and suitably sized for the application in accordance with this Code.

A pump-out tank is an option of 'last resort', but may be installed on an existing lot which cannot be connected to sewer or contain all of its wastewater onsite. The contents of the tank are pumped into a sewage-sludge truck and transported and discharged to an approved sewer main access hatch or centralised sewage treatment plant. This is often not a sustainable option for sewage management, because of the economic and environmental costs associated with pump-out, transport and licences to discharge septic sewage effluent into reticulated sewerage.

Pump-out tanks are best suited to premises with low or intermittent use. The most sustainable practice is to irrigate the maximum amount onsite and accumulate the residual wastewater in the pump-out tank.

Best practice should include:

- Water conservation fittings and fixtures, including dual-flush toilets and spring-loaded taps to prevent excess water filling the tank.
- A suitably sized tank, with a minimum storage capacity equal to at least seven days daily inflow
- A water meter on the water supply to the premises.
- An audio/visual or telemetric alarm system which alerts the premises occupier when the tank is three-quarters full and requires pumping out, in the event the tank fills more quickly than the pump-out schedule.
- Extra ballast to weigh down the tank to prevent groundwater lifting it out of the soil after the tank has been pumped out.
- Be suitably located so as to permit access for the pump out vehicle.
- Setbacks for pump out tanks are the same as for septic tanks.
- A contract with a sewage/sludge pump-out operator to regularly pump out the wastewater.
- A strategy for recording the volume of wastewater pumped out each time.
- Pump-out tanks may be installed for public toilet blocks on Crown Land, provided the responsible government entity has a suitable risk management plan and procedures for the management of the wastewater and the pump-out tank.

9.4. Pit toilets

Pit toilet is a generic term rather than a registered brand name and is also known as a latrine or long-drop.

Pit toilets are one of the most basic forms of sewage treatment and disposal and commonly used in remote areas of the NT where it is not practical to install a WMS.

A pit toilet comprises a closet super structure above an earth pit. The pit acts as a receptacle and slowly decomposes the human wastes by naturally drying the waste pile. When the pit becomes full, lime is added to it and then covered with earth. Another pit is dug and the closet superstructure is usually transported above the new pit.

The most common and effective types of pit toilets are the ventilated improved pit (VIP) toilets, which are constructed to include a fly wire covered vent pipe and darkened interior to minimise the presence of insects and odours.

9.4.1. Design and installation requirements

The following performance criteria can be applied to pit toilet installations:

- The structural design of pit toilets should include:
    - a large (typically 200 mm), insect screened, black painted vent pipe to assist ventilation by convection.
    - a storage pit of appropriate capacity.
    - a pedestal designed to minimise fouling.
    - being comparatively darker inside the toilet so that any flies breeding in the pit are attracted to the top of the vent pipe rather than the toilet as an escape route.
- The type of toilet pedestal (squat plate, pedestal, etc.) should reflect community practices.
- A minimum setback of a 100 m from the pit toilet to a bore or water course is mandatory.
- Sufficient artificial lighting shall be provided to allow safe access to and from the pit toilet at night.
- The toilets should have easy, all weather access. In areas known to be subject to periodic flooding, pit toilets should be mounded so that the top of the toilet pedestal remains above flood levels. They should not be installed in areas of permanent high-water table.
- The pit for a raised pit toilet should be dug at the end of the Top End dry season to maximise the available depth of unsaturated soil.
- On sloping land, the pit toilet shall be constructed on a levelled site and spoil from the pit used on the high side of the pit toilet to divert stormwater away from the pit.
- Community participation in deciding on the location of each pit toilet is essential.
- New pit toilet holes need be prepared when the old holes are filled to within 300 mm of the surface and the existing superstructure relocated over the new hole or a new structure constructed. The old hole should be marked, perhaps by planting a tree to prevent the site from being reused.
- Handwashing is an essential aid to the prevention of the spread of many common diseases that rely on faecal/oral routes of transmission and suitable facilities should be included as an integral part of all toilet facilities.

- o Ideally the hand washing bowl and water supply forms part of the pit toilet structure, but on rare occasions it may be necessary to locate the hand washing facility on a neighbouring building.
- o The hand washing facility should be located to encourage its use. It is rarely acceptable to dispose of wastewater from the hand washing facilities into the pit toilet because of the potential for mosquito breeding and the collapse of the pit through waterlogging. Separate provision is required for the disposal of this water into a nearby sullage trench.

- There may be a need to specify a minimum size for the pit though this is dependent on the size if the structure. Based on an adult producing about 0.065 m^3 per year (including toilet paper) then the size of the pit should be approximately 1500 mm diameter x 2500 mm deep. The occupational health and safety issues of hand digging excavations should not be overlooked.
- The reality is also that nobody is tied to a single toilet – there are public toilets, workplace toilets, household toilets and general indiscriminate defecation.
- There needs to be mechanisms to check when pits need to be replaced and the costs of replacement and general maintenance need to be factored.

9.5. Recreational vehicle dump points

A recreational vehicle (RV) dump point also known as a motorhome or caravan dump point is a designed facility intended to receive the discharge of wastewater from any holding tank or similar device installed in any (RV), and having a means of discharging the contents to the sewer or to a holding tank.

An RV dump point typically includes a receptacle with a cover which allows users to easily connect or empty their storage tank. There is normally an adjacent water tap and hose where users can wash their hands and clean the surrounding area.

RV dump points in the NT typically comprise sewered public facilities provided by government agencies and local government authorities. There are also private unsewered facilities available for patrons of caravan and tourist parks.

9.5.1. Design and installation requirements

The following performance criteria can be applied to dump point installations:

- RV dump points pose a unique problem for on-site wastewater management because the recirculating fluid used in RV tanks may contain formaldehyde and/or paraformaldehyde.
- The presence of these chemicals inhibits bacterial action inside of a septic tank, which leads to solids carry over and premature failure of the land application system. Compounding the problem is that RV units recirculate the fluid several times before it is dumped. The fluid disposed in the dump point then is both strong and preserved.
- Must be installed in accordance with AS/NZS 3500.2.
- RV dump points require a performance solution see section 2.2.2.

10. Ancillary structures

10.1. Access and inspection openings

All tanks are required to have access and inspection openings shafted to the surface level using an access shaft.

All covers shall be terminated a minimum 100 mm above the finished ground surface level. The surrounding surface must be graded away from the cover(s) to prevent ingress of surface water. Inspection openings are to be fitted with a threaded access cap, concrete block surround and cover.

For connections to a community wastewater management system, existing septic tanks may need to be shafted to surface level for maintenance purposes such as desludging, testing and inspection.

10.2. Pump wells

Pump wells are only to be installed when it is necessary to pump effluent or recycled water to the land application system where the depth of the connection of the land application system does not permit the connection of the WMS by gravity drains. AS/NZS 3500.2 states that pumping shall only be used where it is not able to gravitate to the connection.

Pump wells are not a suitable solution to managing water logged sites and not allowed under the PCA.

10.3. Distribution boxes

A distribution box is a device which provides a means of evenly distributing effluent via gravity to a land application system. In order to alternate flows to multiple land application systems, other devices may be used, such as an effluent diverter valve.

11. Determining hydraulic flows and load inputs

Mandatory requirement: This section recognises NT local conditions with respect to determining hydraulic flows and load inputs for the design of WMS, however, it must be read in conjunction with the Section 5 – Design of on-site systems of AS/NZS 1547:2012.

This section takes precedence over design flows listed in Appendices H and J in AS/NZS 1547:2012 to allow for NT local conditions, especially for sizing septic tank capacities for dwellings in Aboriginal communities.

11.1. Design considerations

This section provides guidance for determining hydraulic flows and load inputs.

Wastewater design flow volume will depend on the type of facility, the water consumption per person, and the type of any installed water-use reduction fixtures. Any underestimation of design flow rate could result in overloading and failure of the WMS. Consequently, designers should use peak daily flow allowances (i.e. peak occupancy) and not average flow rates.

11.2. Calculating the total design volume flow

The total design flow volume of a WMS is determined via the following equation:

The total design flow volume = maximum design occupancy number x design flow allowance per person.

- The maximum occupancy number of a premises is dependent upon factors such as the intended use, physical size and internal floor plan of the building.
- The design flow allowance per person is dependent on factors such as the installed water fixture facilities, user's water-use pattern and source of water supply.

11.3. Design occupancy numbers

Design occupancy allowances recommended for design purposes for various types of facilities are provided in Tables 7 and 8. The design for intermittently loaded WMS (such as holiday dwellings) should provide a WMS sized for permanent use.

Table 7: Occupancy allowances

Dwellings in urban and rural living zones	
Number of bedrooms	Occupancy for design purposes
1 to 3	5
4	6
5	7
6	8
Dwellings in Aboriginal communities	
Number of bedrooms	Occupancy for design purposes
1 to 2	5
3	7.5
4	10
Holiday accommodation	
Guests	Maximum occupancy
Staff	Maximum number of staff
Hospitals	
Patients	Maximum occupancy
Staff	Maximum number of staff
Aged care facilities – self care	
1 bedroom	1.3 persons per unit
2 bedroom	1.3 – 2.0 persons per unit
3 bedroom	2.0 – 4 persons per unit
Staff	Maximum number

Notes:

- Dwellings in urban and rural living zones: A nominal capacity of 'number of bedrooms plus two'. This takes into consideration the potential future occupancy, not just the number of people who may be intending to live in the dwelling. Designers must include any additional room(s) shown on the dwelling plan such as a study, library, sunroom or granny flat that could be used as a bedroom.

- Dwellings in Aboriginal communities: A nominal capacity of '2.5 persons per bedroom'. This takes into consideration the potential for increased numbers of people who may be intending to reside in or visit the dwelling.
- An additional occupancy allowance must be made in situations where dwellings are proposed which have additional rooms which could be used as bedrooms. This is calculated based on one extra person multiplied by the ratio of the total floor area of the additional room/s to that of the smallest bedroom (and rounded up).
- Design occupancy must allow for a seasonal peak, not just the average daily flow. Holiday homes tend to have intermittent occupancy but when occupied are likely to have a higher occupancy than a continuously occupied dwelling. Peak flow storage within the treatment and/or land application system must be provided, and/or conservative design loading rate must be used in sizing the land application system.
- Retirement village average occupancy is estimated as 1.3 people per unit with occasional overnight guests. In the case of retirement homes, occupancy should be based on the number of beds per bedroom. A higher water use/user must be included in facilities providing community care (unless site-specific data are available).

11.4. Design flow allowance per person

Table 8 provides recommended design wastewater per capita flow allowances for all dwellings and a range of other domestic type facilities (such as accommodation facilities, restaurants, public toilets, etc.). There is no differentiation between the various sources of water supply, because most residential and commercial premises will be supplied with a reticulated water or bore supply. On-site roof water tank supplies are not a sustainable water source in the NT.

These flows are recommended minimums for design purposes (unless actual comprehensive water usage/flow records along with actual occupancy numbers are available).

Table 8: Domestic flow allowances for reticulated community or bore water supply

Domestic flow allowances for standard fixtures		
Source		Typical wastewater flow allowance per capita L/person/day
Dwellings with 6/3 L flush toilets and standard fixtures	All waste	150
Toilet	Blackwater	50
Hand basin	Greywater	10
Kitchen	Greywater	10
Bath and shower	Greywater	50
Laundry	Greywater	30

Table 9: Commercial flow allowances for reticulated community or bore water supply

Commercial flow allowances for standard fixtures	
Source	Typical wastewater flow allowance per capita L/person/day
Camping grounds/caravan parks • Permanent occupation • Casual occupation	 150 80
Child care centres	50
Clubs • Members, guests and staff • Bar trade (per customer) • Restaurant (per diner)	 40 20 20
Construction and mining camps • Resident staff • Non-resident staff	 180 40
Factories and offices	40
Health care centres • Non-resident staff	 40
Holiday/school camps	100
Hospitals and aged care facilities • Patient beds • Resident staff • Non-resident staff	 150 150 40
Hotels/Motels • Accommodation for guests • Resident staff • Non-resident staff • Bar trade (per customer) • Restaurant (per diner)	 100 150 30 20 20
Kiosk/Tearooms	10
Public halls	20
Public swimming pools	20
Public toilets	15
Restaurants • Non-resident staff • Bar trade (per customer) • Restaurant (per diner)	 40 10 20

Commercial flow allowances for standard fixtures Source	Typical wastewater flow allowance per capita L/person/day
Schools	
• Day pupils plus non-resident staff	40
• Resident staff and boarders	150
• Kiosk	10
Service station/roadhouse	
• Non-resident staff	40
• Bar trade (per customer)	10
• Restaurant (per diner)	20
• Public toilets (with shower)	10
• Public toilets (no shower)	5
Sports centres including public swimming pools	50

11.4.1. Organic capacity

Design organic capacities for WMS shall be determined by using the following equation and BOD loadings from Table 12.

Design organic capacity (g/d) = P2 x BOD_5

Where:

P2 = Number of persons using the WMS

BOD_5 = Organic loading rate in grams per person per day (g/p/d)

Table 10: BOD_5 loadings

Source of wastewater	BOD_5 loading (g/p/d)
Raw sewage	70
After primary treatment/septic tank	50
Commercial and industrial premises	Refer to Table 12

Example 1:

Example for dwelling in urban and rural living area. An AWTS (after primary treatment/septic tank) for a 4 bedroom dwelling would require an organic capacity as follows:
P2 = 6 persons

BOD_5 = 50 g/p/d

P2 x BOD_5 = 6 persons x 50 g/p/d = 300 g/d

Example 2:

A restaurant (no liquor licence) with 4 staff catering for a maximum of 100 guests per day with a septic tank would require an AWTS designed for an organic load as follows:

P2 – 100 persons (guests) + 4 persons (staff) = 104 persons

BOD_5 = 104 persons x 15 g/p/d = 1,560 g/d

11.4.2. Capacity calculation criteria for domestic premises

11.4.2.1. Flush size

- A dual flushing cistern having a nominal 3/6 litre flush fitted with an external overflow connected to a WC pan with a nominal 50 mm water seal should be fitted to new installations.

11.4.2.2. Number of persons

- Minimum number of persons for calculations: Five (Refer Table 7).
- Maximum number of persons for calculations: Ten (Refer Table 7).

11.4.2.3. Wastewater minimisation

- Householders should minimise wastewater generation by limiting water usage and by the selection of appliances which conserve water usage. Appliances such as low volume shower heads, front loading clothes washing machines and low water consumption dishwashers should be chosen.

11.4.2.4. Capacity calculation for septic tanks and greywater tanks

Capacity requirements for single dwelling septic tanks are based around an allowance for settling volume plus accumulated scum/sludge storage volume between desludging periods.

AS/NZS 1547:2012 establishes an allowance for scum and sludge accumulation in an all waste septic tank system of 80 litre/person/year. This helps retain the average flow for at least 24 hours to settle the solids and float the scum effectively so that there is a clear zone at the level of the discharge outlet. The standard also recommends that septic tanks be desludged at no less than 3 to 5 year intervals.

The minimum scum and sludge storage allowance is 1,600 L for all septic tanks, irrespective of the number of persons for which the septic tank is designed.

Daily flow allowances:

- All-waste tanks, 150 L/person.
- Blackwater tanks, 60 L/person.
- Greywater tanks, 90 L/person.

Scum/sludge storage allowances:

- All-waste tanks, 80 L/person/year.
- Blackwater tanks, 50 L/person/year.
- Greywater tanks, 40 L/person/year.

11.4.2.5. Calculation

Equation for calculating primary treatment capacity (L) = (P1 x S x Y) + (P2 x DF) where:

- P1 = Number of persons using the system.
- S = Rate of sludge/scum accumulation in litres per person year (L/p/y).
- Y = Desludging frequency in years.
- P2 = Number of persons using the system.
- DF = Daily flow in litres per person per day (L/p/d).

11.4.2.6. Septic tank capacities for dwellings

Table 11: Septic tank capacities for dwellings

Dwellings in urban and rural living areas				
Number of bedrooms	Occupancy for design purposes	All waste tank capacity (L)	Blackwater tank capacity (L)	Greywater tank capacity (L)
1 to 3	5	3,000	2,000	2,000
4	6	4,000	2,000	2,000
5	7	4,000	2,500	2,500

Dwellings in Aboriginal communities				
Number of bedrooms	Occupancy for design purposes	All waste tank capacity (L)	Blackwater tank capacity (L)	Greywater tank capacity (L)
1 to 2	5	3,000	N/A	N/A
3	7.5	4,000	N/A	N/A
4	10	5,000	N/A	N/A

Note:

- The settling volume allowance of 150 L/person for all waste tanks is equivalent to the per-capita daily flow allowance for standard dwellings. The excess settling capacity available for households with lower per-capita flow allowances provide for some hydraulic buffering.
- The minimum all waste tank size of 3,000 L is based on a 1 to 3 bedroom dwelling in an urban and rural living area accommodating up to five persons.
- The minimum all waste tank size of 4,000 L for a 4 bedroom dwelling in an urban and rural living area is based upon accommodating up to five persons, however there is redundancy for the addition of an extra bedroom or 'granny flat'.
- A septic tank designed for a 1 to 3 bedroom dwelling in an urban or rural living area with a minimum of 5 persons should be desludged approximately every 5 years.
- For a larger dwelling or dwelling in an Aboriginal community or for increased occupancy over five persons, the tank size should be increased accordingly or alternatively, the tank should be desludged more frequently, e.g. approximately every 4 years.

11.4.2.7. Examples of sizing septic tanks for dwellings

Equation for calculating primary treatment capacity (L) = (P1 x S x Y) + (P2 x DF).

Example 1:

Calculate the size of a septic tank for a 1 to 3 bedroom dwelling with a 5 year desludging frequency in an urban and rural living zone:

- (L) = (P1 x S x Y) + (P2 x DF)
- (L) = (5 EP x 80 L/p/y x 5yr) + (5 EP x 150 L/p/d)
- (L) = (2,000) + (750)
- (L) = 2,750 L (round up to a 3,000 L septic tank)

Example 2:

Calculate the size of a septic tank for a 4 bedroom dwelling with a 5 year desludging frequency in an urban and rural living zone:

- (L) = (P1 x S x Y) + (P2 x DF)
- (L) = (6 EP x 80 L/p/y x 5yr) + (6 EP x 150 L/p/d)
- (L) = (2,400) + (900)
- (L) = 3,300 L (round up to a 4,000 L septic tank)

Example 3:

Calculate the size of a septic tank for a 3 bedroom dwelling with a 4 year desludging frequency in an Aboriginal community:

- (L) = (P1 x S x Y) + (P2 x DF)
- (L) = (7.5 EP x 80 L/p/y x 4yr) + (7.5 EP x 150 L/p/d)
- (L) = (2,400) + (1,125)
- (L) = 3,520 L (round up to a 4,000 L septic tank)

Example 4:

Calculate the size of a septic tank for a 4 bedroom dwelling with a 4 year desludging frequency in an Aboriginal community:

- (L) = (P1 x S x Y) + (P2 x DF)
- (L) = (10 EP x 80 L/p/y x 4yr) + (10 EP x 150 L/p/d)
- (L) = (3,200) + (1,500)
- (L) = 4,700 L (round up to a 5,000 L septic tank)

11.4.3. Capacity calculation criteria for commercial and industrial premises

11.4.3.1. Capacity

- Minimum septic tank capacity is 3,000 L.

11.4.3.2. Number of persons

- Minimum number of persons is 5.

11.4.3.3. Calculation

Equation for calculating primary treatment capacity (L) = (P1 x S x Y) + (P2 x DF) where:

- P1 = Number of persons using the system
- S = Rate of sludge/scum accumulation in litres per person year (L/p/y)
- Y = Desludging frequency in years
- P2 = Number of persons using the system
- DF = Daily flow in litres per person per day (L/p/d)

Minimum scum and sludge storage in most cases is 1,600 L, but may be increased to 1,920 L on premises with commercial cooking facilities or with over 50 persons.

11.4.3.4. Septic tank capacities for commercial and industrial premises

Commercial and industrial premises dealing with food or other organic matter in the wastewater stream will need to consider not only the hydraulic aspects of the design but also the capacity of the system to deal with high and irregular organic loadings (see Table 12).

Premises in this category include (but are not limited to) hotels, motels, guesthouses, bed and breakfast establishments, restaurants, cafes, wineries, poultry farms, mushroom farms, cheese factories, take-away food premises, shops, schools, toilet amenity blocks, childcare centres, reception centres, conference centres, nursing homes, hospitals, environment centres, sport centres, community halls and public recreational areas.

The provision of a buffer tank may provide the additional capability for the higher organic loading. Any proposed premises with a commercial kitchen should consider installing a suitably-sized additional septic tank at the start of the treatment train to cope with the high organic load. Best practice is two septic tanks in sequence followed by a secondary treatment system of appropriate organic and hydraulic load capacity.

All WMS installed on commercial premises should have a flow meter fitted to the discharge pipe to measure the daily volumes of effluent in litres (not megalitres). Two or more complete WMS may be installed in series at a non-residential site to produce the required effluent quality. All the elements in both treatment trains must be installed.

Table 12 provides recommended design wastewater per-capita flow allowances and sludge/scum rates for a range of commercial and industrial premises. Under any uncertain circumstances, the higher, more conservative flow allowance figures should be applied in the design.

These rates are recommended minimums for design purposes (unless actual comprehensive water usage/flow records along with actual occupancy numbers are available).

Table 12: Hydraulic and BOD_5 allowances for commercial and industrial premises

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
AGED CARE FACILITIES							
Accommodation and resident staff	WC/urinal, basin, bath/shower, laundry, kitchen sink, dishwasher	Total number of beds plus resident staff	80	Total number. of beds plus resident staff	150	50	See Note 1
Non-resident staff	WC/urinal, basin, kitchen sink, shower	Number of staff per shift x number of shifts	25	Number of staff per shift x number of shifts	40	20	
CAMPING GROUNDS AND CARAVAN PARKS							
Permanent occupation	WC/urinal basin bath/shower laundry, kitchen sink	Total number. of sites x 3.5 per site	80	Total number of sites x 3.5 per site	150	50	See Note 2
Casual occupation	WC/urinal basin bath/shower laundry, kitchen sink	Average daily number of sites occupied over the past 12 months x 3.5 per site	48	Total number of sites x 3.5 per site	100	45	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
CHILD CARE CENTRES							
	WC/urinal basin bath/shower laundry, kitchen sink, dishwasher	Total number of children and staff	58	Total number of children and staff	50	45	See Note 2
CLUBS							
Members, guests and staff	WC/urinal basin bath/shower, kitchen sink (tea service area only)	Average daily number over 7 day period plus staff	25	Highest daily number over 7 day period plus staff	40	20	See Note 3
Bar trade (per customer)	WC/urinal, basin bar sink, glass washer	Average daily number over 7 day period	5	Highest daily number over 7 day period	10	5	
Restaurant (per diner)	WC/urinal, basin, kitchen sink, dishwasher	Average daily number over 7 day period	10	Highest daily number over 7 day period	20	5	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
COFFEE SHOPS/KIOSKS							
	WC/urinal, basin kitchen sink	Average daily number over 7 day period plus staff	30	Highest daily number over 7 day period plus staff	10	10	See Note 2
CONSTRUCTION AND MINING CAMPS							
	WC/urinal basin, shower, laundry kitchen sink, dishwasher	Total number of persons using facilities	80 x number of years to be used	Total number of persons using facilities	180	50	See Note 2
HEALTH CARE CENTRES							
Staff	WC/urinal, basin, kitchen sink, shower	Number of staff using system per shift, x number of shifts	40	Number of staff using system per shift, x number of shifts	40	25	See Note 2

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
HOLIDAY CAMPS							
e.g. scout, youth and church centres with casual occupation	WC/urinal, basin, shower, laundry, kitchen sink, dishwasher	Total number of beds (single equivalent)	48	Highest daily number using facilities	100	50	See Note 2
Staff and/or caretaker data residential to be added where applicable							
HOTELS/MOTELS/LIVE IN CONFERENCE CENTRES							
Accommodation	WC/urinal, basin bath/shower, laundry, kitchen sink	Total number of beds (single equivalents)	48	Total number of beds (single equivalents)	100	40	See Note 3
Resident staff	WC/urinal, basin, bath/shower, laundry, kitchen sink	Total number of live-in staff	80	Total number of live-in staff	150	50	
Bar trade	WC/urinal, basin, bar sink, glass washer	Average daily number over a 7 day period	5	Highest daily number over a 7 day period	10	10	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
Dining room, lounge area, non-resident use	WC/urinal, basin, kitchen sink, dishwasher	Average daily number of diners per 7 day period	10	Highest daily number over 7 day period	15	10	
Non-resident staff	WC/urinal, basin, kitchen sink	Number of staff per shift x number of shifts	25	Number of staff per shift x number of shifts.	30	20	
	Shower			As above	10	5	
PUBLIC HALLS							
	WC/urinal basin, kitchen sink (tea service area only)	Average daily number over 7 day period	Up to 4 days use per week: 25 Over 4 days use per week: 40	Highest daily number over 7 day period	10	8	See Note 2
PUBLIC SWIMMING POOLS							
Including kiosk e.g. take away food	WC/urinal, basin, shower, kitchen, sink	Average daily number over 7 day period plus staff	20	Highest daily number over 7 day period plus staff	20	15	See Note 2

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
PUBLIC TOILETS							
	WC/urinal, basin	Average daily number over 7 day period	20	Highest daily number over 7 day period	5	10	See Note 2
	Shower			as above	10	5	
RESTAURANTS							
No liquor licence	WC/urinal, basin, kitchen sink, dishwasher	Average daily number over 7 day period plus staff	35	Highest daily number over 7 day period plus staff	15	10	See Note 3
With liquor licence	WC/urinal, basin, kitchen sink, dishwasher, glass washer	Average daily number over 7 day period plus staff	35	Highest daily number over 7 day period plus staff	25	15	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
ROADHOUSES/SERVICE STATIONS							
Staff	WC/urinal, basin, kitchen sink	Number of staff per shift x number of shifts	25	Number of staff per shift x number of shifts	30	20	See Note 3
	Shower				10	5	
Public toilets	WC/urinal basin	Average daily number over 7 day period	20	Highest daily number over 7 day period	5	10	
	Shower				10	5	
Restaurant (takeaway and sit down meals)	WC/urinal, basin kitchen sink, dishwasher	Average daily number over 7 day period	10	Highest daily number over 7 day period	10	10 g per meal	
SCHOOLS and KINDERGARTENS							
Including kiosk facilities, e.g. takeaway foods	WC/urinal, basin, kitchen sink	Total number of students plus staff	25	Total number of students plus staff	20	15	See Note 2
	Shower			10% of total number of students and staff	10	5	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
Canteen facilities provided (e.g. plated hot and cold meals)	kitchen sink, dishwasher	Total number of students plus staff	10	Total number of students plus staff	5	5	
SEMINAR/CONFERENCE ROOMS (maximum capacity)							
No meals	WC/urinal, basin, kitchen sink	Total seating capacity plus staff	25	Total seating capacity plus staff	30	20	See Note 3
Meals, no liquor licence	WC/urinal, basin, kitchen sink, dishwasher	Total seating capacity plus staff	35	Total seating capacity plus staff	35	25	
Meals with liquor licence	WC/urinal, basin, kitchen sink, dishwasher, glass washer	Total seating capacity plus staff	35	Total seating capacity plus staff	40	30	

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
SHOPPING CENTRES							
Staff	WC/urinal, basin, kitchen sink	Number of staff per shift x number of shifts	25	Number of staff per shift x number of shifts	20	20 or 150 g per day per 100 m^2	See Note 2
Public	WC/urinal, basin	Average daily number over 7 day period	20	Highest daily number over 7 day period	5	10	
Shop facilities	Double bowl sink basin	Per shop	20 L/shop/y	Per shop	40 L/shop/d	10	
Supermarket	Double bowl sink, basin, cleaners sink	Per supermarket	40 L/super-market/y	Per supermarket	500 L/super-market/d	10	
SPORTS CENTRES							
e.g. gyms, squash courts, indoor cricket, basketball	WC/urinal, basin, shower, kitchen sink	Average daily number over 7 day period plus staff	25	Highest daily number over 7 day period plus staff	40	20	See Note 2

Premises	Fixtures	Sludge allowance		Daily flow rate		BOD_5 loading for septic tank effluent	Remarks
(L) = (P1 x S x Y) + (P2 x DF)		Number of persons	Litres/person/ year (L/p/y)	Number of persons	Litres/person/day (L/p/d)	Grams/person/day (g/p/d)	
Calculate each use and add to obtain total capacity:		P1	S	P2	DF	BOD_5	
STAFF ABLUTIONS AND WORK PLACE INSTALLATIONS							
e.g. factories, commercial office	WC/urinal, basin, kitchen sink	Number of staff per shift x number of shifts	25	Number of employees per shift x number of shifts	30	20	See Note 2
	Shower			Number of employees per shift x number of shifts	10	5	
Canteen facilities provided for kiosk meals	Kitchen sink, dishwasher	Number of staff per shift x number of shifts	10	Number of employees per shift x number of shifts	5	5	

Note:

1. Sludge allowance is the greater of (P1 x S x Y) or basic allowance of 1,920 L.
2. Sludge allowance is the greater of (P1 x S x Y) or basic allowance of 1,600 L.
3. Sludge allowance is the greater of (P1 x S x Y) or basic allowance of 1,600 L. For over 50 persons, the basic allowance is 1,920 L.

11.4.4. Minimum septic tank capacities for commercial and industrial premises

The minimum capacity of any non-domestic septic tank shall be 3,000 L or the effective capacity as calculated using Table 12, whichever is greater.

Table 12 only makes allowance for human waste and does not allow for industrial wastes. Certain discharges to a septic tank are not recommended as they could impair its effective operation.

11.4.5. Desludging requirements for commercial and industrial premises

The capacity of smaller septic tanks must be of sufficient volume to accommodate the build-up of sludge/scum over 3 to 5 year periods.

It is however recognised that providing a 4 year sludge/scum capacity, may result in impracticable sizes for septic tanks servicing commercial and industrial and premises. Subsequently, the desludging frequency (Y) required may be increased in accordance with the following table to reduce the size of the septic tank required.

Table 13: Desludging frequency for commercial and industrial premises

Annual sludge/scum accumulation (P1 x S)	(Y) desludging frequency
Less than 4,000 L	4 yearly
Greater than 5,000 L and less than 10,000 L	2 yearly
Greater than 10,000 L	1 yearly

The value of "Y" is used in the equation (P1 x S x Y) + (P2 x DF) and can be calculated by multiplying S and P1 together first. If the result of (P1 x S) is less than 5,000 L then Y = 4, between 5,000 and 10,000 L then Y= 2, and above 10,000 L Y=1.

Although the desludging period may reduce the capital cost of installation, maintenance costs will be increased and the installation of a reduced sized septic tank is conditional upon it being desludged at the frequency used in calculating the tank size.

An owner of a septic tank or maintenance contractor should have each septic tank inspected for sludge and scum build-up at least once a year. If the depth of sludge and scum exceeds two thirds of the total depth, the operational effectiveness of the septic tank may be reduced and subsequently the contents of the tank should be pumped out by a licensed commercial operator or suitably skilled operator on communities. The tank should not be cleaned after it is emptied and it shall be immediately filled with clean water and returned to service.

12. Setback distances

Mandatory requirement: This section recognises NT local conditions with respect to determining setback distances for the design of WMS and replaces the setback distance range in Table R1 of Appendix R Recommended setback distances for land application systems (informative) of AS/NZS 1547:2012.

12.1. Introduction

Setback distances between WMS components and site features [such as property boundaries, structures (existing or planned), waterways, etc.] are required to maintain performance and allow for repairs/maintenance. In addition, land application system effluent contains potentially pathogenic micro-organisms, dissolved nutrients and chemicals capable of traveling long distances if they reach the groundwater aquifer.

The site features that need to be considered include property lines, water supplies, wetlands, watercourses, buildings and utilities, etc. (Table 14). Proximity to any ecologically sensitive or high amenity value receiving environment must be carefully evaluated.

12.2. Tables

Table 14: Minimum setback distances from edge of device/treatment system components to edge of site feature

Device/system component	Minimum setbacks	Additional information
Septic tank, holding tank, pre-treatment tank, distribution sump and pump sump	• 2 m from any building, swimming pool, property boundary and land application area. • 20 m from any watercourse, bore or dam used or likely to be used for a domestic water supply. • 1 m from any septic tank, wastewater treatment unit, collection well, pre-treatment tank, distribution sump or pump sump.	• Device/system components must be sealed. Refer to Tables 13 & 14 for setback distances to land application areas. • In situations where the placement of a septic tank, holding tank, pre-treatment apparatus or pump sump intersects the angle of repose for the building/allotment boundary footings or foundations, or its position may affect the stability of building/allotment boundary footings and/or foundations, advice must be sought from a hydraulic engineer/consultant for their installation. • Includes RV dump points utilising collection wells which are pumped out and do not discharge to a land application area.

Device/system component	Minimum setbacks	Additional information
Manufactured wastewater treatment unit, greywater system, and other built in-situ design	• 2 m from any building, swimming pool, property boundary and land application area unless otherwise specified by a hydraulic engineer/consultant. • 20 m from any watercourse, bore or dam used or likely to be used for a domestic water supply. • 2 m from the surface or shallow subsurface irrigation area. • 1 m from any septic tank, holding tank, pre-treatment apparatus, distribution sump or pump sump.	• Device/system components must be sealed. Refer to Tables 13 & 14 for setback distances to land application areas. • Where separate primary and secondary treatment tanks or separate septic tank/treatment tank and pump sumps are used: o Tanks/sumps must be installed on a level compacted /solid base. o Tanks/sumps must be spaced so that ground movement will not result in structural damage or loss of integrity of the base support of the shallower tank (angle of repose factor). o Systems should be down slope (where practical) from any building located on the site. o In situations where the placement of manufactured secondary treatment systems, greywater systems, and other built in-situ designs intersects the angle of repose for the building/allotment boundary footings or foundations, or its position may affect the stability of building/allotment boundary footings and/or foundations, advice must be sought from a hydraulic engineer/consultant for their installation.

Table 15: Minimum setback distances from edge of land application area to edge of site feature

Land application area	Minimum setbacks	Additional information
Subsurface effluent disposal system (e.g. absorption trench, absorption bed, ETA, ETS bed)	• 2 m from a septic tank, wastewater treatment unit, holding tank, pump sump, pre-treatment tank, allotment boundary, diversion trench. • 2 m from any other WMS land application area. • 3 m downslope from a building/swimming pool/stormwater drain, or where the site is flat, 3 m from any point of the building/swimming pool/stormwater drain. • 6 m upslope from a building/swimming pool/stormwater drain.	
Shallow subsurface irrigation from secondary treatment system	On a flat or gently sloping site (i.e. gradient <10%): • 0.5 m from an allotment boundary. • 2 m from a wastewater treatment unit, septic tank or pump sump, pre-treatment apparatus, diversion trench. • 2 m from any other WMS land application area. • 2 m from any building, including those erected on adjoining allotments • 2 m from a stormwater drain. • 3 m from a swimming pool including surrounding paved area.	• Add 3 m if site features are >10% downslope. • These setbacks apply unless otherwise specified by a hydraulic engineer/consultant. • Note: Where it is intended to locate the shallow subsurface irrigation area up slope of a building, the hydraulic engineer/consultant should be consulted to determine the likely impact on the building's structure and the need for any additional requirements such as diversion trenches.
Surface spray and from secondary treatment system	On a flat or gently sloping site (i.e. gradient <10%): • 3 m from an allotment boundary. • 3 m from a wastewater treatment system, septic tank,	• Add 3 m if site features are >10% downslope. • These setbacks apply unless otherwise specified by a hydraulic engineer/consultant. • For water recycling schemes utilising spray irrigation, DoH may increase

Land application area	Minimum setbacks	Additional information
	pump sump, pre-treatment apparatus, diversion trench. • 2 m from any other WMS land application area. • 3 m from any building, including those erected on adjoining allotments. • 3 m from a stormwater drain. • 3 m from a swimming pool including surrounding paved area.	setback distance requirements to a minimum of 30 m from the site feature or request other measures to reduce the risk of public exposure to aerosols. • Note: Where it is intended to locate the surface irrigation area upslope of a building, a hydraulic engineer/consultant should be consulted to determine the likely impact on the building's structure and the need for any additional requirements such as diversion trenches.
No discharge WMS utilising passive secondary treatment (e.g. impermeable channels)	• 1 m from an allotment boundary. • 2 m from a wastewater treatment system, septic tank pump sump, pre-treatment apparatus, diversion trench • 2 m from any building, including those erected on adjoining allotments. • 2 m from a stormwater drain. • 3 m from a swimming pool including surrounding paved area. • 30 m from surface waters and groundwater detailed in Table 16.	• Add 3 m if site features are >10% downslope. • These setbacks apply unless otherwise specified by a hydraulic engineer/consultant.
Pit toilet	• Refer setbacks for primary treated effluent in Table 16.	• Not permitted in sewered areas.
Composting toilet	• Refer setbacks for secondary treated effluent in Table 16.	

Table 16: Minimum setback distances from edge of land application area to surface water/groundwater/bores/floodplains

Feature	Setback for primary treated effluent	Setback for secondary treated effluent	Additional information
Surface waters			
Dam, reservoir, waterway for domestic potable water supply	200 m	100 m	
Waterway, wetland (continuous or ephemeral, non-potable); estuaries, coastal foreshore areas, Dams, reservoirs or lakes (stock and domestic, non-potable)	60 m	30 m	• Measured to the 'mean high water spring tide'.
Groundwater bores			
Water utility production bore			• Refer Guidance Notes for Wastewater Management.
Domestic bore used for potable water supply	100 m	50 m	
Water table			
Depth to seasonal water table			• Refer to 'Depth to seasonal water table' in AS/NZS 1547:2012 - Table K1 Land application systems – Limitations due to site, soil and climatic factors.
Duration of continuous season soil saturation			• Refer to 'Duration of continuous season soil saturation' in AS/NZS 1547:2012 - Table K1 Land application systems – Limitations due to site, soil and climatic factors.
Shallow permanent water table			• Refer to 'Shallow permanent water table' in AS/NZS 1547:2012 - Table K2 Selecting the land application system to fit the site and soil.

Feature	Setback for primary treated effluent	Setback for secondary treated effluent	Additional information
Hardpan or rock			
Shallow soil and very shallow soils over creviced bedrock			• Refer to 'Shallow soil'& 'Very shallow soils over creviced bedrock' in AS/NZS 1547:2012 - Table K2 Selecting the land application system to fit the site and soil

Notes:

- Setback distances from buildings of less than 3 m are only appropriate where drip irrigation (covered or subsurface lines) land application areas are being used with low design irrigation rates.
- Setback distances from upslope boundaries as low as 0.5 m may be possible where drip irrigation land application is used with low design irrigation rates (e.g. 2.5 mm/day).
- Setback distance from surface water area is defined as the areal edge of the land application area (design area plus surrounding absorption buffer) to the edge of the waterway (e.g. the bank of a pond, stream, river, stormwater channel).
- Specific setbacks as determined by a site-and-soil evaluator may be required for areas of new subdivisions to mitigate cumulative adverse effects.
- Specific setbacks may be required for areas of recycled water schemes to mitigate cumulative adverse effects, and impacts on public health and the environment.
- Specific design considerations are required for discharge of effluent into Category 1 and 6 soils. Where groundwater quality protection is required in Category 1 soils (gravels) the level of in-ground treatment will be limited unless measures are taken to slow the soakage rate.
- Where NTG flood mapping is available, land application areas must be located outside the 1 in 100-year coastal inundation areas [1% Annual Exceedance Probability (AEP)]. Refer to AS/NZS 1547:2012 - Item G, Table R2 and Northern Territory Government Natural Resources Maps website.
- Distances must be measured horizontally from the external wall of the treatment system and the boundary of the disposal/irrigation area, except for the 'highest seasonal water table' which is measured vertically through the soil profile. For 'coastal foreshore areas', the measuring point shall be from the 'bank-full level'.
- Effluent typically contains high levels of nutrients that may have a negative impact on native vegetation and promote the growth of weeds. When determining setbacks, for subdivisions, the developer should consider the potential impact of nutrients from the proposed WMS.
- Establishing an effluent disposal/irrigation area upslope of a building may have implications for the structural integrity of the building. This issue is beyond the scope of the Code and should be examined by a structural engineer on a site-by-site basis.
- The highest seasonal water table occurs when the water table has risen up through the soil profile and is closest to the ground surface. In the Top End, this usually occurs in the wettest months of the year, however most SSE's are conducted during the dry season so evidence of mottled soil may be the determining factor.

- Refer to Notes in AS/NZS 1547:2012 Table R1 Guidelines for horizontal and vertical setback distances and Table R2 Scale for development of setback distances.
- Refer to AS/NZS 1547:2012 Table K1 & K2 for further information about how to achieve setback distances.
- Setback distances to water utility bores (other than those owned/managed by Power and Water Corporation) shall be negotiated between the water utility and DoH.

13. Design of land application systems

This section must be read in conjunction with the following Section and Appendices of AS/NZS 1547:2012:

- Section 5.5: Land application system design.
- Appendix K: Land application systems – Guidance on selection.
- Appendix L: Land application methods – Trenches, beds and ETA/ETS systems.
- Appendix M: Land application methods – Irrigation systems.
- Appendix N: Land application method – Mounds.

13.1. Overview

The land application system (also referred to as 'land application area') receives wastewater from the wastewater treatment unit and provides further treatment and discharge of effluent, via:

- Assimilation through the soil matrix for eventual plant uptake of soil moisture via transpiration.
- Evaporation.
- Percolation through the soil matrix for eventual assimilation with groundwater.

This section provides design specifications and guidance on the selection and design of land application systems, as well as construction and operation, and discusses:

- The choice of land application systems (including shallow irrigation, conventional and non-conventional systems).
- Design loading/irrigation rates, including the long-term acceptance rate.
- Sizing and placing the land application area.
- Design of dosing and distribution systems.
- Recommended planting to improve nutrient uptake and evapotranspiration.

13.2. Land application system design

The land application system design shall be based upon the results of the SSE report which factors in risk assessment criteria for the proposed site. These criteria are incorporated into the design process to determine a Design Loading Rate (DLR) and Design Irrigation Rate (DIR) appropriate to a suitable land application system.

13.2.1. Performance requirements for land application system design

To meet the performance objectives in section 4 of AS/NZS 1547:2012 for WMS, land application systems shall:

- Be of sufficient capacity to receive, treat, and absorb all treated wastewater flows.
- Complete the uptake and absorption of the final effluent within the boundaries of the property.
- Avoid the likelihood of creating unpleasant odours, or the accumulation of offensive matter.
- Not cause a public health nuisance in terms of the *Public and Environmental Health Act 2011*.

- Not cause or likely to cause environmental harm in terms of the *Waste Management and Pollution Control Act*.

13.2.2. Design process

The design process shall ensure that the selected land application system has a design area large enough to cope with the expected flow of effluent from the wastewater treatment unit, and is able to distribute the effluent over the entire land application area.

13.2.3. Soil category/DLR/DIR values

Soil category DLR/DIR values shall be used to determine to size of the selected land application system. Refer to AS/NZS 1547:2012 for further information:

- Clause 5.5.5: Soil and LTAR/DLR/DIR.
- Table 5.2: Soil categories and recommended design irrigation/loading rates (DIR/DLR) for land application systems, which cross references Tables L1, M1 and N1.

13.3. Land application systems – Guidance on selection

Refer AS/NZS 1547:2012 - Appendix K – Land application system – Guidance on selection (Informative)

The Tables in Appendix K of AS/NZS 1547:2012 provide information on the factors affecting the construction or operation of common land application systems and provide a guide to choosing or modifying an existing land application system to suit the identified site and soil constraints.

- Table K1 provides a general commentary on the site, soil and climatic factors that limit the construction or functioning of the most common land application systems.
- Table K2 identifies common site and soil constraints and provides guidance on appropriate land application system that are most suited. Also indicated are design modifications, installation practices or system management that may be used to modify the chosen system.

13.3.1. Land application methods

There are four ground absorption effluent disposal systems covered by this Code which are appropriate for use where effluent is to be disposed of within both residential and non-residential allotments. These are:

- Absorption trenches.
- Absorption beds.
- Evapotranspiration-absorption systems.
- Mound systems.

Other systems such as secondary treatment systems (STS), and recirculating evapotranspiration systems are feasible where site conditions are unsuitable for the disposal of effluent by absorption or transpiration within a single allotment, as assessed in this section.

13.3.2. Effluent dispersal in sands and gravels

Neither soil absorption trenches/beds nor primary treated effluent should be used in sands and gravels (i.e. soil categories 1 or 2a) because of the risk of pathogens and nutrients moving rapidly through the soil profile and negatively impacting the groundwater (unless the soil does not have a high perched or a seasonal water table). The best practice land application systems for sands and gravels are surface irrigation, sub-surface irrigation, mounds and recirculating evapotranspiration system.

13.4. Components used in land application areas

13.4.1. Indexing valves

Indexing valves allow multiple land application areas (beds or irrigation areas), to be used. The indexing valve will apply a set volume of effluent to the first application area after which the pump turns off and the valve automatically switches to the second application area where the process is repeated. Indexing valves are used in sub-surface drip irrigation and ETA bed land application areas. This creates a dry/wet effect in the beds allowing for greater treatment of the wastewater.

13.4.2. Dosing systems

Gravity-driven dosing siphons or flout systems are located after the collection tank (greywater or septic tank) and can be used to dose land application areas. Siphons ensure that effluent reaches the ends of ETA beds providing even distribution.

13.4.3. Distribution boxes

These are used when installing two or more absorption trenches or beds and allow for the even distribution of wastewater between the individual beds. Distribution boxes are to be installed level to ensure an even delivery of wastewater to each absorption trench or bed. They must be structurally secured to prevent movement overtime.

13.5. Land application methods - Absorption trenches and beds

Refer AS/NZS 1547:2012 - Appendix L – Land application methods – Trenches, beds and ETA/ETS systems (Normative).

Absorption trenches and beds and are the most universal land application method. Absorption trenches and beds utilising perforated plastic pipe, arch drain or modular drain may be used in all applications. These were historically the system of choice before more advanced evapotranspiration systems were developed. Conventional absorption systems may be used in well-drained areas with low groundwater tables, although some typical site issues (such as high groundwater level, periodical flooding/inundation, inadequate permeable soil depth or shallow distance to bedrock, etc.) may restrict their use.

Even though effluent will infiltrate through the side walls of the trench, as well as the base, the DLRs only use the base of the trench or bed to calculate the land application area.

Absorption trenches and beds should not be used in Soil Categories 1 and 2a [unless the soil does not have a high perched or seasonal) water table] due to the high infiltration rates of wastewater that can carry pathogens, salts and nutrients to the groundwater.

It is not recommended that absorption trenches and beds are installed in Soil Categories 5b, 5c and 6. However, where a site-and-soil evaluation has been conducted in accordance this Code, absorption trenches and beds may be proposed for Soil Categories 5b, 5c and 6.

To determine the minimum requirements for absorption trench and beds, it is necessary to calculate the required contact area in square metres. The effective contact area of an absorption trench and bed only includes the basal area (not the side walls).

The formation of the biomass on the soil contact surfaces within the soakage system is a limiting factor on the effluent percolation. The cumulative effect of the biomass is greater in cohesive soils such as clay, silts and fine sands, the exception being when the soil is the limiting factor, for example heavy clay or rock.

Depending on the soil type, absorption trench and bed spacing from side wall to side wall will vary between 1 m (for sandy loams) and 2 m (for clayey soils), and may be greater where required. The minimum spacing of 1 m is in accordance with AS/NZS 1547:2012.

Clause L.6.1.1 of AS/NZS 1547:2012 states that 'individual trench or bed lengths shall be limited to approximately 20 m. A longer trench or bed is possible if the installer can guarantee a level bottom over the proposed length. In such situations, the designer shall specify the maximum trench or bed length appropriate to the construction method to be used. The total trench or bed length is normally divided into equal proportions.'

Absorption beds are similar to trenches, but consolidated in one continuous area of media.

13.5.1. Discharge control trenches

Discharge control trenches (Figure L4 in AS/NZS 1547:2012) are not permitted due to the lack of side wall absorption and because the effluent can be directed to groundwater.

13.5.2. Boxed trenches

Boxed trenches (Figure L3 in AS/NZS 1547:2012) constructed from brickwork and precast reinforced concrete are not permitted, however modular plastic drainage cells are permitted.

13.5.3. Modular drainage cells

Modular drainage cells are typically manufactured from high strength recycled polypropylene which is inert to soil borne chemicals and bacteria. They provide a uniform surface and a void space to provide an effective subsurface drainage system using a boxed absorption trench or flatbed drainage cell configuration in accordance with manufacturer's instructions. They must be covered in a non-woven filter fabric and can be backfilled with natural ground in accordance with Figure L3 in AS/NZS 1547:2012.

Flatbed modular drainage cells must include an integrated distribution channel(s) installed in accordance with manufacturer's instructions, to ensure even distribution of effluent through the land application system.

All modular drainage cells must be sized in accordance with AS/NZS1547:2012 using the basal width to calculate the land application area. For the purposes of sizing a boxed absorption trench backfilled with natural ground, the basal width of each trench shall be 600 mm (equivalent to the width of a standard backhoe bucket).

13.5.4. Sizing of absorption trenches

Absorption trench dimensions are determined from the following formulas which are based upon Appendix L in AS/NZS 1547:2012.

Step 1: Obtain hydraulic load (Q, L/d). This shall be based on equivalent persons (EP).

Step 2: Obtain Design Loading Rate (DLR, mm/day). The DLR varies with effluent primary/secondary quality and conservative DLRs must be used where site constraints exist.

Step 3: Obtain absorption trench design factors:

- Select absorption trench construction method.
- Set trench design width (W) – Depends on construction.

Step 4: Determine absorption trench surface area (A, m^2):

A = Q/DLR

Where: Q = Total daily flow in L/day; DLR = Design loading rate in mm/day.

Step 5: Determine absorption trench length (L, m):

L = A/W

Where: A = Result from Step 4; W= Absorption trench width in metres.

Step 6: Determine number of connected trenches (N):

N = L/20 m (max length), rounded up to the nearest integer.

13.5.5. Sizing of absorption beds

Step 1: Obtain hydraulic load (Q, L/d). This shall be based on equivalent persons (EP).

Step 2: Obtain Design Loading Rate (DLR, mm/day). The DLR varies with effluent primary/secondary quality and conservative DLRs must be used where site constraints exist.

Step 3: Obtain absorption bed design factors:

- Length:width ratio (R)
- Aggregate/natural ground distribution bed thickness (T1, 300 mm – 550 mm)
- Topsoil cover thickness (T2, 50 mm – 150 mm).

Step 4: Determine absorption bed surface area (A, m^2):

A = Q/DLR

Where: Q = Total daily flow in L/day; DLR = Design loading rate in mm/day.

Step 5: Determine absorption bed width (W):

W = $\sqrt{A}/R$

Where: A = Result from Step 4; R = length:width ratio.

Step 6: Determine absorption bed length (L):

L = WR

Where: A = Result from Step 5; R = length:width ratio.

Step 7: Determine total bed depth (T, mm):

T = T1 + T2

Where: T1 = Aggregate/natural ground distribution bed thickness; T2 = Topsoil cover thickness.

13.6. Land application methods - Evapotranspiration-Absorption Trenches or Beds (ETAs)

Refer AS/NZS 1547:2012 - Appendix L – Land application methods – Trenches, beds and ETA/ETS systems (Normative).

An Evapotranspiration-absorption (ETA) trench or bed system is suitable for sites with heavy or clay soils (such as Category 4-6 soil profiles). The trenches are comprised of a pipe distribution system, sand and aggregate, and suitable soil for the long-term application of effluent. The trenches are designed to be covered by plants, typically a lawn grass is used.

They are recognised under AS/NZS 1547:2012 and disperse the treated water via three natural water processes: sub-surface infiltration into the soil, evaporation from solar and wind influences, and transpiration by plants into the atmosphere. The ETA trenches/beds themselves provide additional treatment through bio-mat filtration, soil adsorption, and the ability of plants to assimilate nutrients and water into their biomass. An ETA trench/bed has improved performance and Long Term Acceptance Rate (LTAR) in comparison to conventional trenching.

ETAs may be used as an alternative to conventional absorption trench and absorption bed systems, especially in locations with low permeability soils. Sizing of ETAs. ETAs are sized the same as absorption beds.

13.7. Land application methods – Irrigation systems

Refer AS/NZS 1547:2012 - Appendix M – Land application methods – Irrigation systems (Normative).

Shallow irrigation systems are well suited to moderate draining soils. In slow draining and fast draining soils, an adequate overlying topsoil depth is needed, and environmental requirements must be met.

The distribution of wastewater in shallow irrigation systems is usually designed based on areal[1], rather than basal[2] loading. The areal loading rate is determined according to soil characteristics and environmental constraints with lower rates appropriate for sites having environmental limitations, including poorer soakage characteristics.

In spray irrigation, effluent is secondary treated and disinfected prior to being dispersed over the soil or vegetated area by sprinklers. Effluent is sprayed at a low rate and generally relies on evaporation to enhance the system's ability to dispose of effluent. Stringent bacterial effluent quality standards apply to spray- irrigated wastewater and drip irrigation is strongly preferred, wherever practicable.

In terms of design, the spray head is not greater than 500 mm above the finished irrigation surface. All wetted diameters for each spray head are not greater than 2 m and are contained inside the designated irrigation area. All surface irrigation including spray irrigation systems are not recommended due to their higher environmental and public health risks. Extreme care is required during design when determining the areal loading rate and to locate the irrigation area. The irrigation area must be located to avoid any potential for contamination of natural springs or runoff to surface water and cultural sites.

Other design considerations include:

- Wet weather storage to control irrigation during rainfall.
- Wind exposure, aerosol formation and spray drift.
- Setback distances from property boundaries.
- Public access to the irrigation area.

Notes:

1. Typically applied for shallow irrigation systems, where the loading application area comprises the entire irrigation area including the area between the distribution lines.
2. For conventional land application systems, the design land application area only comprises the basal area of the trench, bed or mound excluding the area in between.

13.7.1. Shallow subsurface drip irrigation system

The default for recycling secondary quality effluent is pressure-compensating subsurface irrigation (with disc or mesh filters and scour and vacuum valves) which evenly distributes effluent throughout the irrigation area. This ensures water is not wasted by evaporation or runoff, flexible garden designs are possible, water is delivered to the plants' roots in the topsoil layer and it provides the highest protection for environmental and public health.

The distribution pipes (drip-lines) fill up with effluent until a certain pressure is reached which opens the emitter valves. For a 450 m^2 irrigation field with 13 mm diameter pipes, at least 60 L may be required to be pumped into the pipes to reach the required pressure to open the emitters. More controlled pressure can be applied when the field is divided into two or more zones and these smaller areas are intermittently dosed using a sequencing valve.

13.7.2. Sizing of shallow subsurface drip irrigation system

Step 1: Obtain hydraulic load (Q, L/d). This shall be based on equivalent persons (EP).

Step 2: Obtain Design Irrigation Rate (DIR, mm/day). This shall be adjusted to accommodate site constraints. In some circumstances, DIR may be reduced to accommodate nutrient/salt loads or pathogens.

Step 3: Obtain irrigation system details:

- Irrigation field length:width ratio (R, typically 1 to 2)
- Irrigation drip line spacing (S, m) (typically 1)
- Dripper flow rate (F L/hour) (typically 4.5 L/hour)
- Dripper outlet spacing (B, m) (typically 0.5m).

Step 4: Determine minimum irrigation area (A, m^2):

A = Q/DIR

Where: Q = Total daily flow in L/day; DIR = Design irrigation rate in mm/day.

In some circumstances, 'A' may need to be increased to accommodate nutrient/salt loads.

Step 5: Determine number of sprinklers (N):

W = $\sqrt{AR}$

Where: A = Result from Step 4; R = length:width ratio.

Step 6: Determine approximate sprinkler spacing:

D = 2R (1 – Os)

Where: R = length:width ratio; Os, generally 0.1 to 0.3.

13.7.3. Low Pressure Effluent Distribution (LPED) system

A Low Pressure Effluent Distribution (LPED) system is a series of narrow gravel-filled trenches with good quality, friable, humus-rich topsoil between and above the trenches. Where the local soil is inadequate, good quality topsoil must be imported to the site. This system was designed in the USA for difficult sites such as an impervious B horizon. The system utilises the permeable nature of friable humus-rich topsoil to spread effluent through the side walls into the 1 to 1.5 m trench spacing. The topsoil helps maximise evaporation and transpiration through the grass cover. Pump dosing is essential to evenly spread the effluent along the trenches.

Limitations of the LPED system are the risk of distribution holes becoming blocked by biosolids and roots, and limited effluent storage capacity between the trench aggregate. Even distribution along the trench is crucial to utilise the land available and prevent failure of the system.

LPED systems require flushing to address slime build-up and clogging of distribution holes.

13.7.3.1. Sizing of LPEDs

LPEDs are sized similarly to absorption beds.

13.7.4. Covered surface drip irrigation system

These systems are referred to in AS/NZS1547:2012 - Appendix M Land application methods – Irrigation systems (Normative) and comprise effluent being applied directly to the surface of the soil under a cover of 150 mm mulch.

Mulch is easily washed away during a Top End wet season and is not necessarily reinstated, so covered surface drip irrigation is not permitted in the NT.

13.7.5. Spray irrigation system

The use of spray irrigation systems of disinfected effluent is not permitted on household lots <4,000 m^2 due to the public health risks.

13.7.5.1. Sizing of spray irrigation system

Step 1: Obtain hydraulic load (Q, L/d). This shall be based on equivalent persons (EP).

Step 2: Obtain Design Irrigation Rate (DIR, mm/day). This shall be adjusted to accommodate site constraints. In some circumstances, DIR may be reduced to accommodate nutrient/salt loads or pathogens.

Step 3: Obtain irrigation system details:

- Sprinkler throw radius (R, m)
- Design sprinkler overlap fraction (Os, generally 0.1 to 0.3).

Step 4: Determine minimum irrigation area (A, m^2):

A = Q/DIR

Where: Q = Total daily flow in L/day; DIR = Design irrigation rate in mm/day.

In some circumstances, 'A' may need to be increased to accommodate nutrient/salt loads.

Step 5: Determine number of sprinklers (N):

$(N) = A/(2R)^2(1 - Os)$

Where: A = Result from Step 4; R = length:width ratio.

Step 6: Determine approximate sprinkler spacing (D)

(D) = 2R(I – Os).

Step 7: Determine irrigation lateral length (L, m):

$L = W - S = \sqrt{A}/R \ - S$

Where: W = Result from Step 5; S = Result from Step 3; A = Result from Step 4;
R = Result from Step 6.

Step 8: Determine number of irrigation laterals (N):

N = A/WS

Where: A = Result from Step 4; W = Result from Step 5; S = Result from Step 3.

Step 9: Determine minimum pump flow rate in field (P, L/s):

P = FLN/3600B

Where: F = Result from Step 3; Result from Step 7; N = result from Step 8; B = Result from Step 3.

13.8. Land application methods – Mounds

Refer AS/NZS 1547:2012 - Appendix N – Land application methods – Mounds (Normative).

Mounds or mound systems (also referred to as Wisconsin mounds) are effluent drain fields constructed on the surface of the soil from imported fill material, usually washed river sand. The system can operate with a low rate dosing pump to inject effluent into a distribution system buried on the mound.

The main use of the mound system is in situations where drainage of the natural soil is a problem. Other uses are in locations where low height flooding may occur. They are used as an alternative to below ground drainage fields. Water disposal is by evaporation and some low level of soil absorption.

The sand filled mound is essentially a secondary treatment aerobic sand filter system positioned above the dispersal site. Water is removed by evaporation from sun and wind, and transpiration from the grasses and ground covers planted over the mounds. Any effluent migrating to the base of the mound is regarded as equivalent to secondary treated wastewater and is further treated and dispersed by natural soil absorption processes. The mound will need to be turfed to prevent erosion.

Mound systems are normally only be considered on larger allotments in areas with high water tables, shallow rock or very difficult soil types. The system requires a pre-treatment step, such as a septic tank followed by a pump chamber.

Mound systems are best suited for the treatment and dispersal of treated water from clusters of domestic houses, and commercial or industrial applications. The treatment system is capable of handling relatively large flows and sites that have fluctuations in wastewater generation volumes, such as sports ovals, caravan parks, restaurants, and cellar doors.

13.8.1. Sizing of mound system

Step 1: Obtain hydraulic load (Q, L/d). This shall be based on equivalent persons (EP).

Step 2: Obtain distribution bed loading rate (BLR, mm/day). This shall not exceed 40 mm/d.

Step 3: Obtain maximum mound bed loading rate (DLR, mm/d).

Step 4: Obtain mound system details:

- Distribution bed length to width ratio (R, typically 6 to 8)
- Ground slope (α; degrees, 8.5° typical maximum
- Fill batters of 1 in b (minimum b = 3)
- Distribution bed thickness (T1, minimum 225 mm)
- Sand cover over distribution bed (T2, minimum 150 mm)
- Top soil cover over mound (T3, minimum 150 mm)
- Sand depth below distribution bed (T4, minimum 600 mm).

Step 5: Determine minimum distribution bed area (Ar, m^2)

Ar = Q/BLR

Where: Q = Total daily flow in L/day; BLR = Distribution bed loading rate in mm/day.

Step 6: Determine distribution bed width (A, m)

(A) = $\sqrt{Ar}/R$

Where: Ar = Result from Step 5; R = Bed length to width ratio.

Step 7: Determine distribution bed length (B, mm)

(A) = AR

Where: A = Result from Step 6; R = Bed length to width ratio.

Step 8: Determine minimum mound height at distribution bed (T, m)

T = T1 + T2 + T3 + T4

Where: Refer Step 4 for T1, T2, T3, T4.

Step 9: Determine mound extent upslope (I, m)

(I) = T/[(1 ÷ b) + tanα]

Where: T = Result from Step 8; b = fill batter; α = ground slope.

Step 10: Determine mound extend downslope (J, m)

(J) = [T + (A x tan α)]/[(1 ÷ b) – tanα]

Where: T = Result from Step 8; A – Result from Step 6; α = ground slope; *b = fill batter.*

Step 11: Determine upper mound extent across slope (K1, m)

(K1) = Tb

Where: T = Result from Step 8; b = fill batter.

Step 12: Determine lower mound extent across slope (K2, m)

(K2) = [T + (A x tanα)] x b

Where: T = Result from Step 8; A = Result from Step 6; α = ground slope; *b = fill batter.*

Step 13: Check toe loading rate (TLR, l/lineal m of toe/d)

(TLR) = Q/[B + (2 x K1)]

Where: Q = Total daily flow in L/day; B = result from Step 7; K1 = result from Step 11.

Step 14: Check mound base loading rate does not exceed allowable maximum DLR of 16 mm/d

DLR_{Actual} = Q/[B + (2 x K1) x (A + J)]

Where: Q = Total daily flow in L/day; *B = result from Step 7;* K1 = result from Step 11; *A = result from Step 6; J = result from Step 10.*

13.9. Land application method – Recirculating evapotranspiration systems

These WMS are designed to resemble a series of raised garden beds utilising vegetation to process wastewater by evapotranspiration. Pre-treatment is required and the recirculating nature of these technologies result in a relatively small footprint for each system. These systems can achieve 'no release' of wastewater to the environment.

Recirculating evapotranspiration systems must be designed and installed as a PCA performance solution see section 2.2.2.

14. References used in the development of the Code and Guidance Notes

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