Richmond Valley Council

RICHMOND VALLEY COUNCIL

ON-SITE SEWAGE AND WASTEWATER MANAGEMENT STRATEGY

REVISED 2017

ADOPTED BY COUNCIL ON 20 FEBRUARY 2018

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1.0 INTRODUCTION

Richmond Valley Council was formed in February 2000 as a result of the amalgamation of the former Casino Council and Richmond River Shire Council. The Council covers an area of approximately 3,050 square kilometres and has a growing population (22,037 as at 2011 http://www.censusdata.abs.gov.au). Council's vision for the area is a collaborative community working together to advance a resilient and robust economy which reflects a strong sense of community, successful businesses and a healthy environment.

Richmond Valley Council has approximately 3000 On-site Sewage Management System. This strategy aims:

- To provide a framework to manage and regulate the impact of on-site sewage management systems in the Richmond Valley Council area, and to ensure user accountability;
- To provide appropriate information to the general community, plumbers and consultants to improve on-site sewage management.

1.1 BACKGROUND

The purpose of this document is to provide guidance to owners, applicants, installers, consultants and developers on all aspects of on-site sewage and wastewater management systems for single domestic households; from planning through to implementation and maintenance.

This document amends Richmond Valley Council's 2001 On-site Sewage and Wastewater Management Strategy.

1.2 LEGISLATIVE BACKGROUND

In March 1998 the NSW Government introduced changes to its on-site sewage management regulations in response to the need for improved health and environmental outcomes.

These changes enhance the capacity of Richmond Valley Council to monitor, manage and regulate sewage pollution, in accordance with the principles of ecologically sustainable development.

On-site sewage and wastewater management and disposal is regulated by a number of guidelines and legalisations, such as:

Local Government (Approvals) Amendment (Sewage Management) Regulation 1998.

a. This Regulation defines a 'sewage management facility' as:
   I. a human waste storage facility; and
   II. a waste treatment device intended to process sewage and includes a drain connected to such a facility or device.

b. The Local Government (Approvals) Regulation 1993, as amended by the Local Government (Approvals) Amendment (Sewage Management) Regulation 2005.

c. Environment and Health Protection Guidelines "On-Site Sewage Management for Single Households" (a.k.a. *The Silver Bullet*).

The amendments do not alter the existing powers and duties of the Council to regulate the installation of an operation of on-site sewage management systems under Section 68 and Section 124 of the Local Government Act, 1993.

However, the new regulation stipulates:

- Council's responsibilities and powers to regulate the installation and ongoing operation of on-site sewage management systems
- Performance standards for on-site sewage management, including protection of public health and prevention of environmental damage
- Accreditation roles and responsibilities of NSW Health
- Responsibilities of owners to seek a renewable approval to operate the facility and
- Council's responsibilities to develop a Strategy for on-site sewage management within its area.

1.3 SCOPE

The on-site sewage management regulations and guidelines provide a framework for implementation of ecologically sustainable on-site sewage management practices. Management of existing on-site systems and addressing sewage management for all new sewage management installations is a major focus of this strategy.

It is intended that this should be achieved, as far as possible, by a process of implementation of appropriate guidelines for site evaluation criteria, maintenance requirements and operating requirements for all sewage management systems. Community and user education is also to be undertaken to compliment the Strategy in a manner which is sensitive to local circumstances.

This On-site Sewage and Wastewater Strategy encompasses all single dwelling domestic on-site wastewater disposal systems within the Richmond Valley Council area. In regards to commercial premises such as greyhound facilities, you are recommended to gain advice from Council.

The Strategy is divided into Part A and Part B with eight (8) Appendices designed to provide information in regards to the processes required to install new and upgrade existing on-site sewage management systems in the Richmond Valley Council area and the types of on-site sewage management systems and Land Application Areas (here on referred to as LAA) available. A daily disposal model accompanies the Strategy and is used to calculate LAA for new installations and a matrix is included for upgrades of existing systems.

The Strategy is divided into Part A and Part B with eight (8) Appendices.

Part A - Introduction and Definitions - includes information on the scope of the Strategy, legislation, aims, goals, guiding principles and definitions.

Part B - Design Requirements - provides step by step guidance in completing on-site sewage management reports and site and soil assessment.

Appendix 1 - On-site Treatment Systems and Components.

Appendix 2 - Land Application Areas (LAA).

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Appendix 4 - Blank Site and Soil Assessment Forms.

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1.4 CITATION

This Strategy is cited as the “Richmond Valley Council Sewage and Wastewater Management Strategy Revised 2017” and is a revision of the 2001 “Richmond Valley Council Sewage and Wastewater Strategy”.

1.5 STATUS

This Strategy is in draft form. Following Council review it should be placed on public exhibition for twenty-eight (28) days before being formally considered by Council.

1.6 COMMENCEMENT DATE

This Strategy will become effective from the date it is adopted.

1.7 APPLICATION

This Strategy shall apply from the commencement date to all development consents and construction certificates and applications under Section 68 Local Government Act 1993 relating to or affected by the matters contained in the Strategy.

Applications to Richmond Valley Council for the installation of an on-site sewage management system or an upgrade to an existing system on or after 6 April 1998 are subject to two (2) separate approvals, being:

a. an approval to install, construct or alter a sewage management system,

b. an approval to operate an on-site sewage management system.

These two (2) approvals have been incorporated into one (1) form.

The approval to install, construct or alter a sewage management system relates to the installation of a new on-site sewage management system or the upgrade of an existing system.

This application is made under Section 68 of the Local Government Act and is required to be submitted to Council with the appropriate fees for Council approval prior to any works commencing.

The approval to operate an on-site sewage management system is issued after Council has undertaken a final Council inspection of the installation works and the works are to the satisfaction of Council.

It is an offence under the Act to undertake work to install or alter an on-site sewage management system without prior written approval by Council and an offence to operate a sewage management system without Council approval.

1.8 RELATIONSHIP

This Strategy applies to all land within the Richmond Valley Council, except those areas provided with reticulated sewer drainage and/or otherwise exempted by legislation.

This Strategy supersedes all previous information issued by Richmond Valley Council with respect to on-site wastewater treatment and disposal.

1.9 REGULATIONS

- AS 1546:1 - On-site domestic wastewater treatment units - Septic Tanks.
- AS 1546:2 - On-site domestic wastewater treatment units. Part 2: Waterless composting toilets.
- AS 1546:3 - On-site domestic wastewater treatment units. Part 3: Aerated wastewater treatment systems.
- AS/NZS1547-2012 - On-site Domestic Wastewater Management.
- Local Government Regulations 1993.
- Local Government Act 1993.
- Local Government (General) Regulation 2005.
- Protection of the Environment Operations Act 1997.
- Public Health Act 2012.
- Richmond Valley Council LEP.
- Environment and Health Protection Guidelines - *On-Site Sewage Management for Single Households* (a.k.a. The Silver bullet).
- AS/NZS 3500 – National Plumbing and Drainage Code.
- National Construction Code Series: Volume 3 - Plumbing Code of Australia.
- Plumbing and Drainage Act 2011.

1.10 AIMS

This Management Strategy has a number of aims, including:

- Providing a framework to manage and regulate the impact of on-site sewage management systems in the Richmond Valley Council area, and to ensure user accountability,
- To provide appropriate information to the general community, plumbers and consultants to improve on-site sewage management.

1.11 OBJECTIVES

The general objectives of this Strategy plan are:

- To ensure the protection of the surrounding environment including groundwater, surface water, land and vegetation through the selection of a system suitable for that particular site.
- To aid in the prevention of public health risk from on-site sewage disposal.
- To continue in maintaining and improving community amenity.
- Ensuring maximum re-use of resources.

- Ensuring ecologically sustainable development.
- Ensuring that these guidelines can be continually reviewed and updated as new technology is developed.
- Recognises the value of wastewater for the possibilities of effective reuse of this resource.
- To aid in the public recognition of on-site sewage treatment systems;
- Ensure on-going maintenance and monitoring program which will involve the land owner/resident and Council.
- To create a framework for improved management of on-site wastewater disposal systems.
- To develop a public awareness of the operating and maintenance and reporting requirements relating to On-Site Sewage Treatment and effluent disposal.

1.12 GOALS

To achieve the objectives outlined above, the following goals have been set:

- To create and maintain a database of all existing on-site sewage systems.
- To ensure that all sewage management systems and LAA's comply with environment and health protection guidelines and Council operating requirements.
- To reduce the frequency of system failure as a result of householder misuse.
- To ensure that all on-site systems are inspected at regular intervals, are desludged and maintained as required.
- To consult with Aerated Wastewater Treatment Systems (AWTS) service agents to ensure that three (3) monthly maintenance reports are submitted in accordance with NSW Health certificate of accreditation requirements.
- To ensure that LAA complies with site requirements and are not failing.
- To review Council development standards and approval criteria for subdivisions, development and building to ensure that appropriate provision are made for sustainable on-site sewage management when residential development occurs in non-sewered areas.

1.13 GUIDING PRINCIPLES

The following principles should be applied in the design and operation of on-site sewage management systems:

- Selection of a treatment system and LAA: first consider low-tech passive design gravity fed systems i.e. a septic tank and ETA beds; compost toilet with greywater tank and ETA beds; and, use of reed beds.
- Maximise the opportunity for nutrient and water re-use by vegetation uptake. Re-use by evapotranspiration is preferred, but disposal is acceptable in particular circumstances given the environmental sensitivity of an area, and the individual circumstances of the case.
- Evenly distribute effluent throughout the LAA.
- Reduce the amount of natural resources utilised in construction from off site.

- Systems must minimise the risk of runoff of wastewater including during rain/storm events.
- Systems must minimise the risk, to householders and the public, of spread of pathogens/microorganisms.
- Intermittent dosing is desirable where possible.
- The minimum number of persons in a household is to be five (5) persons. If it is known that the number of persons will be greater than five (5), that value is to be used. If the number of bedrooms is 5 or greater, than the number of bedrooms plus one is to be used to calculate the number of persons.
- Treatment and LAA's are to be provided with a maintenance schedule and be maintained on a regular basis. Richmond Valley Council maintains a register of all on-site sewage management systems and their maintenance requirements.

2.0 DEFINITIONS

Absorption - the absorption and/or uptake of effluent into the soil by capillary action.

Absorption trench or bed or area - a land application system which uses the principle of absorption.

Adsorption - the physical or chemical attachment of substances to the surface of soil particles.

Aerated wastewater treatment system (AWTS) - a system which uses the processes of aeration followed by clarification to achieve biological treatment of wastewater.

All-waste - the combined blackwater and greywater from a dwelling premise that is generating domestic waste.

Appropriately qualified and experienced irrigation designer - Council defines this person as *“A person holding specialist qualifications in irrigation design and/or who has demonstrated to the satisfaction of Council that they have relevant experience in the competent design of wastewater irrigation systems. (Note: An individual who holds current accreditation as a Certified Irrigation Designer (CID) as issued by Irrigation Australia Ltd is one way of satisfying this criterion)”.*

Blackwater - wastes discharged from the human body either direct through a water closet (flush toilet) and/or urinal.

Biochemical Oxygen Demand (BOD) - the amount of oxygen required for the biological decomposition of organic matter.

Buffer Distance - the distance of wastewater disposal areas (i.e. LAA) to such items such as dwellings, driveways and environmentally sensitive areas.

Certified Irrigation Designer (CID) - An individual that holds a current certified irrigation designer (CID) certificate as issued by Irrigation Australia Ltd, and who can provide evidence of design work completed using treated wastewater in landscape, horticultural and/or agriculture projects.

Collection Well - (See pump well)

Compost Toilet - treatment units which employ the process of biological degradation in which organic material is converted into compost like material through the action of micro-organisms and invertebrates.

Desludging - removal of the accumulated sludge and scum from the septic tank.

Design Area - the area of any particular lot where the land-application area and its reserve area are to be located.

Design Loading Rate (DLR) - the long term acceptance rate (LTAR), reduced by a factor of safety, expressed in L/m2/day or mm/day as applied to the horizontal design area of a land-application system.

Dispersive soil - a soil that has the ability to pass rapidly into suspension in water.

Distribution box - a concrete box mainly used to evenly distribute effluent from septic/greywater tanks to ETA beds.

Domestic Wastewater - Wastewater originating from household or personal activities including; water closets, urinals, kitchen bathrooms (including shower, washbasins, bath, spa bath but not spa); and laundries. Includes such 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.

Drainage - An indication of the local wetness conditions likely to occur in most years.

Soil wetness is further described as very poorly drained, imperfectly drained, moderately well drained, well drained and rapidly drained.

a. Very poorly drained - Water is removed from the soil so slowly that the water table remains or near the surface for most of the year.

b. Poorly drained - All horizons remain wet for periods of several months.

c. Imperfectly drained - Some horizons are wet for periods of several weeks.

d. Moderately well drained - Some horizons may remain wet for as long as one week after water addition.

e. Well drained - Some horizons may remain wet for several days after water addition.

f. Rapidly drained - No horizon is normally wet for more than several hours after water addition.

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 - the liquid discharge from a wastewater treatment unit.

Effluent Filter - placed in outlet of septic/greywater tanks to reduce the level of solids entering the LAA

Environmental Performance – refers to the performance of on-site domestic wastewater systems; relative to both public health protection and protection of the natural and physical environments.

Ephermal Stream - a water course that has its channel above the water table at all times. Only carrying water during and immediately after rain i.e. gully.

Evapotranspiration absorption (ETA), Trench, Bed or Area - a land application system that embodies the principles of evaporation, transpiration and absorption.

Evapotranspiration - removing water from soil by evaporation and from plants by transpiration.

Faecal Coliforms - a type of bacteria that live only in the gut of warm-blooded animals. It can be detected in the general environment if that environment is contaminated with human excreta and therefore can act as an indicator of recent faecal contamination.

Geotextile - a water permeable material used in foundation stabilisation, soil particles moved by water erosion are designed not to pass thorough the geotextile fabric, (care should be taken as there are different fabric spacing sizes and qualities).

Greywater - wastewater from washing machines, laundry tubs, showers, hand basins and baths specifically excluding wastewater from kitchen, toilet, urinal or bidet. Greywater does not normally contain human waste unless laundry tubs or basins are used to rinse soiled clothing or baby's napkins.

Groundwater - the body of water in the soil, all the pores of which are saturated with water. If the body of water is present at all times it represents permanent or true groundwater.

Holding Tank - a tank used for holding wastewater prior to pumping out (minimum capacity 2050Ltitres). Also see pump well.

Indexing valve - allows for intermittent dosing of up to six (6) land application areas using a pump.

Land Application Area (LAA) - the area over which wastewater is applied i.e. disposal area.

Long-term acceptance rate (LTAR) - the maximum rate that a land-application system can treat primary or secondary effluent. It allows for loss to the soil by percolation through the base and side-walls of the system and other losses to the atmosphere by evaporation and evapotranspiration.

Low Tech - gravity fed systems with minimal maintenance requirements.

Maintenance Certificate - a document that certifies that an on-site domestic wastewater system has been inspected by an accredited person and is judged to be properly operated and maintained.

Pathogens - micro-organisms that are potentially disease causing; these include, but are not limited to bacteria, protozoa and viruses.

Primary Treatment - the separation of suspended material from wastewater by settlement and/or flotation in septic tanks, primary settling chambers etc., prior to effluent discharge to either a secondary-treatment process, or to a land application system.

Pump Well - a well-used for holding wastewater prior to pumping out (sometimes called a collection well).

Pump Out - refers to the removal of wastewater from a septic or greywater tank, usually occurring every five (5) years.

Reed bed - A system for further treatment of effluent consisting of a bed of rock or other durable media in which wetland plants are grown.

Scum - the floating mass of wastewater solids buoyed up by entrained gas, grease or other substances which form an accumulating layer on the liquid surface inside the treatment tank.

Secondary Treatment - Aerobic biological processing and settling or filtering of effluent received from a primary treatment unit. Effluent quality following secondary treatment is expected to be equal to or better than 20g/m3 5-day biochemical oxygen demand and 30g/m3 suspended solids.

Septic Tank - a single or multiple chambered tank through which wastewater is allowed to flow slowly to permit suspended matter to settle and be retained, so that organic matter contained therein can be decomposed (digested) by anaerobic bacterial action in the liquid. The term covers tanks used to treat all waste greywater or blackwater.

Setback - the distance that a wastewater system must be situated from any facility, boundary or body of water (see buffer distance).

Sewage Management - any activity carried out for the purpose of holding or processing, or reusing or otherwise disposing of, sewage or by-products of sewage.

Sewerage - the network of collection drains carrying domestic wastewater or effluent away from properties for off-site treatment.

Sludge - the semi-liquid solids settled from wastewater.

Sodic - a soil condition in which the percentage of exchangeable sodium is high enough to cause significantly increased clay dispersivity, decreased soil structure stability and to potentially decrease soil permeability.

Soil Absorption - (includes leach drains, drain fields, absorption trenches, seepage beds and seepage pits) subsurface land application systems that rely on the capacity of the soil to accept and transmit the applied hydraulic load.

Soil Permeability - a calculated value derived from the rate at which a head of liquid is absorbed into soil, usually measured in m/d as Ksat.

Sub-soil – this is a depth a minimum of 300mm below the soil surface for the disposal of primary treated wastewater.

Sub-surface - 0-300mm depth.

Sub-Surface Drip Irrigation - pressurised irrigation system requiring a minimum of secondary treated wastewater, usually installed at a depth of 150mm and may require disinfection.

Sullage -see Greywater.

Transpiration - the transfer of water to the atmosphere through plants.

Wastewater - the used water arising from domestic activities in dwellings, institutions or commercial facilities consisting of all waste, greywater, or blackwater.

Wastewater System - an on-site domestic wastewater system that receives treats and absorbs wastewater within the property boundaries of the site of generation.

Water-table - the upper surface of groundwater below which the soil is permanently saturated with water.

WAX/WAE - Works as Executed - a diagram of the work undertaken drawn by the plumber after the installation is complete showing all measurements and the position of inspection openings (sometimes stated as WAE).

Section 2 - Part B - On-Site Sewage Management Systems Design, Installation Requirements, and Consultants Reports

2.1 Introduction

A significant number of on-site sewage management systems fail to meet environmental and health protection standards. To improve the performance of systems in the Richmond Valley Council area, this design document provides supporting information to ensure sites are adequately assessed and on-site sewage and wastewater systems do not threaten human health and the environment.

All new on-site sewage management system designs require a consultant's report with the LAA sized using the daily disposal model. In regards to simplifying the process a matrix has been produced for use in simple upgrades of existing on-site sewage management systems alleviating the need for plumbers in some circumstances to use Council's daily disposal model when proposing standard upgrades.

Please note that any upgrade, alteration or new installation requires the submission of a Section 68 application form and the payment of the appropriate fee. Any plumbing above the tank will require a plumbing permit from Council.

2.2 Upgrade Matrix - Sizing Land Application Areas for the Upgrade of Existing On-Site Sewage Management Systems

In order to make the process of sizing LAA easier for standard upgrades (see Upgrades - Section 11.2) Council has provided a Matrix that can be used. The Matrix can be used on sites that have a reasonable soil type i.e. clay loam or loam, and no limitations. Those sites with a poor soil quality i.e. light to heavy clay or limitations i.e. within 100 metres of a water body shall require a wastewater report. All upgrades will require site and soil assessment forms to be submitted. Blank site and soil assessment forms can be found in Appendix 4.

The Matrix will size areas conservatively and those plumbers/consultants wishing to reduce the area of the land application area shall be required to provide justification to Council as to why the area size should be reduced. This may result in a wastewater report having to be submitted to Council.

The Matrix can be found in Appendix 3 and will provide information on those sites that will require a wastewater report. Those consultants or plumbers wishing to use the daily disposal model instead of the Matrix may do so.

3.0 COUNCIL REQUIREMENTS FOR CONSULTANT'S REPORTS

Council requires the submission of a consultant's report for all new installations on undeveloped land and those upgrades deemed by Council to have significant limitations. When designing on-site sewage and wastewater disposal systems the following steps need to be taken:

a. Undertake desktop research to determine Deposited Plan (DP) and Lot numbers; flooding depths (1:100 and 1:20 year flood levels) and frequency; acid sulphate soils, consult with Council's database of contaminated lands etc. geology and soils of the area (see Table 1) using Soil Landscapes of the Lismore - Ballina 1:100,000 Sheet or the Soil Landscapes of the Woodburn 1:100,000 Sheet by Morand (1994), noting that this step does not preclude a proper site and soil assessment.

b. Conduct a site inspection and complete Site and Soil Assessment Forms (Appendix 4). Consultation with the property owner is to occur in relation to the type of system and disposal method proposed. Ensuring the owner is aware of any maintenance requires for the proposed system and restrictions on the site. Council requires a minimum of two (2) boreholes to be undertaken to a depth of 1.0 metre.

c. Identify a suitable LAA. Once, identified the LAA for effluent disposal is to be clearly marked by pegging out the proposed area for Council's site inspection. Pegs need only be sufficient to locate the LAA.

d. Calculate the LAA using the daily disposal computer model. If Soil Category is 5 or a 6 (light to heavy clays) then Council may require secondary treatment of the soils and soil conditioning will be necessary (e.g. gypsum for dispersive soils and lime). Council will also require secondary treatment if more than three (3) ETA beds each measuring twenty (20) metres long by two (2) metres wide are proposed, unless a pump well and dosing via the installation of an indexing valve is proposed (maximum number of ETA beds will be four (4)).

e. Write a detailed wastewater report.

f. Submit three (3) copies of the wastewater report for new dwelling and three (3) copies for system upgrades to Council as part of the Application to Install or Alter a Sewage Management Facility.

In deciding upon treatment and land application solutions it may be helpful to start from the site and soil constraints and work backwards through the treatment train. For those designs requiring a sub-surface drip irrigation design please note that Council requires a design from a certified irrigation designer or an appropriately qualified and experienced irrigation designer - See Section 2 Definitions. (Wastewater reports were sub surface drip irrigation is the preferred disposal method, will not be accepted by Council without the sub-surface drip irrigation design attached to the report.)

3.1 DETAILS REQUIRED IN WASTEWATER REPORTS

***Proposed system*:** An outline of the proposed system components is to be stated on the first page of the report so that it is clear to Council officers, owners and installers.

The type and size of system to be installed: Important relevant site constraints are to be stated also.

Site Specific: Reports are to be specific, succinct and with information relevant to the site under review. Justification of the type of system nominated is to be included in the report. Consultants must state the date/s that they conducted site inspections. Where any variations from the Strategy are proposed, discussion and all necessary documentation must be provided.

Site Constraints: Reports are to accurately indicate the distances of dry gullies, watercourses or any other environmental features on-site in relation to the LAA. Should a proposal be designed within the relevant buffer distance or have environmental constraints, upfront acknowledgement of the limitation is to be reported (see Tables 1 and 2 - Section 10.3) and explanation of how it is proposed for the limitation to be managed e.g. maximising the buffer distance, installing a secondary treatment device, such as, a reed bed, AWTS, etc. Important relevant site constraints must be clearly identified in the report and stated upfront in the proposal on the front page. Failure to do so may result in the report being refused.

Owners Acknowledgement*:* Submitted wastewater reports are to include *a* statement by the owner that they are aware of the type of system being nominated in the report and of the maintenance schedule required to be carried out for the nominated system.

Irrigation Reports: Subsurface drip irrigation designs are required to be designed by a Certified Irrigation Designer (CID), certified by a CID or a competent person with demonstrated experience, to minimum requirements set by Council (see Appendix 2).

a. Spray irrigation designs are to be produced by a person with suitable experience in irrigation design.

Site Plans: All reports are to include two (2) site plans as follows:

a. A small scale plan extending to surrounding areas (usually using a 1:25,000 topographic map) showing contours and
b. A large scale plan showing the location of the proposed sewage management system and any existing on-site sewage management components (for alteration); pegged out effluent application areas including soil analysis bore logs; wells/bores; buildings and facilities; environmentally sensitive areas including permanent or seasonal waterways within 100m of the treatment or disposal areas; bunds, berms, drains or swales for the diversion of run-off around effluent application areas; buffers surrounding the effluent application areas.

Plan of LAA: The plan is to be a detailed design suitable for use by the installer and/or Council Officers for construction purposes. .

Full specifications and engineering details: Submission of full details of the chosen treatment systems (including composting toilets) which include NSW Health accreditation and system specification documents along with justification for the choice including calculations to allow Council to assess all individual components of the sewage management system including construction, installation, operation and maintenance.

Completed site and soil assessment forms: See appendix 4.

Number of residents: This shall be based on a minimum of **five (5) people**, unless the actual number of people residing in the dwelling is greater – (see guiding principles for dwellings with five (5) or more bedrooms). Secondary dwelling i.e. granny flats are to be based on a minimum of number of bedrooms plus one.

Printout of the daily disposal computer model calculation**:** See appendix 5.

Plans of management: Including operation, maintenance and service requirements of all components of the proposed sewage management system.

a. This information must be specific to the particular system proposed, and provide all necessary instructions for the occupier/owner or service personnel including an emergency action plan in the event of a breakdown.

b. Generic reports irrelevant to the site or type of system installed will be rejected. The schedule is to stipulate the type of system, the person responsible for maintaining the various components of the system including treatment device and disposal area (i.e. owner or servicing agent) and specific time frames or conditions for servicing the various components.

c. It will be a condition of approval that this information be displayed in an appropriate place for the benefit of future occupiers, owners and service personnel.

d. A final inspection will not be granted unless this service schedule is displayed.

4.0 INSTALLERS REQUIREMENTS

- *Plumbing and Drainage Work*

  All plumbing work is to be carried out by a licensed plumber and carried out in accordance with the provisions of AS/NZS 3500.

- *Certification/Commissioning Certificates/Works as Executed (WAE)*

  On-site sewage management systems, such as, AWTS's, biological filters systems, reed beds and sand filters, are to be certified upon installation by the installer as being installed in accordance with the approved irrigation design. The certification/commissioning certificate is to be submitted to Richmond Valley Council together with a "works as executed" (WAE) diagram once the system has been installed (see Section 8.0).

- *Irrigation Installations*

  Spray, sub-surface drip irrigation or surface irrigation under mulch designs are to be installed by a person who can demonstrate suitable experience in irrigation installation.

- *Irrigation Maintenance Reports*

  All wastewater irrigation areas including subsurface drip, surface drip or spray are to be maintained on a regular basis as per the condition of approval for the installation. Sub-surface drip irrigation is required to be maintained every three (3) months and the maintenance report submitted to Council within seven (7) days.

5.0 RESPONSIBILITIES OF INSTALLERS AND DESIGNERS

In regards to the original design, it is Council's expectation that the designer has discussed all design options with the land owner and the land owner is aware of the maintenance and operational requirements including the cost of running the proposed on-site sewage management system. Wastewater reports are to be signed off by the land owner.

In regards to the responsibilities of installers and designers it is Council's expectation that should an installer (i.e. plumber) have issues with the design the first point of contact is with the consultant to resolve the matter. This may be with the actual design or when on-site installing the on-site sewage treatment system. It is the responsibility of the owner to ensure that the plumber and consultant liaise.

Council is to be contacted if a major change is proposed to the original design such as a change of treatment system (i.e. changing from a septic tank to and AWTS) or LAA.

6.0 Responsibilities of Council - Section 68 Applications

Council's role in the approval process for on-site sewage management applications is that of the assessing/approving authority. Through this role Council's objective is to ensure that the application/approval process adequately satisfies the objectives of the legislative framework, companion guidelines and this Strategy. Council's role is not that of applicant, designer or installer and as such it does not take on the responsibilities associated with these roles. Council will review designs through the assessment/approval process to ensure the objectives, goals, guiding principles and design parameters of legislative and/or guideline frameworks are adequately satisfied.

Council will primarily communicate assessment matters with the nominated applicant and where requested by the applicant, communication may occur with other parties, as it is the applicant who carries the responsibility for compliance with the terms of any approval issued by Council. It is important that the above distinction between the various parties' roles and responsibilities is recognised and the applicant roles are fulfilled accordingly to achieve an effective design, approval and installation outcome.

7.0 Council Inspections

On submission of a Section 68 form, Council will undertake an initial inspection of the site to access the suitability of the submitted design prior to issuing an approval or a request for further information and in some instances a refusal. Council will undertake an inspection during the installation of the approved on-site sewage management system and then undertake a final inspection once all work is completed.

It is necessary to provide a minimum of 48 hours' notice for a Council inspection.

Inspections of external drainage lines and the whole land application area can only be carried out by Council Officers. Private certifiers or designers do not have authority to inspect any aspect of on-site sewage installations or drainage.

It is a requirement of sub-surface drip, spray and surface dripper under mulch irrigation systems that the installer contacts Council prior to back-filling so that the system can be inspected and tested. Spray irrigation areas will require testing to ensure all sprays are operational in the presence of a Council officer and the plumber.

It is a requirement of absorption or evapotranspiration systems that an inspection is carried out prior to back-filling the trench/bed. The last metre of the trench/bed is to be left open for inspection purposes.

Failure to obtain an inspection by Council is an Offence under the Local Government Act 1993. Persons breaching this legislation are liable to prosecution or infringement notices which may result in a monetary penalty. See Section 8 - Post Council Inspection Requirements, for the post inspection requirements i.e. WAX/WAE and commissioning certificates.

8.0 Post Council Inspection Requirements

On completion of Council's final inspection a WAX/WAE diagram will be required to be submitted to Council by the plumber and in some instances i.e. AWTS and reed beds, a commissioning certificate will be required. These requirements will be conditioned in the installation approval.

Only when these documents have been received by Council and are to the satisfaction of Council will the approval to operate be issued by Council.

8.1 Works as Executed Diagrams (WAX/WAE)

The works as executed diagram will be a detailed diagram including such information but not limited to:

a. All system components and sizing.
b. Distances to between components i.e. house to septic tank.
c. Address of the property and owners name.

For example, a new 3000 litre septic tank and with three (3) ETA beds will show:

a. the house,
b. the distance from the house to the septic tank,
c. the distance to the distribution box,
d. the size of the ETA beds (i.e. 20m x 2m),
e. the diversion swale if installed

And label such components as:

a. the septic tank,
b. effluent filter,
c. inspection openings,
d. distribution box and
e. ETA beds.

Installations that have been installed as in the original approved plan may be resubmitted with a statement saying as such.

8.2 Commissioning Certificate

The installation approval will state those installations that will require a commissioning certificate. This requirement is usually associated with AWTS's, reed bed and biological filter system installations and sub-surface drip irrigation and spray/sprinkler land application areas.

Information required in the commissioning certificate must include:

a. Plumbers name and licence,
b. Electricians name and licence (for AWTS and systems with pump wells),
c. Confirmation that the system has been installed as per Australian Standards and NSW Health accreditation guidelines.

PLEASE NOTE - If telemetry is installed, the installer's name and licence number is required.

9.0 Requirements for Plumbers Reports for Building Extensions with Existing On-Site Sewage Management Systems

Richmond Valley Council receives regular development applications for land owners wishing to undertake building extensions to their dwellings. In many cases this will involve an extra wastewater load entering their on-site sewage management system. It is therefore necessary for the plumber to prepare a small report/statement and a plan of the system. This report is to be submitted with the correct paperwork (Section 68 application) and fees to Council.

If there is no extra wastewater load then Council still requires a report/statement to say as much. In the event the system is already failing or is likely to fail with extra load, upgrade details are required prior to the issue of the Construction Certificate. Council will undertake an inspection to verify the report.

Plumber's reports shall include the following:

a. An accurately dimensioned plan of the existing on-site sewage management system.

b. Details of the existing on-site sewage management system (i.e. type and capacity of the tank, bed/trench length, greywater diversions) and its current condition (i.e. is it showing signs of deterioration, is effluent pooling).

c. Buffer distances to environmentally sensitive areas i.e. waterways, dams, drinking bores, gullies etc.

d. State whether the extension results in an extra wastewater load in the household.

e. If there is a load increase, what is the system's ability to cope with the additional load?

f. If there is a load increase and the on-site system needs upgrading details shall be provided of the proposed upgrade of the on-site system to Council.

g. If the upgrade is on a constrained site, Council may request that an effluent report from a wastewater consultant is submitted.

h. All upgrades are to meet the requirements of Richmond Valley Council's On-site Sewage and Wastewater Management Strategy Revised 2014.

10. Site Assessment

The site assessment task in the design of on-site sewage management systems is critical to the overall successful long term operation of an environmentally sustainable system. There are different situations that require different levels of information such as:

10.1 Rezoning and New Subdivisions

This document provides the framework for the implementation of ecologically sustainable on-site sewage management systems for single dwelling/dual occupancy sites. In this respect it provides the framework and requirements for the design and installation of single systems on land where it is already zoned for residential development and where a residential sub-division has been approved. Council's current minimum lot size for new sub-divisions is one (1) hectare (10000m^2).

Information required for this type of development would be but not limited to:

a. Nutrient balance calculations for the catchments involved;

b. Assessment of characteristics of the upstream and receiving catchment, including land uses and physical constraints;
c. Assessment of ground water flows and natural springs;
d. Evidence of high water tables and sub-surface rock layers or restrictive horizons;
e. Assessment of and
f. Requirement for the laboratory analysis of soils.

Soil sampling requirements for this type of development include:

a. Determination of Phosphorous sorption rates;
b. Sodicity;
c. Electrical Conductivity;
d. Bulk Density;
e. Cation Exchange Capacity.

A qualified professional (being a suitably qualified geotechnical civil or environmental engineer, soil scientist, land surveyor or other experienced person who has attended an accredited training programme and is familiar with the regulatory requirements for site evaluation) must sign off on the soil type.

All the details must be verified for each site along with a calculation of the maximum disposal area required, and minimum allotment size sought allowing for buffers and safety factors. The maximum range of options is to be maintained at the rezoning stage and Council will wish to see a report which canvases options and selects the option that uses the most land and with an identified duplicate on the allotment. The allotment size is then to be determined, with a minimum of one hectare required.

Council is not confident with respect to covenants (i.e. 88B instruments) and their effectiveness as a means of controlling the wastewater management system type selection process. In effect this means the largest land area option will be used as the base for sizing the proposed building envelope and allotment size. The land application area is required to be located on the allotment containing the residence or building and is to be above the 1:20 year flood level.

Consideration is also to be given to the guiding principles in this document relating to Councils preference for low-tech passive design gravity fed systems and any planning requirements i.e. a Land Use Conflict Risk Assessment (LUCRA).

10.2 New Development on Land Previously Zoned

Any site requiring on-site wastewater disposal should be examined in accordance with the following site and soil evaluation parameters (Section 10.3). This assessment will be used to determine the appropriate location for on-site wastewater disposal. There may be situations where the wastewater disposal area has to be selected first prior to siting a residence because there are no other locations on the block that are environmentally suitable.

10.3 Site and Soil Evaluation Parameters

A check list is provided in Appendix 4 - Blank Site and Soil Assessment Forms, for a quick reference guide for consultants, plumbers and the general public and is detailed in the following text.

Boreholes samples are required to examine the soil profile at the subject site where on-site disposal is proposed to be located. Boreholes will be required to be dug to a depth of at least 1.0metre. Council requires a minimum of two (2) boreholes to be undertaken for all on-site sewage management approvals.

The following provides a definition and methodology to the required parameters.

A. Soil Texture Classification

Soil texture is a measure of the behaviour of a small amount of soil when moistened and kneaded into a ball (bolus) and then manipulated between the thumb and forefinger to form a ribbon (AS1547:2012 - Table E1.)

There are fifteen (15) grades of texture, which are commonly recognised and which are determined from the behaviour of the moistened bolus.

Soils are made from four (4) basic soil properties being sand, silt, clay and organic matter which affect the texture characteristics of a soil sample.

There are six (6) broad texture groups identified in AS1547:2012 which can be used to determine the textural grades of the profile. These are:

- Gravels and sands
- Sandy loams
- Loams
- Clay loams
- Light clays
- Medium to heavy clays.

Soil texture will be used to determine the classification and range of clay content. Each texture grade change within the soil profile should be recorded and examined for pH. Council’s minimum requirement for texture classification is as stated in AS1547:2012 (Table E1).

B. Soil Structure

The soil structure is to be determined from visual assessment of the site and borehole testing, through the examination of exposed soil surfaces. A summary of soil structures is:

Degree of Pedality	Appearance
Massive	Coherent, lacking any partings both vertically and horizontally over a distance > 400mm. Pieces do not break along planes of weathering.
Single Grained	Loose incoherent e.g. sandy soils.
Weakly	Peds indistinct and barely observable on pit face. When disturbed approximately 30% consists of peds smaller than 100mm.
Highly	Peds quite distinct in undisturbed soil >60%. When disturbed consists of peds smaller than 100mm.

C. Colour Description

A colour description of the soil profile should be given, and described in the moist condition by the following colours: black, white, grey, red, brown, orange, yellow, green or blue.

The classification can be modified as required by pale, dark or mottled.

D. Slope Assessment

The slope of the site: to be expressed as a percentage; should be determined in the field through the use of such instruments as a clinometer or protractor, or via a formal survey of the site. It is necessary to record the shape of the slope; either concave, convex or straight; because concave slopes are generally unsuitable for wastewater disposal.

A minimum distance of twenty (20) metres will be required to determine the degree of slope. It is strongly recommended that the site be surveyed which will aid greatly in slope assessment.

E. Aspect

A compass should be used to ascertain the direction of the slope, with North and North East facing slopes being the recommended positions due to high evapotranspiration, and higher crop factors can be used.

F. Exposure

The exposure to sunlight and prevailing winds is an asset to disposal areas as there will be an increase in the uptake of water vapour through both evapotranspiration and straight evaporation, depending on the disposal system selected.

G. Boulders, Floaters or Rock Outcrops

The site must be traversed on foot and record the presence of any boulders/floaters or rock outcrops. Disposal in these areas should be avoided. Cracks in rock layers may allow wastewater to shortcut the disposal field and enter water supplies. These may also be found when undertaking the digging of bore holes.

H. Distance to Waterways

An accurate distance must be recorded to the nearest waterway including intermittent creeks and gullies. A survey will aid in the determination of distance - (See **P Buffer Distance** this section).

I. Run on and Upslope Seepage

Any run-on or upslope seepage must be recorded. If the construction of a catch drain or swale above the disposal field would not alleviate the problem, then an alternative location for the on-site sewage management system and land application area must be chosen.

J. Flooding Potential

The flooding potential of the site must be determined, especially for the lower areas of Council's area. All disposal areas shall be above the 1:20 year flood height for new sub-divisions/boundary adjustments, and treatment systems are to be above the 1:100 year flood level. Council and or the NSW Department of Public Works may be able to supply flood height records for various localities. Vacant lots with dwelling entitlements proposing disposal below the 1:20 year flood level will require secondary treatment of the wastewater. LAA's on existing blocks with a dwelling below the 1:20 year flood level will not be required to go to secondary treatment unless other constraints apply such as the proposed disposal area is within 100 metres of a river.

K. Site Drainage

Any visible signs of poor drainage should be noted such as hard packed soils, vegetation growth characteristics of damp sites, evidence of springs, and pooling of water. It is not recommended that disposal areas be installed within sites with poor drainage.

L. Fill

Council does not recommend the installation of LAA where fill has been used. Council may consider the use of verified clean fill consisting of soil, which has settled and is on a stable, relatively flat site for wastewater disposal. However other types of fill with coarse fragments etc. and located on steep sites are not to be used for wastewater disposal, unless approved by Council.

M. Erosion/Mass Movement

The property must be assessed for existing mass movement and erosion, such as gullies, slips and rills. Adequate drainage controls must be undertaken to ensure that wastewater is not concentrated within one location, and upslope runoff is diverted around the disposal.

N. Field pH

The pH of a soil can alter the availability of nutrient elements for plant uptake and can cause metal toxicities if pH is too low or too high. A field pH level should be undertaken to determine the acidity/alkalinity of the soils. Soil pH of between 6.5 to 8 is ideal for plant uptake of phosphorous, potassium and nitrogen.

O. Modified Emerson Aggregate Test (SAR 5)

This is a modification of the Emerson Aggregate Test (Emerson 1967). This test provides a field assessment of the aggregate stability (dispersiveness) by using typical greywater - water with detergent added or Sodium Absorption Ration (SAR) 5 solution. The test involves placing about three (3) 5mm diameter undisturbed soil aggregates from the profile within a beaker of either of the above solutions, and left undisturbed for five (5) hours.

Three (3) reworked aggregates, such as the ones used for texture classification are also placed in a beaker of SAR 5 solution or typical greywater for two (2) hours.

The behaviour of the aggregates is then recorded from the following:

1. Class 1 - No change to aggregate, therefore non-dispersive.
2. Class 2 - Aggregates slake - smaller aggregates/particles fall off the original aggregate.
3. Class 3 - Aggregates disperse (cloud solution).
4. Class 4 - Worked bolus material disperses.

If the end result is that the soil is dispersive then gypsum will have to be applied to the disposal area at a pre-determined rate in order to aid in the prevention of degradation to the soil structure.

P. Buffer Distance

An accurate distance must be recorded to watercourses, gullies and other environmental features in relation to the LAA. In the event a proposal cannot achieve the relevant buffer distance nominated below or have environmental constraints, upfront acknowledgement of the limitation is to be clearly reported and explanation of how it will be managed for the limitation e.g. maximising the buffer distance, installing secondary treatment etc. is to be stated. This provides the potential for some level of flexibility subject to a merit based assessment for single lots with an existing dwelling entitlement. This level of flexibility is not afforded to rezoning and subdivision applications as buffer distances are treated as absolute minimums.

The following buffer distances apply to disposal areas situated near watercourses:

- **100metre buffer -** Watercourse/wetland comprise two types of systems.
    1. Perennial - Those watercourses that essentially flow all year-round and consist of base flow during dry periods.

2. Intermittent - Those watercourses or wetlands that flow for only certain times of the year, when they receive water from surface runoff or from springs or ground water. During dry years they may be reduced to a series of separate pools or may even cease to flow entirely. However, these pools are still connected to the water table/ground water.

   Gullies and ephemeral streams have channels which are above the water table at all times and therefore do not receive spring or groundwater flows. They carry water only during and immediately after rain. They may be dry for extended periods but subjected to flash flooding during high intensity storms.

- **250 metre buffer** - Domestic groundwater wells/bores.

The following buffer distances apply to disposal areas discharging secondary treated wastewater:

- **Six (6) metre up-gradient and three (3) metre down-gradient** of property boundaries, swimming pools, driveways and buildings.

The following buffer distances apply to disposal areas discharging primary treated wastewater:

- **Twelve (12) metre up-gradient and six (6) metre** down-gradient of property boundaries
- **Six (6) metre up-gradient and three (3) metre down-gradient** for swimming pools, driveways and buildings.

The reduction of buffer distances may be considered by Council if justified by referring to AS1547:2012 (Tables R1 and R2).

Table 1 - Site Limitations

Site Feature	No limitation exists	Limitation exists	Solutions to limitations
Slope -For steeper ground use narrow ETA beds or SSI	<15%	>15%	Secondary treatment and irrigation (subsurface, spray etc.)
Landform	Divergent (drainage-spreading) land shape e.g. hill crests	Convergent (drainage-concentrating) land shape	Bunds above concentrating sites
Exposure - Good aspect and exposure to sun enhances evapotranspiration.	Facing within NW or NE quadrant, and high sun-wind exposure	Facing within SW or SE quadrant, and sheltered from sun-wind	Plant uptake encouraged
Distance to Water Body and man-made features Potential for polluting downstream waters	>100m to perennial and intermittent watercourse **AND** >250m to domestic groundwater wells **AND** >40m to gullies, dams **AND** In the case of SDI, spray or dripper under mulch > 6m if up-gradient and >3m if down-gradient of property boundaries, swimming pools, driveways and buildings. (In the case of ETA beds: >12m if up-gradient and >6m if down-gradient of property boundaries, but 6m/3m as above for pools, dwellings etc.)	<100m to perennial and intermittent watercourse **OR** <250m to domestic groundwater wells **OR** <40m to gullies, dams **OR** In the case of SDI, spray or dripper under mulch <6m if up-gradient and <3m if down-gradient of property boundaries, swimming pools, driveways and buildings. (In the case of ETA beds: <12m if up-gradient and <6m if down-gradient of property boundaries, but 6m/3m as above for pools etc.)	Secondary treatment of effluent Disinfection
Run-off/seepage entering site from above	Minor	Major, where diversion not practical	Swales, diversion drains
Flooding Potential	Disposal system above 1 in 20 year flood contour **AND** Treatment system above 1 in 100 year flood contour	Disposal system below 1 in 20 year flood contour **OR** Treatment system below 1 in 100 year flood contour	Secondary treatment if below 1:20 flood level or pump above 1:20 flood level.

			Electrical components above 1:100year flood contour
Site Drainage	No visible signs of surface dampness	Signs of surface dampness	If due to shading, trim trees or find alternative area
Vegetation indicating water logging	Absence of sedges etc. that indicate water logged soil	Presence of sedges etc. that indicated water logged soil	Secondary treatment or find alternative area
Surface Condition	No bare ground or cracking	Bare ground or cracking	Secondary treatment
Fill	Disposal area not on fill	Disposal area contains fill	Attempt to find alternative area
Erosion/Mass Movement	No sign of rills, slips	Rills, slips	Promote appropriate vegetation growth

Table 2 - Soil Limitations

Soil Feature	No limitation	Limitation	Solutions to limitations
Carry over ✓ or × from Table 1			
Soil Category	Receiving soils for primary treated effluent: Soil Categories 1-5 excluding mod. or weakly structured light clays Receiving soils for secondary treated effluent: Soil Categories 1-5	Receiving soils for primary treated effluent: Soil Categories 5 or 6 excluding strongly structured light clays. Receiving soils for secondary treated effluent: Soil Category 6 (as noted: dispersive or shrink-swell soils are to be considered as Soil Category 6 soils)	Secondary treatment
Coarse Fragments Coarse fragments, rocks, boulders impede absorption	Occupies <20% of soil volume	Occupies >20% of soil volume (Need to increase Soil Category by one class)	Increasing Soil Category means increasing disposal area
Field pH (Raupach mixed indicator/barium sulfate) pH extremes inhibit plant growth	>5.5	Other	Secondary treatment. Conditioning with lime may assist if pH<5.5
Dispersiveness using modified Emerson Aggregate test	Class 1 or 2	Class 3 or 4	Secondary treatment. Soil amelioration with gypsum.

10.4 Calculation of the Land Application Area (LAA)

The daily disposal model shall be used to calculate the LAA for all new systems and proposed upgrades requiring a consultant's report. For upgrades of existing on-site sewage management system the Matrix may be used.

11.0 Choosing the Type of On-site Sewage Management System and Land Application Area (LAA) to Install

Any upgrade or alteration to an existing system or the installation of a new system is required to comply with current Australian Standards, regulations and Council's On-site Sewage and Wastewater Management Strategy. The type of system installed will be determined by a site and soil assessment, in many cases the soil type is the determining factor in the selection of the type of on-site sewage management system and LAA that is to be installed. Other limitations such as the size of the block and buffer distances to water bodies, swimming pools and driveways will also need to be considered.

Details of the type of treatment systems and LAA available and their maintenance and operational requirements are to be found in Appendix 1 and Appendix 2.

Note: Council's On-site Sewage and Wastewater Strategy guiding principles promote the use of low-tech gravity fed systems.

11.1 INSTALLATION OF NEW ON-SITE SEWAGE MANAGEMENT SYSTEMS

Council requires the submission of a consultant's report for all new installations on undeveloped blocks of land.

As stated above soil type and site limitations may rule out the use of septic tanks and a requirement to install a system that treats the wastewater to a secondary level. Many new house sites are on flat sites resulting in insufficient fall on site. If this is the case, then there will be a requirement to install a pump well to pump the wastewater to the LAA.

If a property owner has a preference for a certain type of on-site sewage management system, the property owner is advised to discuss their preference with the consultant who will be preparing their wastewater report to determine if the system can be installed on the block. In some circumstances the site constraints may not allow for the preferred system. Advice can also be sought from Council.

11.2 UPGRADE OF EXISTING SYSTEMS

Under the Local Government Approval Regulation Amendments (2005), requires Council to inspect existing systems and to issue a licence on the basis of the performance of the system. Upgrades to the existing system will be assessed by Council following these inspections, and as a result of upgrade work undertaken the existing conditions of the approval to operate may change i.e. a septic tank is replaced by an AWTS.

Any buildings additions that are carried out between inspections will be noted and owners asked to rectify the situation. In most cases a Section 68 application by a plumber will suffice, however, in difficult or constrained sites an effluent report by a suitably qualified consultant will be required.

An upgrade of an existing system may be required if:

- there is a proposed extension to an existing dwelling
- change of use
- there is an increase in the amount of activity for the development, e.g. a café opening for breakfast, lunch and dinner
- existing systems which have failed i.e. failing LAA
- there is a pit or pan toilet on-site
- unauthorised greywater discharges i.e. no greywater tank
- a system is showing signs of deterioration i.e. it is an old system and past the functional life span i.e. concrete corrosion in old septic tanks.

The upgrade will be required to comply with sizing set out in the strategy. In regards to a failing LAA, if the existing septic tank is undersized and in a good condition, then in some circumstances, it may be able to be retained with council conditioning that it is pumped out more regularly than every five (5) years i.e. every three (3).

The majority of upgrades are due to a failing LAA's. In the case of septic tanks the old absorption trench is usually failing and will need to be replaced with evapotranspiration beds (ETA beds). In some cases the septic tank is very old, showing signs of deterioration and undersized for the wastewater generated from modern households and will therefore need to be replaced with a minimum 3000 litre septic tank and effluent filter.

Traditionally Aerated Water Treatment Systems (AWTS) were installed with 200m^2 of spray irrigation. In many cases these have not been maintained and need replacing. In village and rural residential areas this will result in sub-surface drip irrigation being installed, usually under a lawn area or the installation of ETA beds. Requirements for the upgrade of spray irrigation areas are stated in Appendix 2.

All pit or pan toilets are prohibited and when located by Council inspections, these systems must be upgraded. Upgrades usually result in a septic tank being installed though it is possible for some households to install a compost toilet and greywater tank and LAA, depending on the site.

Households discharging greywater directly to the grounds surface must direct the greywater to the existing septic tank. **Note:** Due to an increase in the wastewater load to the existing septic tank there may be a need to increase the size of the LAA or alternatively a separate greywater tank and LAA may be installed.

11.3 SMALL BLOCKS

There are a number of small blocks in the Richmond Valley Council area with the potential to have issues with failing on-site sewage management systems. In some cases it may be impossible to meet nutrient requirements and in some cases the hydraulic load may be too large.

The first priority with these difficult, constrained sites is to protect public health and deal with the hydraulic load. This usually involves the secondary treatment of the wastewater and in some cases the installation of water saving devices and in some instances, a compost toilet may need to be installed to reduce the hydraulic load.

With upgrades on small blocks it is sometimes necessary to place the LAA inside recommended buffer distances. In these cases it is usual practice that if the recommended buffers cannot be met then secondary treatment is required and depending on site constraints disinfection may be required.

11.4 METHODS OF WASTEWATER TREATMENT

In the Richmond Valley Council area the two main methods utilised for wastewater treatment are septic tanks and AWTS. The majority of land owners in the Richmond Valley Council area opt to install a septic tank and ETA beds because it is the cheapest option for wastewater treatment and disposal, allowing for gravity feed to the LAA and for the wastewater to be treated without the use of electricity to run various components, for further detail see Appendix 1.

11.5 Methods on Wastewater Disposal in the LAA

In the Richmond Valley Council area the two (2) main methods of wastewater disposal are ETA beds and sub-surface drip irrigation.

ETA beds can be used for primary treated wastewater (i.e. septic and greywater tanks) and secondary treated wastewater (i.e. AWTS, reed beds, certain types of biological filter systems and sand filters).

Whereas sub-surface drip irrigation can only be used with secondary treated wastewater (i.e. AWTS, reed beds, certain types of biological filter systems and sand filters). Sub-surface drip irrigation requires a sufficiently sized pump and quarterly maintenance; for further detail see Appendix 2.

11.6 Requirement for Secondary Treatment of Wastewater

The site and soil assessment will reveal the need for secondary treatment due to environmental constraints and soil type. Council requires secondary treatment for all vacant land that have a medium-heavy clay soil classification and some light clay soil classification types.

In cases where more than three (3) ETA beds (each measuring 20 metres long by 2 metres wide) are proposed for a primary treatment system, consideration should be given to secondary treatment due to the increased costs of gravel in ETA beds.

Discussion should take place with the owner comparing the advantages and disadvantages of each scenario. A secondary treatment system will reduce the size of the LAA.

Table 3 - Strengths and Weaknesses of Secondary Treatment Systems

Performance criteria	AWTS	Biological Filter System	Reed bed (horizontal flow wetland)
Power required?	Yes	Yes - some gravity fed	No
Fall of site	Any	Any	Flat to moderate slope
Surface area	Small	Small	4-6m2/EP
Maintenance	High-contractor required	Medium-contractor required	Owner can do
Construction cost	High	High	Moderate
Nitrification	Good	Moderate to good	Poor to moderate
Nitrogen removal	Low	Low	Moderate to good
Intermittent dosing needed?	No	No	No
Tolerance to peak loads	Low	Low	Very good
Tolerance to low loads (holidays)	Low	Moderate	Good
Visual impact	Low unless above ground	Low	Can be landscaped
Awareness? Does the device invite user participation & hence awareness/commitment?	No	No	Yes
Disinfection	Yes	Dependent on model type	No
Maintenance	Undertaken by plumber	Undertaken by plumber	Undertaken by owner or plumber

Source: Davison (2003), modified RVC (2010)

11.7 NON-DOMESTIC ON-SITE SEWAGE MANAGEMENT SYSTEMS

Any person proposing the installation of a non-domestic on-site sewage management system is advised to discuss the matter with Council's Environmental Health Officers.

Examples of a non-domestic system are rural tourist establishments with attached restaurant, greyhound facilities, boarding kennels and honey processing facilities.

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Appendix 1 - Types of Treatment Systems, Maintenance and Operational Requirements and Associated Components

1.0 GENERAL

There are a number of different sewage management systems available in the Richmond Valley Council region and the performance of these can vary from other parts of the world and Australia due to climatic conditions, population characteristics, loading cycles, human dietary habits, and influent quality.

The types of on-site treatment systems are listed below.

2.0 SEPTIC TANKS

The septic tank used for single houses is a small anaerobic oxidation plant, which removes suspended solids from the wastewater and breaks them down anaerobically. The resultant effluent is low in settled solids but high in biological oxygen demand (BOD) and requires biological treatment before release to the environment. The septic tank to be installed must have at least one internal buffer.

Other solids settle to the bottom of the tank, whilst most fats, oils and greases float, and the middle zone of wastewater within the tank overflows to the disposal beds. No enzymes are to be added to the system but natural bacteria are permitted. These bacteria can be added to the system, reducing the amount of sludge and therefore increasing the time between the pumping out of the tank, and reducing the smell of the tank. Induct vents are no longer required on septic tanks due to these structures allowing flies and mosquitoes to breed in the tank (E and HP Guidelines, 1998). Due to the larger septic tank size, (>3000L) grease traps are no longer required. The smaller tanks were found to be too small to trap grease effectively. With the larger tanks the kitchen wastes can be connected directly into the septic tank with a baffle installed (E and HP Guidelines, 1998).

All new septic tanks and those requiring upgrading are required to have an effluent filter installed on the outlet of the septic tank (see Appendix 1, Part 2.3). The location of the septic tank must be at a greater distance than 1.5m from any building.

Allowances must be made for easy access to the tank in order for the pumping contractor to get a truck near the septic tank so that the contents of the tank can be pumped out (desludging the tank). All septic tanks need to be manufactured in accordance with Standards Australia, and have an appropriate AS Standards Mark. The NSW Health Department Register certifies manufacturers of the septic tanks and collection wells.

The Australian Standard for septic tanks is AS1546:1 (1998). Septic tank sizes are nominated for domestic flows of up to 14,000 litres per week or daily flows of 2000 litres. AS1546 states that the function of a septic tank is to provide a relatively still zone of adequate size for all domestic flows. Scum and solids are separated from the wastewater flow and must be periodically removed. The serviceable life of the tank is stated as fifteen (15) years. The minimum tank sizes are stated below.

Table 4- Conventional Septic Tank Capacities - Litres

Type of Wastewater	1 to 5 Persons	6 to 10 Persons
All wastewater	3000 litres	4500 litres
Greywater only	1800 litres	2700 litres
Blackwater only	1500 litres	2500 litres

Split systems are recognised in AS/NZS1547 (2012) and AS1546 (1998).

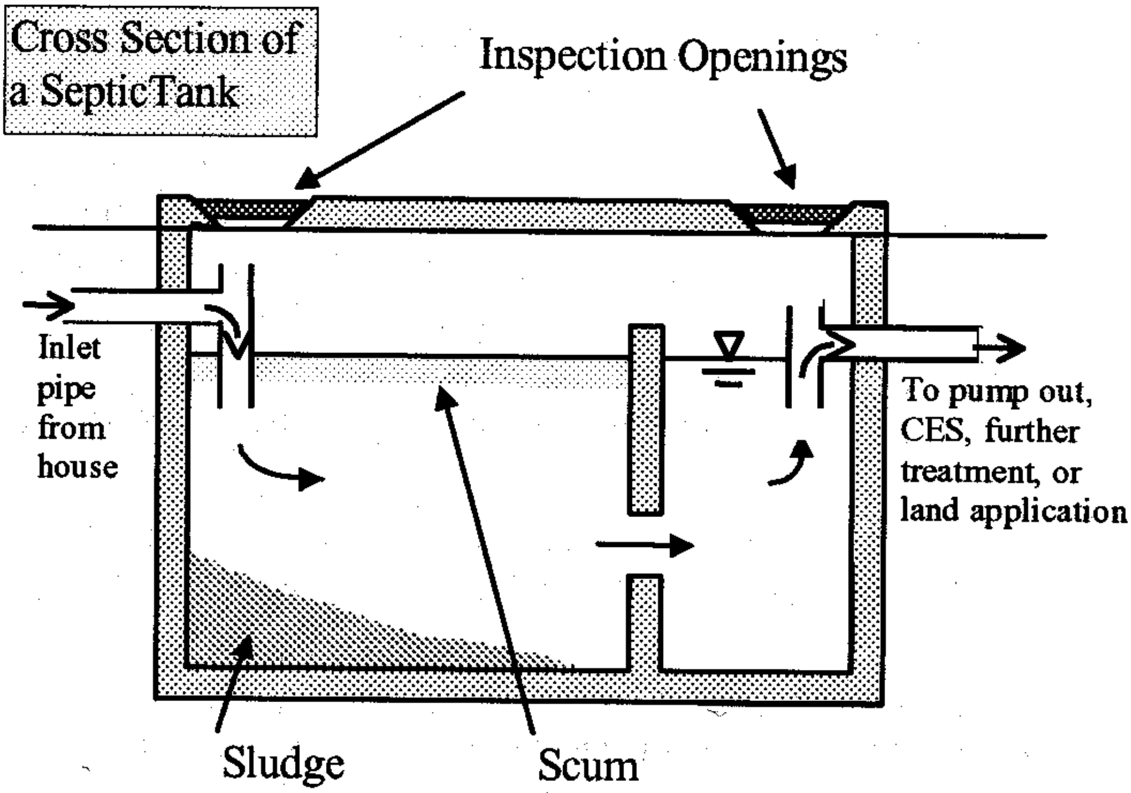


Figure 1- Cross Section of a Septic Tank

2.1 Maintenance for Septic Tanks and Trenches/ETA Beds

For longevity of the on-site sewage management system the following maintenance regime should be employed by the owner/occupier of the dwelling.

- Bleach, bleach-based products, whiteners, nappy soakers and spot removers shall not be disposed of into the on-site system. They shall be disposed of on a disused area of a garden, well away from the disposal area.
- The effluent filter is to be checked monthly and regularly cleaned for a build-up of trapped solids or slime build up.
- It will be necessary to have the contents of the septic tank pumped out on average every three (3) to five (5) years. Generally speaking households of meat eaters would need to pump out their septic every three (3) to five (5) years and vegetarians every four (4) to six (6) years.
- Ensure that the septic tank is mosquito and fly proof.

- Hygiene products, condoms, tampons, sanitary napkins, disposable nappies and cotton buds and the like shall not be disposed of via the on-site disposal system. They should be disposed of into garbage bins in sealed plastic bags.
- Only the recommended amounts of disinfectants should be used. Biodegradable products for septic systems are recommended.

2.2 Warning Signs of Possible Troubles

If any of the following signs of system failure occur, contact the plumber who installed the system. Warning signs include:

- Surface ponding and run-off of treated wastewater.
- Degradation of soil structure - e.g. sheet and rill erosion, surface crusts, or hard surfaces are evident.
- Poor vegetation growth.
- Unusual odours.
- Wastewater is overflowing from the yard gully.
- Drain pipes that gurgle or make noises when the air bubbles are forced back through the system.
- Wastewater is building up in the septic tank and not flowing freely to the disposal area.

2.3 Effluent Filters

An effluent filter is a plastic tube type filter used to reduce suspended solids to a level of about 30ppm or less and reduce the potential for carry-over of suspended solids into the disposal area. This will help prevent the voids in the disposal bed from clogging. Types of effluent filter currently used in the Richmond Valley Council area are Biotube, Taylex, Zoeller or Zabel filters.

However, it should be noted that an effluent filter does not provide secondary treatment of the effluent. Some owners have opted to have the effluent filter fitted to the outside of the septic tank to allow ease of maintenance and ease of handling. Also, the owner does not have to put their hands in the system. This can be achieved by fitting a “U” trap on the outlet.

The effluent filter can be cleaned by removing the effluent filter and washing off the build-up of solids. If the inspection opening on the tank is large enough, the effluent filter can be cleaned over the opening with the contents discharging back into the tank.

It is difficult to determine the how often the effluent filter should be cleaned because of the different lifestyle and diets of land owners. Council advises checking the effluent filter regularly until an understanding of a cleaning regime is gained.

3.0 Aerated Wastewater Treatment Systems

Aerated Wastewater Treatment Systems (AWTS) consist of anaerobic and aerobic processes. They have multi chambered tanks, which provide primary treatment through settling and an aeration process. They typically settle solids and float scum in an anaerobic chamber, much like a septic tank then aerate in a second chamber. The aerobic process consists of injecting compressed air into the effluent for secondary treatment. Disinfection usually consists of chlorination in the majority of AWTS's with a few utilising UV disinfection.

AWTS systems typically produce an effluent of higher quality than that produced by septic tanks with lower Biological Oxygen Demand, lower suspended solids, and lower faecal coliforms. They must be operated continuously and power to the system must not be turned off. If the premise uses solar power, the land owner is advised to ensure that the AWTS can be operated efficiently with solar power prior to purchasing the AWTS.

AWTS are capable of treating wastewater for up to ten people for domestic purposes. The owner of an AWTS must enter into a quarterly maintenance contract with an appropriately qualified service agent. The cost of the quarterly service is borne by the owner. Service reports are to be submitted to Council after each service.

Wastewater from the AWTS must be disposed of by such means as sub-surface drip irrigation and ETA beds. Surface spray (sprinkler) irrigation and surface dripper irrigation under mulch is only permitted in certain cases (See Appendix 2).

All AWTS systems must be accredited with the Department of Health.

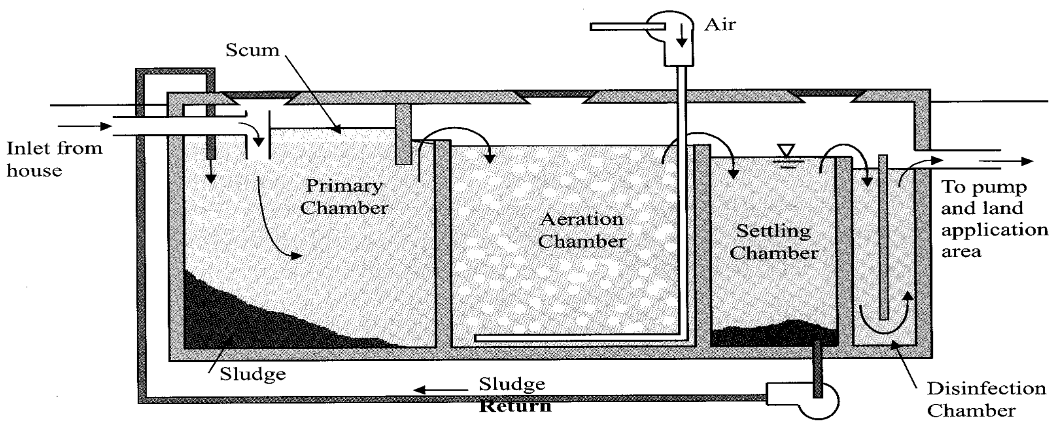


Figure 2 - Cross Section of AWTS

3.1 MAINTENANCE OF THE AWTS AND OTHER TREATMENT SYSTEMS

Regular servicing and maintenance is required, commonly on a quarterly basis. The owner therefore must enter a service contract with a service agent authorised by the Local Council. The cost of each service is borne by the owner. A copy of the service report is forwarded to Council for appropriate action. The service agent must be able to provide service within 24 hours of being notified of a system malfunction.

At each service, all mechanical, electrical and functioning parts of the treatment system should be checked, including:

- All pumps.
- The air blower, fan or air venturi.
- The alarm system.
- The operation of the sludge return system, where installed.
- pH from a sample taken from the irrigation chamber.
- Check on sludge accumulation in the septic tank (primary treatment chamber) and the clarifier where appropriate.

- A thorough inspection and testing (if appropriate) of the effluent disposal field and all fixtures to the AWTS.
- Ensure operation is in accordance with the approved design.

A sludge bulking test is required annually if activated sludge.

On completion of the service a report is to be submitted to Council.

4.0 REED BEDS - ARTIFICIAL WETLAND/CONSTRUCTED WETLAND

Reed beds are sealed containers that are filled with clean gravel (20mm blue metal) and planted with reeds or other suitably approved plants. They are used to further treat wastewater that has undergone primary treatment (i.e. septic tank). The use of a reed bed will reduce levels of nutrients; total suspended solids (TSS) and BOD (biological oxygen demand) before land application (see Reed Beds Diagrams 1 and 2).

Subsurface flow wetlands (reed beds) contain at least 60cm (600mm) of gravel (20mm), which supports the reeds root system. The wastewater flows through the gravel and is not in direct contact with the atmosphere. The waste water level is a minimum of 100mm below the gravel surface. Disinfection of the effluent is not required unless discharging the effluent above ground.

Polyethylene or concrete tubs are to be used for reed beds. These are available from several manufacturers in the Northern Rivers. The use of a liner membrane is not permitted in the Richmond Valley Council area due to concerns that the liner will not last 15 years (as required by the Local Government Act 1993), and evidence that voids behind the liner can provide penetration sites for macrophyte rhizomes. *Pharagmites australis* has a particularly penetrative rhizome and has caused problems in this respect with flexible liners in NSW reed beds having been penetrated by *Phragmites* roots.

Council's recommends that 100mm PVC pipe spreader bars are used as inlet devices. These are placed high in the gravel and surrounded by larger gravel/rocks (50-100mm) to allow for ease of maintenance when checking for root intrusion. Spreader bars are not to be placed on the gravel surface because of odour concerns.

Council recommends the use of towers (made from 300mm stormwater pipe or manufactured stormwater collection pits) as outlet devices because they allow for ease of maintenance and permit a water height pipe to be easily fitted.

The lip of the reed bed is required to be 100mm out of the ground to prevent the ingress of overland flow. In some cases gravel drains/trenches are placed around the reed bed or swales constructed above the reed bed to divert stormwater away from the reed bed.

Reed beds produce a secondary quality of effluent after approximately five (5) days residence time in the reed bed (i.e. the daily wastewater generated in the household is detained in the reed bed for five (5) days) and those land application areas within 100m of a waterway will require a reduction in nitrogen of 50%.

4.1 MACROPHYTES (I.E. REEDS)

While there is general consensus in the literature regarding the benefits of macrophyte presence in a bed, there is no agreement on which is the most suitable species. The majority of reed beds in the Richmond Valley Council area are planted with *Lomandra hystrix* due to ease of supply from nurseries and these reeds do not die off (senesce) in winter.

Various macrophytes have been used in reed beds throughout the world with species from the genera *Phragmites, Schoenoplectus* and *Typha* being the most commonly used. Macrophytes that have been used in this region are *Schoenoplectus validus* (river club rush), *Typha orientalis* (bull rush), *Bolboschoenus fluviatilis* (marsh clubrush), *Lomandra hystrix* and *Baumea articulata* (jointed twigrush). Certain reed beds are planted with *Melaleuca quinquenervia*.

Tube stock for most wetland plant species may be purchased from nurseries that specialise in wetland plants. These plants can also be propagated vegetatively by dividing root clumps obtained from existing constructed wetlands.

4.2 MAINTENANCE AND OPERATION

The reed bed owner usually takes on the responsible for the maintenance and operation of the reed bed. Richmond Valley Council requires that a maintenance schedule be submitted to Council on an annual basis.

In a well-designed reed bed maintenance is minimal and consists of the following:

- Harvesting.
- Check blockages to inlet and outlet structures.
- Cleaning the effluent filter on the septic tank.
- Checking reed growth.
- Altering the water height if reed bed designed to do so.
- Pumping out the septic tank regularly.

5.0 SAND FILTERS

Sand filtration systems typically consist of one or more layers of sand overlayed and underlayed with a gravel layer and all contained within an impermeable membrane. Wastewater is applied evenly to the surface of the sand, through which it percolates vertically to a collection system at the base of the filter. The sand media is a minimum of 500mm deep.

The installation of a sand filter in the Richmond Valley Council area is required to meet Council's Draft Sand Filter Guidelines.

The main requirements of the guideline are:

- The sand sourced for the sand filter is sieved by laboratory and certified to the nominated size;
- A concrete or polyethylene tub is used. Use of liners is prohibited;
- The sand filter is to have a manifold capable of being flushed; and,
- The sand filter is to be intermittently dosed by using a pump or dosing siphon.

Ideally the wastewater should be partially treated before entering the sand filter i.e. an AWTS or reed bed. Richmond Valley Council does not permit direct discharge from a septic tank to a sand filter because experience has shown that primary treated septic tank effluent eventually causes the sand filter to block resulting in the need for expensive maintenance work to be undertaken.

No recirculating sand filters have been accredited by NSW Health at the time of writing. Other sand filters do not require accreditation.

5.1 DRY/WATERLESS COMPOST TOILETS

Compost is a mixture of decomposing vegetable refuse, manure etc. for fertilising and conditioning soils. The dry compost produced from a compost toilet would normally be composted again with garden compost before it is used as a soil conditioner in the planted garden; Jenkins (1994) states “that the complete elimination of pathogens would occur after both these composting processes”.

Dry composting toilets may be either constructed individually on-site (owner built) following a specific design plan or commercial units accredited by NSW Health that are purchased off the shelf.

Dry composting toilets require a bulking agent such as wood shaving which needs to be applied after each use of the toilet. This bulking agent also covers the faecal material and aids in reducing odours from the compost. The toilets are vented and some have mechanical ventilation to ensure good air flow in difficult situations around the compost heap. After a period of time compost is produced from the toilet, and removed from a door at the base of the toilet.

The process is biological and involves micro-organisms attacking the faecal heap and gradually composting the material to humus. The time taken to reduce the material to humus is variable, and the operator of a compost toilet must recognise that the compost heap is a living thing and needs to be cultivated and protected.

There are texts available for those wishing to use a compost toilet and these should be read and understood so that the compost process is encouraged by the household activities.

The use of a compost toilet will remove the toilet component from the water flows or discharges from the dwelling or development. The greywater will still need to be collected and treated in an appropriate manner. Grey water can be treated in conventional greywater or septic tanks.

Leachate/excess urine from the compost toilet can be discharged to the grey water tank or in some cases discharged to a disposal trench. This can actually help the biological process in the greywater tank by adding valuable bacteria.

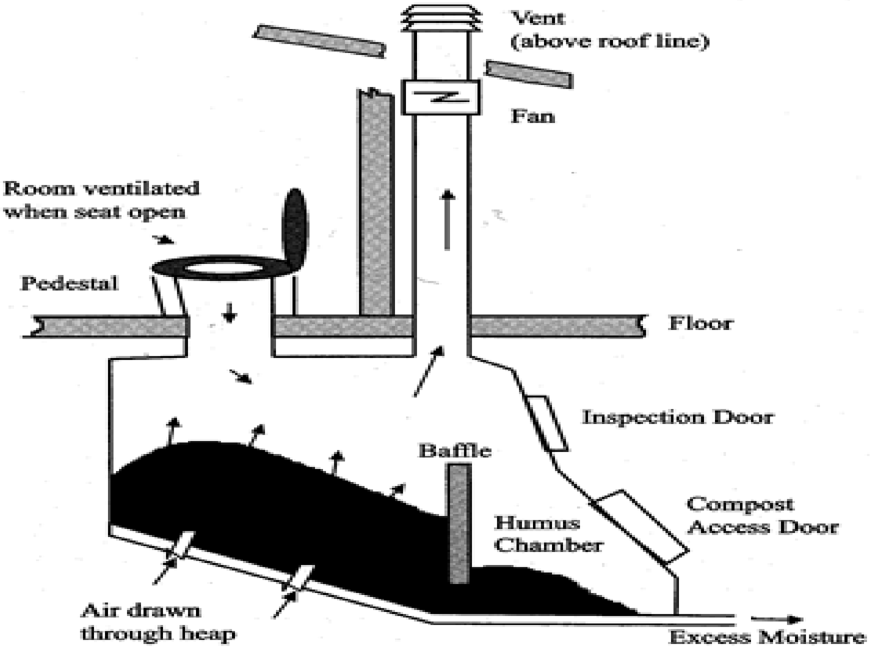


Figure 3- Cross Section of Dry Composting Toilet

5.2 GREYWATER TANKS

Greywater is known as the wastewater produced from the sinks, washing machines, showers, dishwashers while blackwater is the wastewater produced from the toilet. The standard treatment method of greywater approved by Council is a 2050 litre greywater tank.

5.3 GREYWATER TREATMENT SYSTEMS ACCREDITED FOR RE-USE IN THE HOUSE

Those people considering installing an on-site sewage management system that re-uses the wastewater for toilet flushing and laundry use are advised to go to NSW Health webpage, http://www.health.nsw.gov.au/, to determine those on-site systems that are accredited.

Advice from NSW Health is that only accredited greywater on-site sewage management treatment systems are to be permitted for re-use. Any submission to Council for the re-use of greywater would need to provide an effluent report with such information as, accreditation details of the proposed on-site sewage management system, details on the separate pipe work (including the back-flow prevention device) that would supply the treated wastewater for re-use and details of the black water system (i.e. toilet).

Council does not recommend the installation of a greywater treatment system for re-use and advises that a rainwater tank is more suitable for re-use in the house because the approval process less onerous, may be of a lesser cost and easier to maintain.

5.4 PUMP WELLS

Pump wells shall be sized according to the following sizing and usually this involves the installation of a pump well that is 2050 litres in capacity. Anchoring of the pump well is advised.

The pump well will be a minimum capacity of either:

(a) one (1) days storage of the daily household wastewater generation where two (2) pumps are installed,

or

(b) three (3) days storage of the daily household wastewater generation where one (1) pump is installed (minimum size 2050 litres).

5.5 GREYWATER DIVERSION DEVICES (GDD'S)

On 1 July 2006 the Local Government (General) Amendment (Domestic Greywater Diversion) Regulation 2006 came into force. Council approval is required to install a GDD where there is an existing on-site sewage management system.

The installation of a GDD will require that the greywater is discharged below ground (e.g. sub-surface or sub-soil), that buffer distances are met and the work is undertaken by a licenced plumber. All disposal trenches will be sized according to the greywater load the trench receives and there will be a valve allowing the greywater to be discharged back to the existing on-site sewage management system or sewer in times of wet weather.

6.0 COMPONENTS USED IN LAND APPLICATION AREAS

Indexing Valves

Indexing valves allow for up to six (6) separate land application areas (beds or irrigation areas), to be used. This creates a dry/wet effect in the beds allowing for greater treatment of the wastewater. 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 beds LAAs.

Rota Valves

Rota valves are similar to indexing valves and dose each area with approximately 100 litres of wastewater prior to changing over to the next area. These are appropriate for use in sprinkler irrigation areas.

Dosing Siphons

Gravity-driven dosing siphons are becoming more popular. Dosing siphons are passive devices that deliver a set quantity of water in discrete doses. They are used in sloping sites to allow fall between system elements.

Siphons are located after the collection tank (greywater or septic tank) and can be used to dose sand filters or ETA beds. Siphons ensure that effluent reaches the ends of ETA beds thus providing more even distribution and allow for the intermittent dosing of sand filters.

Distribution boxes

These are concrete boxes used when installing two (2) or more ETA beds and allow for the even distribution of wastewater between the individual beds.

Electrical Components

All electrical components shall be installed a minimum of 100mm above the 1:100 year flood level on the property and be suitably protected from the possibility of damage i.e. by garden tools.

Diagram 1- Standard Reed Bed Design

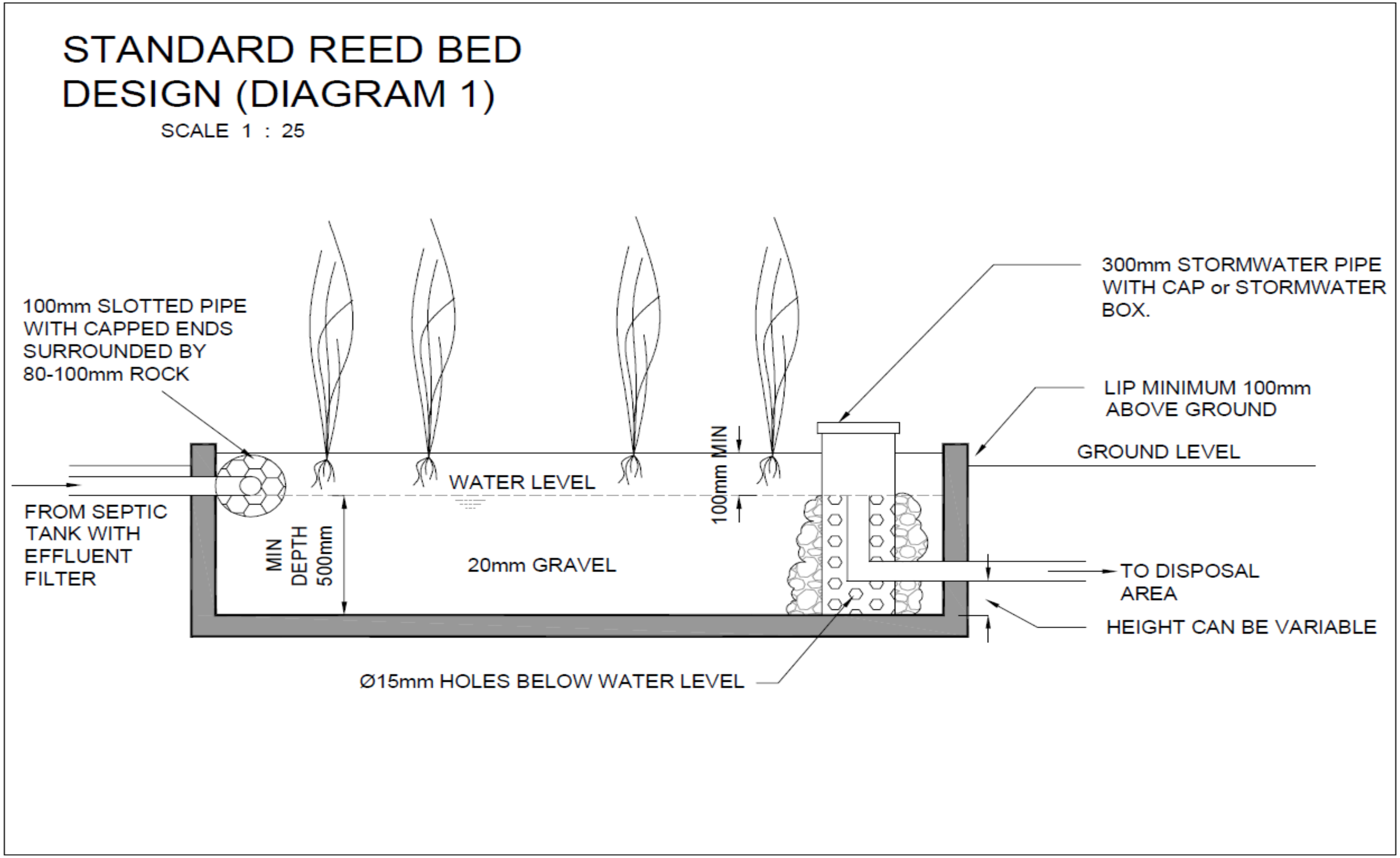
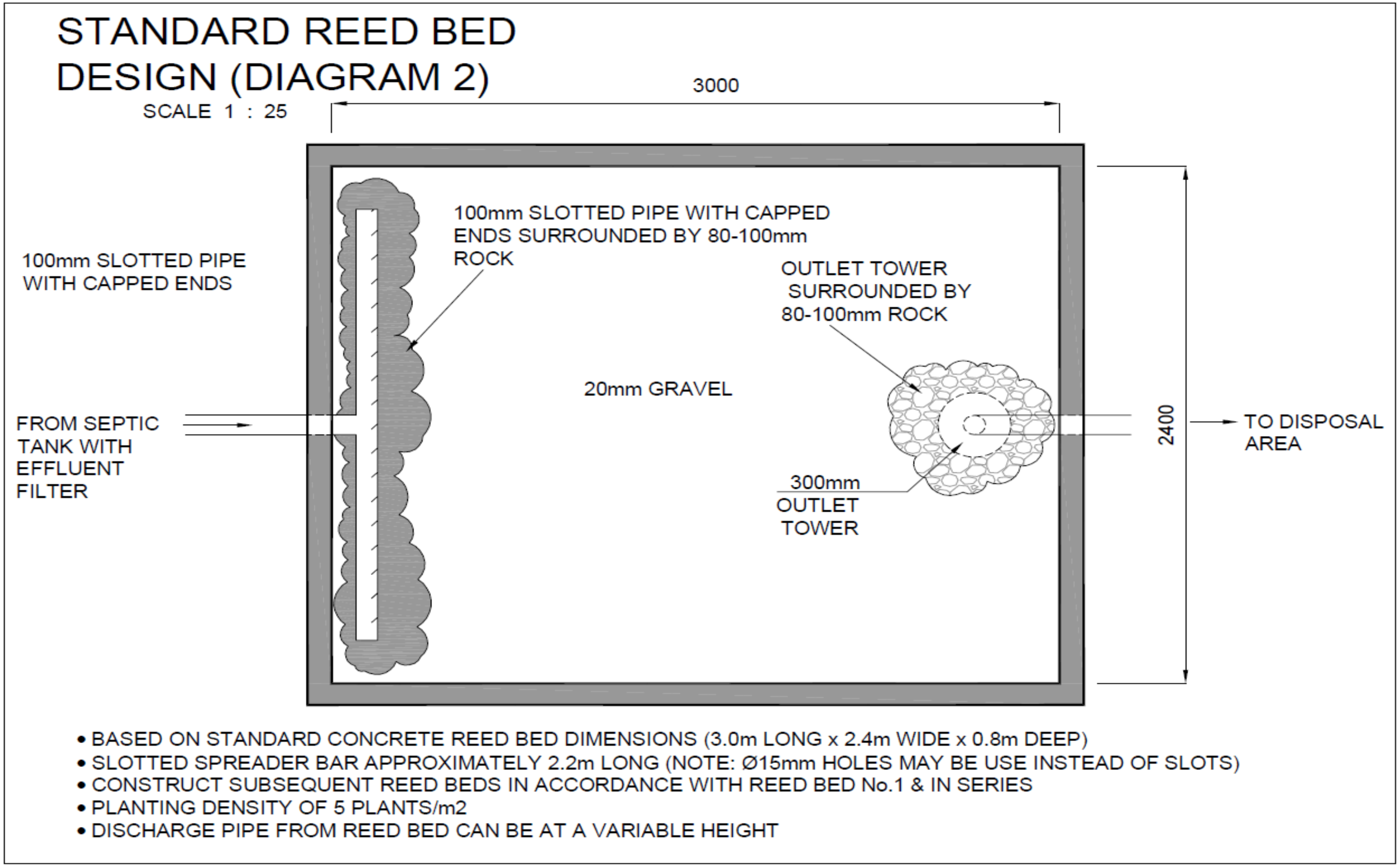

STANDARD REED BED
DESIGN (DIAGRAM 1)
SCALE 1 : 25
100mm SLOTTED PIPE
WITH CAPPED ENDS
SURROUNDED BY
80-100mm ROCK
300mm STORMWATER PIPE
WITH CAP or STORMWATER
BOX.
LIP MINIMUM 100mm
ABOVE GROUND
GROUND LEVEL
WATER LEVEL
100mm MIN
FROM SEPTIC
TANK WITH
EFFLUENT
FILTER
MIN
DEPTH
500mm
20mm GRAVEL
TO DISPOSAL
AREA
HEIGHT CAN BE VARIABLE
Ø15mm HOLES BELOW WATER LEVEL

Diagram 2 - Standard Reed Bed Design



Appendix 2 - Land Application Areas

1.0 INTRODUCTION

There are various methods used to dispose of wastewater. AS1547:2012 and E&HP Guidelines (1998) describe these in detail so it is not the intention of this strategy to reproduce this readily available information. The final method of disposal will be dependent upon the results of a site and soil evaluation.

The majority of on-site sewage managements systems in the Richmond Valley Council area utilise evapotranspiration beds or sub-surface drip irrigation. Generic diagrams of the standard layout of various land application areas are included in this appendix.

Wherever possible a reserve land application area should be provided for. In existing sub-divisions if there is available area, a reserve area should be nominated and retained for this purpose.

1.1 LAND APPLICATION AREAS INSTALLED BELOW THE 1:20 YEAR FLOOD LEVEL ON THE PROPERTY

In regards to the installation of any land application area below the 1:20 year flood level on a property please see Part B - Section 10.3 - J.

Please note Richmond Valley Council does not recommend the installation of mounds/pads for the construction of ETA beds.

2.0 ABSORPTION TRENCHES

Traditionally the older on-site sewage management systems will have absorption trenches and these will usually be replaced with evapotranspiration beds when they fail unless there is a need to upgrade the treatment of the wastewater to a secondary level, in which case sub-surface drip irrigation may be installed.

Richmond valley Council does not generally consider this type of disposal appropriate and would only allow absorption trenches on constrained sites. If proposing to use absorption trenches then Council will require comprehensive justification.

3.0 EVAPOTRANSPIRATION/ABSORPTION BEDS (ETA BEDS)

These beds (see ETA Beds Diagrams 1 and 2) are a combination of evaporation beds with a permeable base. Richmond Valley Council recommends that the surface of the bed is grassed and regularly mowed to keep the grass short. This will allow sunlight to evaporate any surface moisture and for ease of maintenance.

In regards to other vegetation, Council recommends that small shrubs be planted a minimum of two (2) metres from any sidewall and small trees no closer than five (5) metres. This will help minimise root intrusion. Larger trees, such as, mangoes, fig trees and eucalypts should be a minimum of twenty (20) metres. Ideally there should be no overshadowing of the LAA from surrounding vegetation.

Listed are points to consider when installing ETA beds:

- ETA beds must centrally fed, unless the wastewater is pumped into the ETA beds.
- ETA must be installed in natural ground.
- Slopes greater than 15% will require special design or consideration of an alternative method of disposal i.e. sub-surface drip irrigation or may involve sourcing an alternative area to dispose of the wastewater, which may involve the installation of a pump well.
- Diversion swales will be required to be installed above the LAA on sloping sites.
- No vehicular, stock or pedestrian access should be made across the ETA beds. In the case of livestock the land application area is to be fenced to prevent any damage to the ETA beds.
- The maximum length of ETA beds is twenty (20) metres and generally they are two (2) metres wide.
- If ETA beds are two (2) metres wide then the separation distance between beds will be two (2) metres.
- ETA beds are not suitable for medium to heavy or sandy soil types if disposing of a primary treated wastewater i.e. from a septic tank.
- Council will require secondary treatment for all new systems if more than three (3) ETA beds, each measuring twenty (20) long by two (2) metres are proposed unless a pump well is installed, (maximum number of ETA beds will be four (4) for upgrades of existing systems - See Appendix 3).

4.0 SUB-SURFACE DRIP IRRIGATION

Sub-surface drip irrigation utilises secondary treated wastewater and evenly applies the wastewater to the land application area with the use of a correctly sized pump. Council views the use of sub-surface drip irrigation as a high-tech approach requiring high maintenance.

In the Richmond Valley Council area the majority of sub-surface drip irrigation areas are connected to an AWTS and are installed under lawns or grassed areas. Lawn or grassed areas allow for ease of maintenance.

Council does not recommend the planting of shrubs and trees in the sub-surface drip irrigation area due to the potential root intrusion and over shadowing.

Sub-surface irrigation areas are usually installed because of site constraints such as poor soils, high water table; steep sites that rule out the use of evapotranspiration beds and small block sizes.

Minimum Requirements for the Designer

In order to submit sub-surface drip irrigation designs to Council for approval the person must be an appropriately qualified and experienced irrigation designer.

Council defines this person as *"A person holding specialist qualifications in irrigation design and/or who has demonstrated to the satisfaction of Council that they have relevant experience in the competent design of wastewater irrigation systems. (Note:*

An individual who holds current accreditation as a Certified Irrigation Designer (CID) as issued by Irrigation Australia Ltd is one way of satisfying this criterion)".

Design Requirements

All sub-surface drip irrigation designs are to be either:

a. Designed by a certified irrigation designer (CID)

or

b. Certified by a CID (for consultants that do not meet above definition)

or

c. Designed by a person with demonstrated ability to the satisfaction of Council (see above definition).

Council will only accept certified designs from a CID certified in a drip/micro or turf/commercial speciality.

For consultants with limited experience in designing sub-surface drip irrigation areas you are advised to gain adequate training. Council is within its rights to refuse poor designs and should this occur, a designer is advised to submit their design to a CID for assessment and feedback, at their own cost. Council will not provide this service and will not provide a detailed breakdown of its reasons for refusal of a design.

For those plumbers or consultants that have never submitted a sub-surface drip irrigation design to Council, Council requires that your first design is submitted to a CID for comment. The design can then be submitted to Council, with any necessary amendments, together with the CID's comments or the CID's stamp on the design.

Irrigation Designer Requirements and Responsibilities

- It is the responsibility of the designer to ensure the irrigation design is fit for purpose i.e. the design is appropriate for the site.
- Design needs to be consistent with the On-site Sewage Management Report - a copy of report is to be provided to the CID for cross reference.

Please note - it is Council's preference that the CID or their representative attend the site to confirm site/relevant detail is correct for irrigation design purposes in those cases where a consultant has prepared a report. Council realises this may unrealistic for those CIDs outside of the area.

Richmond Valley Council requires the following when preparing the design for submission to Council:

- Two (2) sets of A3 plans - one set with detail for the installation of the sub-surface drip irrigation field showing all components, slope, contour lines, and another set showing such details as but not limited to, aspect, environmentally sensitive areas, buffers and building structures. These plans will be sufficiently sized for Council to clearly identify all components i.e. 1:250.
- Legends will show only those components in the actual design.
- Have a completed copy of Richmond Valley Council's sub-surface drip irrigation design checklist attached - see Appendix 7.
- The CID checklist containing a reference number and a CID stamp - see Appendix 8.

- The irrigation system must be designed to achieve effective flushing velocity of 0.8 to 1.0 metre/second to remove the build-up of soft settled solids, biofilm and other contaminants.
- Design must address root intrusion.
- The design must complement OH&S and ease of maintenance i.e. filters above ground and bracketed to the tank, appropriate warning signage
- Pump efficiency - high frequency watering to be avoided
- Irrigation system must be matched to a suitable pump - Certification must assess proposed pump against irrigation and flushing duties. Information on the pump and brand of drip line is to be submitted with the design.
- The flush pit shall be a minimum of three (3) metres long by 500mm wide and a minimum 400mm deep unless it can be demonstrated that a smaller flush pit will be adequate i.e. provide design details and estimated flushing volumes to the pit.
- All designs are to contain an in-line filter.

Before certifying an irrigation design an accurate site plan and design is to be provided to the CID showing:

- Contours at 1.0 metre intervals.
- Aspect.
- A designated Land Application Envelope.
- Upfront acknowledgement of any constraints which in turn will affect the overall irrigation design i.e. distance to buffers, slope %, drainage, trees, soil profile/groundwater etc.
- Soil profile details including soil type, texture and structure along with the DIR.
- A copy of the On-site Sewage Management Report is to be provided to CID for reference including a sub-surface drip irrigation design checklist.

Please note - that Council's minimum requirements are based on best knowledge until industry provides an agreed upon standard. Flushing velocities were determined based on a usual flushing regime of once every three (3) months to coincide with servicing of AWTS.

Other Design Considerations

- A sub-surface drip irrigation design should be easily read and understood by the plumber installing the irrigation system.
- Wastewater quality is to meet the following standard: 20/30 BOD/TSS.
- The discharge of untreated greywater directly to sub-surface drip will not be permitted.

Maintenance Requirements for Sub-surface Drip Irrigation

Sub-surface drip irrigation requires the following maintenance.

- Quarterly three (3) monthly flushing of the system.
- Cleaning of online filter.

- Vegetation management such as mowing the lawn and trimming vegetation shading the area.
- Checking the components are functioning as required. These components may be the flush valves, vacuum breakers/air release valves, indexing valve and pump.
- If a TECH filter is installed, replacement is made as per manufacturer's recommendations i.e. usually every two (2) years.

5.0 DRIPPER UNDER MULCH IRRIGATION

The design requirements for dripper under mulch would need to comply with the minimum designer requirements for sub-surface drip irrigation.

Richmond Valley Council would only consider the installation of dripper under mulch under exceptional circumstances due to the high rainfall in the Northern Rivers area and would more than likely refuse such an application and recommend the use of another type of disposal i.e. sub-surface drip irrigation or spray irrigation.

Any proposal to install a dripper under mulch irrigation area would need to:

- Provide a good argument for the installation.
- Disinfect the wastewater.
- Be installed on a flat area to avoid any discharge outside of the land application area and have no environmental constraints.
- Provide extensive maintenance and operational guidelines
- Provide a designated land application area.
- A flush pit will be required to be installed (below ground).

Dripper under mulch will not be considered for commercial crops.

6.0 SPRAY IRRIGATION

The use of spray irrigation in the Richmond Valley Council area is generally only permitted in certain instances. Approval to install spray irrigation may be considered under the following:

- Large block size.
- The spray irrigation area is located a reasonable distance from the property dwelling and outdoor living spaces (i.e. thirty (30) metres) and a minimum of 100 metres from a neighbouring dwelling.
- There is an undertaking by the owner that the area is a designated, managed disposal area and not accessed by people or livestock.
- The design complies with the requirements stated in the following Part 6.1.

6.1 UPGRADE OF SPRAY IRRIGATION AREAS

Historically AWTS were installed in the RVC LGA with 200 square metres of spray irrigation and installed under the approval of the Dept. of Health. The spray irrigation was usually installed by the owner or the builder, resulting in numerous problems that have led to system failure.

Examples of these problems are the uneven distribution of the treated wastewater over the LAA resulting in pooling of wastewater in the bottom corner of the LAA, lack of maintenance, some LAA's were never installed, the fine mister sprinklers used block easily and it is possible for spray drift to reach neighbouring properties. Therefore, due to these problems Council has been requiring that the majority of failing sprinkler systems are replaced with ETA beds or sub-surface drip irrigation.

Please note that Council may allow the sprinkler system to remain if the sprinkler system does not represent a public health threat and meets minimum buffer requirements.

To retain an existing sprinkler system, the upgrade of the sprinkler system will need to comply with the following:

- Submit Section 68 Application form including site and soil assessment and a detailed diagram showing the layout of the sprinklers (predicted diameter of the sprinkler throw/pattern) including the spacing of sprinkler heads.
- The design shall be undertaken by a suitably qualified person.
- The installation of a four (4) or six (6) way indexing valve or rota valve.
- The installation of a 120 micron, 50mm (2inch) inline filter may be required. Comment is to be provided if the inline filter is not required.
- The use of heavy droplet sprinklers on hard risers.
- Delivery lines to be buried a minimum of 100mm.
- Details of the pump.
- The LAA will be sized to according to Council's Daily Disposal Model (using SDI parameter).
- On completion of the works the sprinklers will be tested by the plumber in the company of a Council officer.

For non-domestic sprinkler systems Council will require the above and will further require:

- The distribution uniformity (DU), a minimum of 85%.
- The co-efficient of uniformity (CU), a minimum of 85%.
- The Scheduling co-efficient.
- Specification for the type of sprinkler head to be used.

Council may require that during the testing of the sprinkler system that catch cups/cans are in place to verify distribution uniformity.

7.0 LOW PRESSURE EFFLUENT DOSING (LPED)

The use of LPED will require as a minimum the following:-

- The wastewater will be treated to a secondary standard.
- The back portion of the trench shall be utilised as a flush pit to remove bio-film and solids from the pipe.
- Council's daily disposal model to be used to size the hydraulic area of the disposal trenches.
- Design will provide such details as orifice size and flow rate ensuring even distribution between orifices within acceptable limits (i.e. head loss between first and last orifice).

8.0 VEGETATIVE BUFFER

The use of a vegetative buffer will reduce any surface run-off of pathogens and improve infiltration. In some upgrades the land application area is closer to an environmental constraint such as a waterway. In this case the wastewater can be treated to a secondary level and a vegetative buffer planted between the LAA and waterway, see **Appendix 6** for plant details.

In some cases sub-surface drip irrigation areas are placed in close proximity to driveways and Council will condition that a vegetation buffer is put in place to ensure the sub-surface drip irrigation is not driven over.

9.0 TYPICAL DOMESTIC WASTEWATER DESIGN FLOW ALLOWANCES

Table 5 – Typical Domestic Wastewater Design Flow Allowances

Source	**RVC wastewater design flows (L/person/day)**	
	Roof water harvesting	**Reticulated Supply (including bore, spring, creek)**
Households with standard fixtures	**140**	**180**
Households with full water reduction facilities (see Note 1)	**120**	**150**
NOTE 1 - For the purpose of this Strategy, **FULL** water reduction facilities are defined as **"**All water using fixtures having a Water Efficiency Labelling and Standards (WELS) rating of a minimum of three stars or greater, if required by the Basix Certificate that accompanies the Construction Certificate".		

Table 6 - Strengths and Weaknesses of Land Application Areas

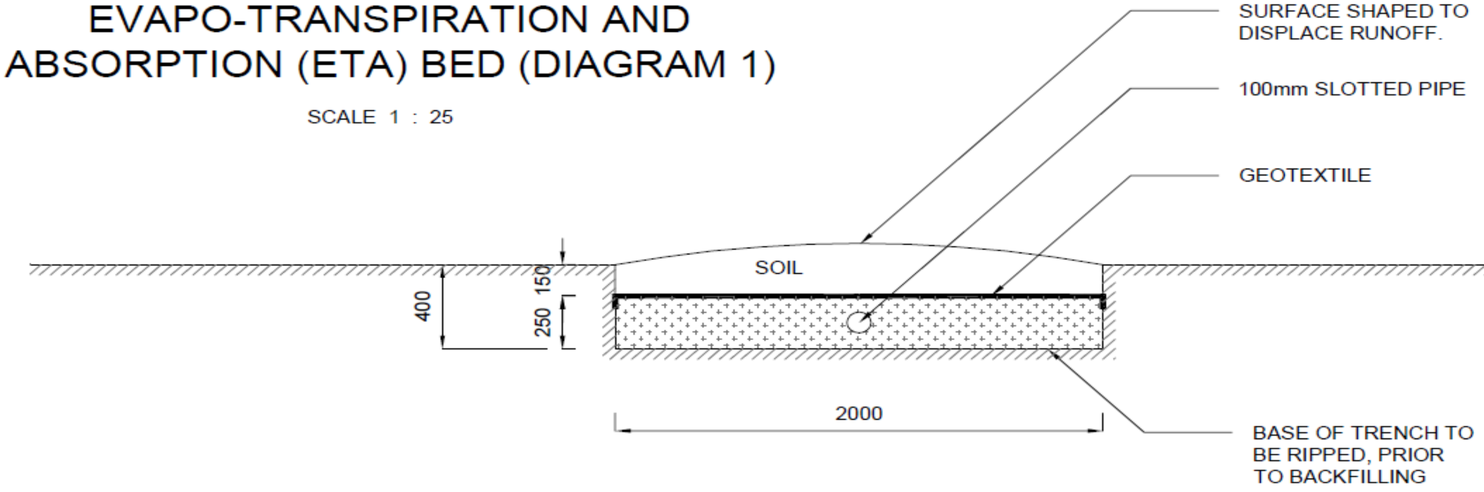
Performance Criteria	Absorption Trenches	ETA Beds	Sub-surface Drip Irrigation	Spray Irrigation	Surface Dripper Under Mulch	Sands Mounds
Application (LCC & AS/NZS 1547:2012)	Only on very constrained sites	Suits clay loams or heavier (AS/NZS 1547:2012)	Most sites	Application area remote from human contact on large acreage	Suits shrub based landscaping - large acreage only	High water tables or clay soils
Disposal or reuse?	Mainly disposal	Mainly disposal. Shallow pipes and heavier soils enhance proportion reused	Mainly reuse if area sized correctly and appropriate harvest regime implemented	Mainly reuse if area sized correctly and appropriate harvest regime implemented	Reuse occurs only if appropriate harvest regime implemented	Reuse occurs via ET through turf cover. Minimisation of downward flow is usually imperative
Risk to environment (nutrient discharge)	Can be high if trenches undersized or in high densities	Can be high if beds undersized or in high densities	Low	Low	Low	Low if correctly designed, built and operated
Power required?	No	No	Pump needed	Pump needed	Pump needed	Pump needed
Fall of site	Some needed	Some needed	Any	Any	Any	Site usually flat
Surface area	Small	Moderate to large	Moderate to large	Moderate to large	Moderate to large	Moderate
Maintenance	Small, owner can do	Moderate –owner can do	High, contractor required	Moderate, owner can do	High, owner can probably do	High, contractor required
Construction cost	Moderate	Moderate	High	High	High	Very high
Minimum level of Pre-treatment required	Primary	Primary	Secondary	Secondary	Secondary	Secondary
Intermittent dosing needed?	No	No	Yes	Yes	Yes	Yes
Root retardant (herbicide) required?	No	No	Yes	No	No	Yes, if subsurface drip irrigation used
Active disinfection (e.g. Cl or UV) required	No	No	No	Yes	Yes	No

Risk to health (pathogen exposure)	Moderate if surface ponding occurs - otherwise low	Moderate if surface ponding occurs - otherwise low	Low	Low if disinfection satisfactory - otherwise moderate	Low- particularly if disinfection satisfactory	Low unless surface ponding occurs at base of mound
Visual impact	Hidden	Largely hidden Can be landscaped	Largely hidden Can be landscaped	Visible Can be landscaped	Visible Can be landscaped	Visible turfed mound, can be incorporated into garden scape
Awareness? Does the device invite user participation and hence awareness/commitment?	No	No	No	Yes	Yes	Possibly

Diagram 3- Evapotranspiration and Absorption (ETA) Bed

EVAPO-TRANSPIRATION AND ABSORPTION (ETA) BED (DIAGRAM 1)

SCALE 1 : 25

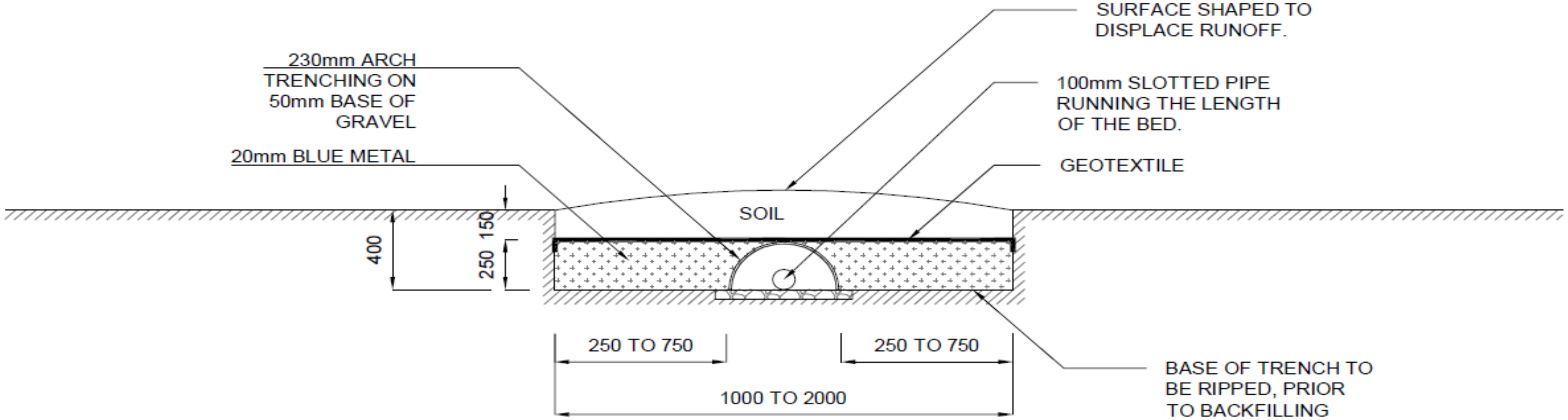


- ETA BEDS ARE TO BE CENTRALLY FED.
- MAXIMUM BED LENGTH IS 20m.
- ONLY SUITABEL ON SLOPES LESS THAN 15%.
- ETA BED IS TO BE GRASSED.
- VEHICLES AND LIVESTOCK ARE TO BE EXCLUDED FROM ETA BED AREA.
- BASE OF THE ETA BED MUST BE LEVEL AND RIPPED PRIOR TO BACK FILLING.
- SWALES/BUNDS/DIVERSION DRAINS MUST BE USED TO PREVENT RUN ON/RUN OFF.
- HEAVY CLAYS/PUGGY OR SANDY SOIL REQUIRE SPECIAL DESIGN FEATURES.

Diagram 4- Evapotranspiration and Absorption (ETA) Bed

EVAPO-TRANSPIRATION AND ABSORPTION (ETA) BED (DIAGRAM 2)

SCALE 1 : 25



- ETA BEDS ARE TO BE CENTRALLY FED.
- MAXIMUM BED LENGTH IS 20m.
- ONLY SUITABEL ON SLOPES LESS THAN 15%.
- ETA BED IS TO BE GRASSED.
- VEHICLES AND LIVESTOCK ARE TO BE EXCLUDED FROM ETA BED AREA.
- BASE OF THE ETA BED MUST BE LEVEL AND RIPPED PRIOR TO BACK FILLING.
- SWALES/BUNDS/DIVERSION DRAINS MUST BE USED TO PREVENT RUN ON/RUN OFF.
- HEAVY CLAYS/PUGGY OR SANDY SOIL REQUIRE SPECIAL DESIGN FEATURES.
- 350mm ARCH TRENCHING MAY BE USED.

Appendix 3 - Matrix for Use in Sizing Land Application Areas (Disposal Areas) for the Upgrade of Existing On-site Sewage Management Systems

1.0 INTRODUCTION

The following set of tables have been produced to simplify the process for plumbers when sizing the land application area (LAA i.e. disposal area) when upgrading existing systems associated with a domestic household. If sizing a LAA for a farm work shed or similar then at a minimum a plumbers report will be required. A Section 68 application form and site and soil assessment will also need to be submitted in all instances.

The stated area sizes have been conservatively sized in conjunction with AS/NZS 1547:2012 *On-site Domestic Wastewater Management* and Council's daily disposal model.

The Matrix has been designed using a minimum number of five (5) people. Any upgrade wishing to use a LAA smaller than stated in the tables will require at a minimum a plumbers report or a wastewater report. The Matrix assumes that most upgrades on older style houses will NOT have full water reduction facilities and therefore must use 150L/person/day (i.e. 750 litres). If the smaller daily load is to be used, full water reducing devices are to be installed.

Site's that have a light clay (moderately structured, weakly structured or massive), medium or heavy clay will require secondary treatment of the wastewater, as may any system within 100metres of a water body or with a major limitation such as an underlying rock layer or high water table. Exceptions to this rule of secondary treatment may be dwellings on a large block of land greater than 4hectares in size and no major limitations or environmentally sensitive areas within buffer distances.

Should there be any dispute over soil type Council has the right to require soil analysis from an accredited laboratory at the land owners/applicants expense.

The size of the septic tank and in some instances the greywater tank will need to comply with AS1547:2012. However, if the septic tank is undersized (no less than 2050Litres) and in a good condition, Council may allow it to remain without the need to replace it, however a condition may be applied requiring the owner to pump out the primary tank more regularly. Any tank smaller than 2050lt will need to be decommissioned and replaced with a minimum 3000lt tank.

Using the Matrix

a. Undertake a site and soil assessment to determine the soil type and any limitations on the block. This will involve undertaking bore logs of the soil profile to a minimum depth of 1000mm.
b. Use the relevant table to determine the size of the LAA based on the soil type found at 1000mm (1metre) or if secondary treatment or a consultant's report is required.
c. If a standard upgrade or secondary treatment is required, submit a completed Section 68 application form *("Application to Install, and/or Construct, Alter or Operate a Sewage Management System (SMS) and Effluent Disposal Area")* with a plan of the layout and pay the appropriate fee. If a consultant's report is required, a plumber is to advise the owner of such a requirement.

1.1 PRIMARY TREATED WASTEWATER - SEPTIC AND GREYWATER TANKS UTILISING ETA BEDS WITH BLOCK SIZE LESS THAN FOUR (4) HECTARES. (CATEGORY 1-5A SOILS ONLY)

Four (4) ETA beds measuring twenty (20) metres long by two (2) metres wide is the maximum size Council will allow. Areas larger than this will be required to install a secondary level treatment system.

Table 1 - Primary Treated Wastewater (i.e. septic and greywater tanks) - Utilising ETA beds with a Block Size Less than 4 hectares (40 000m²) - Sizes shown in Square Metres

Soil Type	5 persons (120lt per person) 600Lt/day	5 persons (150lt per person) 750Lt/day
1.Gravel/sands	40	45
2.Sandy loam	45	55
3.Loams – High/moderately structured	50	60
3. Loams – Weakly structured or massive	70	90
4.Clay loam – high/moderately structured	70	90
4. Clay Loam – weakly structured	125	160
4. Clay Loam - Massive	Secondary treatment required	Secondary treatment required
5.(a) Light Clay strongly structured	160	Secondary treatment required
5. (b)Light clays* - other#	Secondary treatment required	Secondary treatment required
6.Med/heavy clays*	Secondary treatment required	Secondary treatment required

*secondary treatment of the wastewater may require a wastewater report.

- moderately structured OR weakly structured or massive

1.2 PRIMARY TREATED WASTEWATER WITH A LIGHT CLAY (CAT 5B) AND MEDIUM TO HEAVY CLAY (CAT 6) SOIL TYPE ON BLOCK SIZES GREATER THAN FOUR (4) HECTARES AND UTILISING ETA BEDS

Council has a number of larger blocks of land on poor soil types that may have suitable land available to install a larger LAA in replace of installing a secondary level treatment system. NOTE: In allowing for this to occur the land owner accepts the possibility that the land application area may not last as long as it would if secondary treatment of the wastewater was provided. Owners should be advised to consider the cost of the larger LAA to the cost of installing a secondary treatment system.

To comply with this section the following will need to be met:

- Sizing of the LAA based on the table 2.
- There is a minimum of 200mm of a clay loam or better above the light clay layer. If the whole of the soil profile is found to be a light, medium to heavy clay then secondary treatment will be required.
- The land application area is to be a minimum of 40metres down gradient from neighbouring dwellings and 80metres up gradient of a neighbour's house.
- System will require the following special design requirement:
    a. rip 1kg of gypsum per square metre into the base of the ETA bed/s
    b. backfill with a good clay loam or sand
    c. seed any bare areas on the top of the ETA bed
    d. water saving devices are to be installed.

Table 2 - Primary Treated Wastewater with a Light Clay and Medium to Heavy Clay Soil Type on Block Sizes Greater than four (4) hectares (40 000m²) - Utilising ETA beds - Sizes shown in Square Metres. Excluding pug soils.

Soil Type	5 persons (120lt per person) 600Lt/day	5 persons (150lt per person) 750Lt/day
5 (b).Light Clay - Moderately structured	160- Four (4) ETA Beds (20m x 2m)	Not permitted - Secondary treatment required
OR 5(c) weakly structured or massive, AND medium to heavy clay.	160 - Four (4) ETA Beds (20m x 2m)	Consultant's report required - Secondary treatment required

1.3 SECONDARY TREATMENT - REED BEDS AND AWTS UTILISING ETA BEDS

There is a growing trend to install reed beds for septic tanks with failing LAA's which allows for gravity fall to ETA beds. The installation of ETA beds on AWTS will require that an indexing valve be installed where two or more ETA beds are required.

Table 3 - Secondary Treated Wastewater with ETA beds - Sizes shown in Square Metres. NOTE: for reed beds the following calculations are based on the use of two (2) reed beds.

Soil Type	5 persons (120lt per person)600Lt/day	5 persons (150lt per person) 750Lt/day
1. Gravel/sands	40	40
2. Sandy loam	40	40
3. Loams –High/moderately structured	40	40
3. Loams - weakly structured or massive	40	40
4. Clay loam – high/moderately structured	40	40
4. Clay Loam – weakly structured	40	45
4. Clay Loam - Massive	70	90
5.(a) Light Clay strongly structured	70	80
5. (b) Light clay – moderately structured	80	90
5.(c) Light Clay -weakly structured or massive	90	115
6. Med/heavy clays – strongly structured	160*	160*
6. Medium to Heavy Clays other	160*	160*

*Requires special design considerations or the use of sub-surface drip irrigation - see Table 4.

Special design requirements are as follows:

- rip 1kg of gypsum per square metre into the base of the ETA beds
- backfill with a good clay loam or sand
- seed any bare areas on the top of the ETA bed
- water saving devices are to be installed.
- For AWTS or systems with a pump well an indexing valve with air release valve is to be installed.

Gypsum is to be ripped into the base of the ETA beds for all light, medium and heavy soil types. Systems being installed in light clays (b) and (c) and medium to heavy clays will require back filling with a decent soil.

1.4 SUB-SURFACE DRIP IRRIGATION DISPOSAL AREAS

Table 4 - Secondary Treated Wastewater with Sub-surface Drip Irrigation

Soil Type	**5 persons (120lt per person)600Lt/day**	**5 persons (150lt per person) 750Lt/day**
1. Gravel/sands to 3.Loams –High/moderately structured	200	200
3. Loams – Weakly structured or massive	200	220
4. Clay loam – high/moderately structured	300	300
4. Clay Loam – weakly structured	300	400
4. Clay Loam - Massive	300	350
5.(a) Light Clay strongly structured	300	350
5. (b)Light clay – moderately structured to 6. Medium to Heavy Clays – moderately structured	400	400
5.(c) Light Clay -weakly structured or massive	400	400
6. Med/heavy clays – strongly structured	400	400
6. Medium to Heavy Clays – moderately structured	400	450

Soil Type	5 persons (120lt per person)600Lt/day	5 persons (150lt per person) 750Lt/day
6. Medium Clays - weakly structured or massive	400	450

NOTE: The areas shown in Table 4 can be used for systems upgrading existing approved spray irrigation areas providing the upgrade meets Council requirements, i.e. heavy droplet sprinklers, indexing valve, hard risers, disinfected wastewater from an AWTS, buffer distances to dwellings and neighbours, large rural blocks etc.

Sub-surface drip irrigation designs are to be designed by an appropriately qualified and experienced irrigation designer - See Appendix 2 Section 4 for more details.

Sub-surface drip irrigation areas 280m^2 or greater will require the area to be divided into two (2) or more areas i.e. 300 m^2 = 2 x 150 m^2 areas; 400 m^2 = 200 x m^2 areas.

Table 5 - Typical Domestic Wastewater Design Flow Allowances

RVC wastewater design flows (L/person/day)		
Source	**Roof water harvesting**	**Reticulated Supply (including bore, spring, creek)**
Households with standard fixtures	**150**	**180**
Households with full water reduction facilities (see Note 1)	**120**	**150**
NOTE 1 - For the purpose of this Strategy, full water reduction facilities are defines as “All water using fixtures having a Water Efficiency Labelling and Standards (WELS) rating of a minimum of three (3) stars or greater; if required by the Basix Certificate that accompanies the Construction Certificate”.		

Due variation between all sites, taking into account site constraints/environmental factors, as the approval authority Council reserves the right to change any proposed sizes.

Appendix 4 - Blank Site and Soil Assessment Forms

SITE ASSESSMENT		
Details of Proposed Development		
Address Lot, DP Number		
Local Government Area		
Date of assessment		
Proposed Water Supply		
Recent Weather Conditions		
SITE DESCRIPTION		
Allotment Size		
Existing Vegetation		
Slope (%)		
Landform **(for water spreading)**		
Exposure		
Boulders/Floaters **Rock Outcrops**		
Buffer Distance		
Run on and **Upslope seepage**		
Flooding Potential Above 1 in 20 year for disposal area and above 1 in 100 year for treatment system		
Site Drainage		
Vegetation indicating waterlogging		

Surface Condition Bare ground, cracking etc.		
Fill		
Erosion/mass movement Rills, slips etc.		
Limitations	**Overall : no limitations = √, limitation(s) = ×** **If there are any limitations in the above tick boxes, place a cross in the box at right, otherwise a tick.**	
Depth to Water Table		

SOIL ASSESSMENT								
BOREHOLE Number - *1*								
SOIL UNIT (Morand,1994):								
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Soil Category** (cf Texture)	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
Tick box			**no limitation**	*(√)*				
			limitation	*(×)*				
					Overall:	**no limitation** **limitation(s)**		

SOIL ASSESSMENT								
BOREHOLE Number - *2*								
SOIL UNIT (Morand,1994):								
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Soil Category** (cf Texture)	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
Tick box			**no limitation**	*(√)*				
			limitation	*(x)*				
					Overall:	**no limitation** **limitation(s)**		

Appendix 5 - Daily Disposal Model

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FIGURES

APPENDIX 5 - DAILY DISPOSAL MODEL

1.0 INTRODUCTION

As an adjunct to Lismore City Council's On-Site Sewage and Wastewater Management Strategy (LCC 1999), a computer model was created by Greg Alderson and Associates P/L to assist in the sizing of land application areas, particularly evapotranspiration-absorption (ETA) trench-type systems and irrigation-type systems. Additions and modifications were made from 2001 onwards by Antony McCardell of Lismore City Council (LCC) for subsequent releases of the model including this one, particularly in the nitrogen sub-model and user interface. Richmond Valley Council has adopted LCC's model with few alterations.

The computer model simulates some of the processes involved in on-site disposal of wastewater. It is based on published technical material in the literature of wastewater management and associated fields and is similar in many respects to other models. The latest version introduces user interface features such as list boxes, check boxes and buttons from which parameter values may be chosen. These are also replicated in tables in this text. *We recommend that **Step by Step Examples** (Section 13) be followed and tried by consultants, in order to become familiar with the operation of the model.*

1.1 LAND APPLICATION AREAS

In this document land application area (LAA) refers to the physical entity being the area of land onto which treated domestic effluent is to be applied, but more commonly to the numerical size in metres squared (m^2) of that land area, the precise intended meaning in any one instance being dictated by the context. The model's primary purpose is to calculate the LAA size based on

a. Total Nitrogen (TN) loading, with N loss via plant uptake and seepage below the root and gravel zones.

b. Total Phosphorus (TP) loading, with P loss via soil adsorption and plant uptake.

c. Hydraulic loading, with water loss via plant evapotranspiration and percolation.

The LAA size must be sufficiently large to accommodate all three processes yet protect surface and ground water, human health and ecosystems.

2.0 User Input Parameters

Once opened, the Microsoft Excel spreadsheet containing the model is ready to receive various parameters. Cells with text highlighted in blue are reserved for data entry of site-specific parameters which cannot be chosen from pre-set values, an example of which would be the allotment size. Cells which are not for data entry, or are defaults resulting from choices made within list boxes, are left un-highlighted in black. Values provided in list boxes, check boxes and buttons provide suggestions based on the literature. A user may wish to input alternatives but would need to substantiate them by reference to on-site tests, recent literature etc.

2.1 DEFAULT PARAMETERS AND USER-DEFINED PARAMETERS

The **Clear** button resets the model's default parameters. An actual application usually requires resetting at least some of these. To overwrite a default parameter, enter a value in the user-defined column.

3.0 SITE PARAMETERS

3.1 BLOCK SIZE

The allotment size is required later in the calculation process to ascertain permissible N loadings on the allotment. It is entered as meters squared (m^2), hence 1 ha would be 10,000m^2.

3.2 BUFFER FROM LAND APPLICATION AREA TO STREAM/GULLY

This list box offers a choice between two kinds of buffer which apply when the LAA is within either the permanent water buffer of 100 m or the intermittent water buffer of 40 m (DLG *et al.* 1998). Due to the high rainfall of the region, Council now classes any stream (permanent or intermittent) as requiring a 100 m buffer. Similarly all gullies (which have the potential to become intermittent waterways in wet weather) are now considered to require a 40 m buffer. The actual distance from the point on the LAA nearest to the gully or stream is entered into the appropriate user-defined cell only if the LAA is unavoidably situated within the buffer. If the LAA is outside any buffer, then no user-defined input is required.

3.3 WATER SUPPLY TYPE

The water supply type and water efficiency of the household fixtures greatly influences the rate of wastewater generation, shown in Table 1 (the source of the default values in the model). These values are less than values given in the previous version of the Australian Standard (AS/NZS1547:2000). This reflects the fact that, in addition to more careful use of water since the 2002-2003 drought, standard water-reduction fixtures are now very common. Further wastewater generation flow reductions may be claimed at the discretion of Council for enhanced water-saving fixtures and provided that the total organic loading from the dwelling is no higher than it would have been without these enhanced water-saving fixtures. AS/NZS6400 provides information on water efficiency ratings of applications.

Table 1 - Typical domestic wastewater flow generation, litres per person per day (AS/NZS1547:2012)

Source	On-site roof water harvesting water supply (L/p.d)	Reticulated, community supply from borehole, creek or spring (L/p.d)
Household with standard facilities (including automatic clothes washing machine)	120	150

3.4 PERSONS

This is the design ‘number’ of persons contributing to the wastewater stream. Council requires a design based on a **minimum of five (5) people**. In certain complex instances, such as a bed and breakfast situation in which there is a laundry facility for the hosts but not for the guests, the effluent output of one group of people might differ from that of a second group. In such an instance tick the ‘split wastewater sources’ checkbox. The number of people applicable to the first combination of wastewater sources (in this case the hosts) would be entered in the ‘Person – Group 1’ cell and the number of people applicable to the second combination (in this case the guests) would be entered in the ‘Persons – Group 2’ cell. In most common situations there would only be one group and one number to enter.

Within the workings of the model (but transparent to the user) the 'number of persons' is adjusted downwards according to the proportions of wastewater generated by the facilities contributing to the wastewater stream. No adjustment is made when all the wastewater components are present. The total wastewater flow (L/d) is automatically calculated as:

Total_flow = No_ persons x Daily_flow_per_person (1)

4.0 WASTEWATER COMPONENT PARAMETERS

Opinion differs on the typical proportions of hydraulic flow, Total Nitrogen (TN) and Total Phosphorus (TP) within the blackwater stream relative to the total wastewater stream (Table 2).

Table 2 - Proportion of greywater component to total standard wastewater for Flow, TN, TP

	Flow	TN	TP
Greywater alone: proportion to total conventional wastewater stream	**68%** (Jeppesen & Solley, 1994) 65% (DLG *et al.*, 1998)	**30%** midrange of 20%-40% (DLG *et al.*, 1998) 32% (Witt *et al.*, 1974) 18% (Siegrist, 1977)	**60%** midrange of 50%-70% (DLG *et al.*, 1998) 87% (Witt *et al.*, 1974) 70% (Siegrist, 1977)
Blackwater alone (Toilet)	**32%**	**70%**	**40%**

The blackwater figures in bold are adopted as defaults within the model for the proportion of blackwater to total wastewater for water flow, TN and TP.

Where only a proportion of a conventional wastewater stream is to be disposed of, **check boxes** may be ticked to indicate which facilities contribute to the wastewater stream. 'Bathroom' comprises shower, bath and basin while 'Kitchen' includes sink and dishwasher.

Where composting toilets are installed the blackwater stream is either bypassed entirely, so the toilet check box would not be ticked. **Table** 3 was used to supply proportional flow rates for the hydraulic component of the check boxes (Jeppesen & Solley 1994). These figures are for Brisbane but due to similar climate may be applied to our region. Jeppesen & Solley used data from studies in Perth (in 1985) and Sydney (in 1993) to support their estimates.

Table 3 - Average in-house water usage, indicating proportion of wastewater attributable to constituent sources.

Shower	Bath	Basin	Kitchen	Laundry	Toilet	Total greywater	Total	Source
28%	5%	5%	7%	23%	32%	68%	100%	Jeppesen & Solley (1994)
Bathroom								
38%			**7%**	**23%**	**32%**	68%	**100%**	**Adopted in LCC model**

5.0 TREATMENT SYSTEM PARAMETERS

The treatment system parameters reflect the ability to remove total nitrogen (TN). The model requires several N parameters, principally the nitrogen removal percentage, and the default value for this being set by choosing a **Treatment system** from the list box. See Section 10 for a discussion of the nitrogen sub-model.

5.1 NITROGEN REMOVAL %

Choose the treatment system from the list box provided. Each system has a default TN removal percentage displayed upon choosing a system. Septic tanks (DLG *et al.* 1998) and single pass sand filters (Patterson 1994) do not significantly reduce N levels. “Secondary generic” refers to any system not otherwise specifically listed. Thus a single pass sand filter would be classed as “Secondary generic”. Being aerobic, it would be unlikely to remove significant TN (lacking the anaerobic conditions to denitrify). In this case the default 0% would be left unmodified. If the sand filter were a recirculating one, then the default could be over-written with an appropriate value, reflecting the ability of recirculating sand filters to denitrify effluent. Whilst some more advanced models of AWTS claim to reduce TN more significantly, current levels of AWTS fail due to lack of maintenance, user absence and overloading experienced in the RVC area has vindicated a conservative approach in estimating TN reduction in AWTS. Reed beds typically remove 50% or more TN where the design allows for seven (7) days residence time (Davison *et al.*, 2000).

5.2 REED BEDS

If a reed bed is chosen as the secondary treatment device then the default TN removal % will be automatically calculated to be the value which would coincidentally provide secondary standard treatment for BOD, i.e. 20 mg/L BOD outlet concentration, and will be based on an assumed TN production rate of 4.2 kg/p.yr for a full wastewater stream. A user-defined TN removal % may be specified which will change the default reed bed area displayed in the Area Calculations, but if the % is less than that corresponding to a reed bed size producing 20 mg/L BOD outlet concentration a message will appear warning the user that the secondary treatment level will not be reached. A more practical approach is to base BOD and TN removal % performance on the actual total area of reed beds constructed, as discussed shortly.

After the TN removal %, an additional two default parameters are presented: the wetted depth of the reed bed (m) and the “reed bed area if different from calculated”.

The default depth is traditionally 0.5 m but can be otherwise. Recent studies show that the more shallow depth of 0.5 m results in better treatment than greater depths even though deeper reed bed containers are available. However, this model bases performance on volume alone which is the wetted depth multiplied by the reed bed area, then multiplied by the gravel substrate porosity to account for the fact that the gravel occupies part of the volume.

As noted, the default reed bed area is that displayed in the Area Calculations, calculated on the basis that BOD outlet concentration will be 20 mg/L, i.e. of secondary treatment standard. The assumption is that a full wastewater stream from a septic tank has a BOD concentration of 250 mg/L when the wastewater generation rate is 120 L/p.d, more dilute concentrations resulting from proportionally higher flows. The default TN removal percentage is calculated to be the value which would coincidentally provide the “BOD 20 mg/L” based on an assumed TN production rate of 4.2 kg/p.yr for a full wastewater stream. This default value displayed would vary depending on other choices made in the spreadsheet, such as TN production for greywater only, etc.

Since reed bed containers are of fixed dimensions from various manufacturers, the actual reed bed area will usually differ from this value and be equal to the sum of areas of all the containers employed. Hence it is advisable to enter the actual total reed bed area as it may result in concessions that reduce costs. If the total area is greater than the default reed bed area then BOD treatment will be better than secondary standard and TN treatment will also be enhanced, thus potentially reducing the required nitrogen area. If, on the other hand, the total reed bed area is less than the default reed bed area then BOD treatment will not meet secondary standard and the warning message described above will appear. But the area may be close enough in size to warrant approval and this will most likely reduce the cost of reed bed materials (containers and gravel). In this case, TN treatment will be less and the trade-off *may* potentially be a larger nitrogen land application area.

5.3 ALLOWABLE TOTAL NITROGEN EXPORT LOAD

The model assumes that a maximum of 15 kg/system.yr TN will be allowed to percolate below the root zone. This value is roughly equal to the annual amount of TN produced by a family of 3.6 EP, each person producing 4.2 kg/p.yr for a full wastewater stream. In other words the model allows a TN export which is about equivalent to what would have been allowed for a moderate sized family under previous regulations that considered only septic trenches and did not consider the impact of nutrients on the environment.

6.0 LAND APPLICATION

The land application list box offers a choice between ETA beds, subsurface (drip) irrigation and surface spray irrigation systems. For the purposes of the model, the latter two share the same parameters and the same abbreviation, SSI, within the text of this manual.

6.1 Depth of layers in ETA beds

If ETA beds are chosen, then two further parameters are required: 1) the depth of the soil layer above a gravel layer, also called the root zone because it contains the roots of a planted vegetative cover, which is assumed to be mown grass, and 2) the depth of the gravel layer beneath it. The bottom of the gravel layer comprises the bottom boundary of the conceptual “leaky bucket” (as defined in Section 9.1) that is used to calculate the hydraulic area. The default value of 200mm for each of these parameters is likely to vary according to the ETA design, and user-defined values will likely be required.

6.2 DEPTH OF THE ROOT ZONE IN SSI SYSTEMS

If a SSI system is chosen, then only one other parameter is required, being the depth of the root zone which is the depth of the conceptual “leaky bucket” in this kind of land application system.

7.0 SOIL INFORMATION

Various soil related information is required in this part of the model. This information is required for both the hydraulic and phosphorus sub-models (described in sections 0 and 0 respectively).

7.1 MORAND SOIL LANDSCAPE CODE

The soil landscapes of the Richmond Valley Council jurisdiction are very complex, due in part to the widespread existence of fluvial landscapes. The first list box in this section of the model requires the user to consult Morand (1994) *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet.* The list box contains only a small subset of 2-letter (lower case) codes for the Morand soil landscapes found in the RVC jurisdiction. These grouped into a few broad categories. A number of soil landscapes found in the RVC area are described in Morand (2001) *Soil Landscapes of the Woodburn 1:100 000 Sheet.* For codes not presented as defaults in the model, the worksheet **PsorptionFromMorand** may assist in determining the phosphorus sorption parameter (see Section 11.2).

The Morand soil landscape categories are required by the model to calculate the phosphorus area. Each category has an indicative phosphorus sorption value which is supplied as a default. Because the results of soil tests at local laboratories often contain phosphorus sorption data, this default may be over-written with a user-defined value when more precise data is available. See Section 11 for a discussion of the phosphorus sub-model.

7.2 DEPTH TO WATER TABLE OR BEDROCK

The depth to the water table or bedrock is required to calculate the phosphorus area. This is a difficult parameter to estimate (short of drilling or digging). The situations in which it is likely to have an important bearing on the phosphorus area are those where the water table is shallow or the bedrock relatively close to the surface. Every effort should be made to discover this depth in these circumstances. If the depth is known to be greater than about 3 m then the actual value entered is unlikely to affect the calculated phosphorus area.

7.3 TEXTURE/STRUCTURE

The soil's texture and structure is a very important parameter in the model as it determines the percolation rate of treated effluent, and therefore has a great bearing on the calculated hydraulic area. See Section 9 for a discussion of the workings of the hydraulic sub-model.

The texture/structure categories refer to the soil underneath the ETA bed or SSI system. The categories are taken from AS/NZS1547:2012. Whilst the structure/texture should be determined from bolus tests and inspection, Morand (1994) provides good indications of the kinds of texture/structure likely to be encountered within any one soil landscape. Council does not endorse a routine choice of "clay loam – high/moderate structured", due to the common existence of much heavier clays in the LGA. Choices of structure/texture from Morand (1994) must be supported by bolus tests on actual soil from the B horizon of the site being investigated.

The texture/structure of a soil is the main determinant of the maximum deep drainage rate (percolation rate), displayed upon choosing the texture/structure.

8.0 AREA CALCULATIONS

The model returns the hydraulic, nitrogen and phosphorus areas. The largest of the three areas is the limiting design factor and becomes final design LAA. In addition, if a reed bed is chosen as a secondary treatment device, the area of the reed bed and the reed bed's hydraulic retention time is also reported in addition to the estimated BOD outlet concentration.

9.0 MODEL WORKINGS

9.1 HYDRAULIC SUB-MODEL

The climate in the Northern Rivers area stands apart from the rest of NSW with its heavy summer rainfall and higher average temperatures. This justifies a local water balance approach, as indicated in AS/NZS1547:2012. The hydraulic area calculation is based on a daily water balance performed within a domain, the boundaries of which are the surface of the trenches or beds, their sidewalls and basal areas. This domain may be conceived as a "leaky bucket" being permeable at the basal area (Figure 1). Our hydraulic sub-model conforms in many ways to a traditional Leaky Bucket mathematical model which is essentially a flow equalisation model with variable net inputs but a constant output. In the hydraulic sub-model this output is identified as the percolation component. However the output in our model is not exactly constant, but has a constant upper limit which is often realised in wet weather. In short the "leaky bucket" is used only as a convenient metaphor. This spatial domain is henceforth unceremoniously referred to as the "bucket" for short.

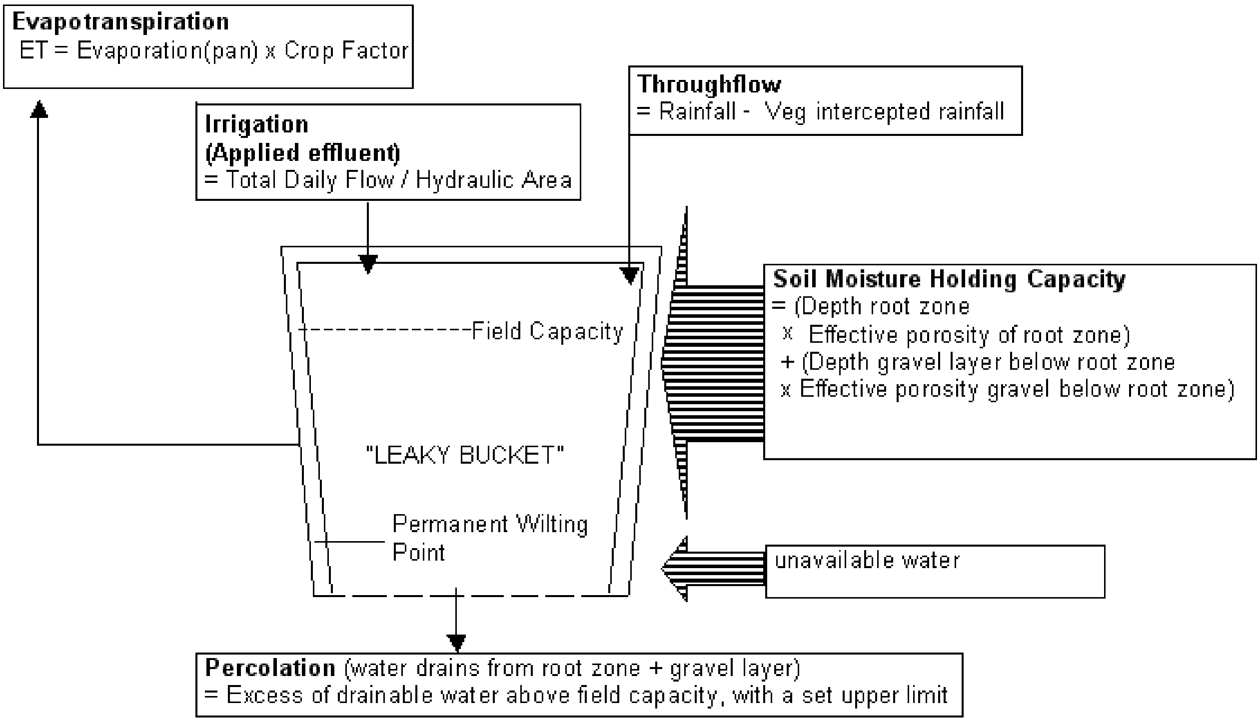

FIGURE 1 - CONCEPTUAL "LEAKY BUCKET" REPRESENTATION OF THE DAILY DISPOSAL MODEL.

A daily water balance is kept for all inputs and outflows, although the balance itself is limited by the approximations used and the assumptions of homogeneity of the land and evenness of distribution of effluent. The balance is based on daily rainfall and evaporation records. In simple terms it may be expressed as

$$\textbf{Bucket} = \textbf{Bucket}_{t-1} + \textbf{Throughflow} - \textbf{ET} - \textbf{Perc} + \textbf{Irrigation} \qquad (2)$$

where

Bucket *is* soil moisture storage in the bucket at the end of the current daily period

Bucket $_{t-1}$ is soil moisture storage in the bucket at the end of the previous daily period

Throughflow is depth of rainfall reaching the soil and infiltrating during the current daily period

ET is evapotranspiration during the current daily period

Perc is drainage of water from the bucket into soil below during the current daily period

Irrigation is depth of effluent applied to the LAA during the current daily period

Note that this model does not take runoff into account, as this does not occur on 95% of the days within the modelling period, as elucidated below. Further, additional refinements are not shown in Eq. (2), but are described in the following sections.

The hydraulic model was originally a translation of a FORTRAN program (Fiander 1980). Fiander's program is based on an unpublished "bucket" model by W. Boughton (undated but c.1980), then of the Water Resources Commission (Fiander, *pers. comm.,* 2003). However the original model has been modified extensively in the current version. The daily water balance is calculated on 21 years (1 July 1970 - 30 June 1991) of rainfall and Class A Pan Evaporation data from Alstonville Agricultural Station. Hence the model is applicable only to areas within this general climatic area. Alstonville was chosen because long term records for both rainfall and evaporation are available. Also the rainfall at Alstonville is typical of the wetter regions within the RVC jurisdiction and hence would tend to yield conservative LAAs for the region as a whole.

9.2 Hydraulic Area (m^2)

A hydraulic area is calculated iteratively so that it is made sufficiently large to allow percolation out of the basal area of the ETA bed or SSI root zone on 95% of the days in the rainfall history.

The following sections detail the calculations used in the water balance.

9.3 Rainfall and Throughflow

Not all the rain that falls on the LAA is capable of infiltrating. A small amount will be intercepted by the vegetative cover. The model assumes that the maximum intercepted is 4 mm. The calculation of rainfall that is capable of infiltrating (throughflow) is based on an algorithm from a European model (Kroes & van Dam 2003) where throughflow is based on physical properties of vegetation such as leaf area index (LAI) and percentage cover. The assumption for our model is that the LAI is 3 and the percentage cover 100%. An empirical coefficient '*a*' determines the limit of rainfall interception. (LAI * *a*) is the asymptote of rainfall capable of being held above ground by the vegetation as interception. For most regular agricultural crops the value of '*a*' is about 0.25 (Kroes & van Dam 2003), thus for those crops with a LAI of 3 the asymptote of interception would be 3 x 0.25= 7.5 mm. As mown grass would be expected to hold less intercepted water than most agricultural crops, a lower value of *a* = 0.133 is used to give an asymptote of 4 mm (i.e. the maximum rainfall interception). For example, with these parameters, the rainfall interception is 2 mm when the daily rainfall is 4 mm and the interception is 3.7 mm when the rainfall is 50 mm. Under our assumptions the original formula (Kroes & van Dam 2003) simplifies to Eq. (3)

Throughflow = Precipitation – 4 x (1-(1/(1+Precipitation /4))) (3)

where

Throughflow is the depth of water (mm) that arrives on the soil from precipitation, after some is intercepted by vegetation (here grass) and the value 4 is the (LAI * a), the asymptote of intercepted rainfall.

The reader is referred to the original formula (Kroes & van Dam 2003) for further details.

Note that this refinement has only a minor effect on the calculation of LAA, which is heavily influenced by the water balance under conditions of very high rainfall.

9.4 Evapotranspiration and the Pan Evaporation Crop Factor

"Crop factors" convert the Alstonville Station Class A Pan Evaporation data to evapotranspiration of the vegetation growing on the LAA, which is taken to be equivalent to a grass cover resembling the Penman-Monteith reference crop evapotranspiration. Crops other than mown grass are discouraged unless appropriately supported by crop coefficient data. The aim is to encourage evapotranspiration. Thus, mulching is not considered effective. Also, the choice of vegetative cover must be balanced against the need to prevent damage to piping etc.

from root intrusion, hence the recommendation that mown grass be used. Eq. (4) is based on the reasonable assumption that in a LAA the grass will never be short of water, hence actual ET will always be equal to potential ET. This greatly simplifies the model.

ET = Pan_evaporation x Crop_factor (4)

where

Pan_evaporation is the monthly Class A pan evaporation (mm) and

Crop_factor is a coefficient. Daily crop factors are given the same value within any one month, and the monthly crop factors are based on seasonal crop factors for Brisbane established through regression analysis of pan evaporation data against Penman-Monteith reference crop ET data (Grayson *et al.* 1996).

9.5 PERCOLATION RATES (MM/DAY)

Eq. (5) is the formula used to calculate the percolation component of the water balance.

Perc = min(Max_perc, max(0, $Bucket_{t-1}$ – $Bucket_{awc}$)) (5)

where

Perc is the depth of water (mm) that is lost to percolation (deep drainage)

Max_perc is the design percolation rate

$Bucket_{t-1}$ is the depth of water in the bucket on the previous day

$Bucket_{awc}$ is the depth of water in the bucket after it has been allowed to drain to the field capacity of the soil layer within it (generic soil data from Dunne & Leopold 1978).

This formula is saying that percolation cannot be greater than the design percolation rate and cannot be smaller than the remainder left in the system from the previous day less the amount that is not able to drain away under gravity. The term in Eq. (5) that has by far the greatest influence on the water balance is the design percolation term Max_perc which equals Perc on very wet days.

9.6 PERCOLATION RATES FOR ETA BEDS (MM/DAY)

The design percolation rates (DLR) used in the hydraulic sub-model for ETA beds are taken to be equal to the long term acceptance rates (LTAR) for the particular soil textures and structures reduced by a safety factor as indicated in AS/NZS1547:2012 for “trenches and beds”.

9.7 PERCOLATION RATES FOR PRESSURISED SUBSURFACE IRRIGATION

The design percolation rates used for subsurface irrigation (SSI), taken from AS/NZS1547:2012, are between 5 mm/d for the most permeable soil type (gravels and sands) and 2 mm/d for dispersive soils and may result in very large LAAs. Alternative values may be appropriate depending on Council approval.

9.8 CAPACITY OF THE BUCKET

When the actual percolation rate is less than the maximum rate in Eq. (5) it is controlled by the amount able to drain out of the bucket over the course of a day. The capacity of the bucket is controlled by the depth and porosity of the porous media within it. In all the hydraulic calculations areal depth of water (mm) refers to the depth adjusted for the porosity of soil or gravel within the bucket.

9.9 DEPTH OF ROOT ZONE

The first (obligatory) layer is the root zone where evapotranspiration occurs in both ETA beds and SSI systems. In an ETA bed this is the layer of soil containing roots above the gravel layer (Figure 2). In a SSI system this layer is assumed to occupy the whole of the bucket.

9.10 DEPTH OF GRAVEL LAYER BELOW ROOT ZONE (M)

The second layer underneath the first, which is present only in ETA beds, is typically a layer of gravel (mostly blue metal in the RVC area) (Figure 2).

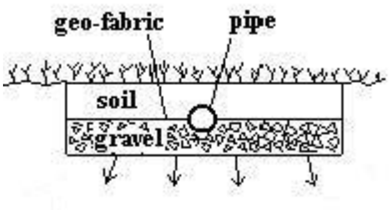

FIGURE 2 - THE TWO LAYERS OF AN ETA BED

9.11 EFFECTIVE POROSITY AND AVAILABLE WATER OF ROOT ZONE AND GRAVEL LAYER BELOW ROOT ZONE

The water holding capacity of the root zone of the bucket, the *effective porosity*, is constrained by the permanent wilting point (PWP) at which the water cannot be extracted from soil particles by the action of plant roots.

$$\textbf{Eff\_porosity} = \textbf{porosity} - \textbf{PWP} \qquad (6)$$

Available water is technically the volume ratio of voids that remain filled with water after drainage from saturation over two days (though most of it drains within a single day) and which remains available for plant root uptake. In our model drainage to the level of available water is assumed to be accomplished in a single day.

$$\textbf{Available\_water} = \textbf{Field\_capacity} - \textbf{PWP} \qquad (7)$$

Bucket (as in $Bucket_{t-1}$) in Eq. (5) is the soil moisture content of the bucket. The maximum possible soil moisture content on any one day (at saturation) is

$$\textbf{Bucket}_{sat} = (\textbf{Depth}_{rootzone} \times \textbf{Eff\_porosity}_{rootzone}) + (\textbf{Depth}_{gravel} \times \textbf{Eff\_porosity}_{gravel}) \qquad (8)$$

In Eq. (8) the moisture content below permanent wilting point is not considered to be part of the bucket's content as it represents water permanently attached to the soil particles.

$Bucket_{awc}$ in Eq. (5) is the soil moisture holding capacity of the bucket at field capacity. It is defined in Eq. (9), where the available water capacity (AWC) of gravel is assumed to be zero (Table 3). Hence the term in the right-most bracket in Eq. (9) can be ignored under normal circumstances.

$$\textbf{Bucket}_{awc} = (\textbf{Depth}_{rootzone} \times \textbf{AWC}_{rootzone}) + (\textbf{Depth}_{gravel} \times \textbf{AWC}_{gravel}) \qquad (9)$$

The porosity and available water capacity of soils varies considerably, both spatially in the field and in the literature. The values chosen for the model (Table 3) are conservative.

Table 3 - Effective porosity and Available Water Capacity (Dunne & Leopold, 1978)

Soil Texture	Effective Porosity	Available Water Capacity (AWC)	Source
Bluemetal (20 mm recommended)	0.43	0.00	field measurements of 20 mm blue metal from LCC Lismore Quarry
Coarse Sand	0.35	0.08	extrapolated from graph in Dunne & Leopold (1978)
Fine sand, Sandy loams	0.38	0.14	ditto
Loams,Clay loams,Silt	0.37	0.15	ditto
Clay (light,med,heavy)	0.34	0.13	ditto

9.12 EXTRA LAA WITH REED BED

To account for the extra hydraulic loading created when rain falls on an open reed bed, the equivalent extra areal depth of irrigation (a relatively small amount) over the LAA, is calculated as

Reedbed_extra = (Reedbed_area x (Throughflow – ET)) / hydraulic_area (10)

where

Reedbed_extra is a gain or loss (mm) spread over the hydraulic area of the LAA

Reedbed_area is the calculated area of the reed bed open to rainfall and ET

Throughflow is the rainfall reaching the reed bed (assumed for simplicity's sake to be the same as the throughflow for mown grass on the LAA)

ET is the evapotranspiration from the reed bed (assumed to be the same as the ET from the grass growing on the LAA)

9.13 WATER BALANCE

The water balance used to calculate the LAA allows exceedence of the bucket's capacity on 5% of days (the wettest days in the rainfall record). The balance on the other 95% of days is accounted for in the following equation:

Balance = $Bucket_{t-1}$ + Throughflow + Irrigation_rate + Reedbed_extra - ET - Perc (11)

where $Bucket_{t-1}$ is the areal depth of water in the bucket at the end of the previous day.

The exceedance on the 5% of wettest days is represented in the following formula:

Exceedance = max(0, Balance – $Bucket_{sat}$) (12)

where

$Bucket_{sat}$ is the water depth (mm) when the bucket is full. The exceedance cannot be less than zero, so when the Balance is less than $Bucket_{sat}$ the exceedance is equal to zero.

Bucket$_{sat}$ is estimated from generic soil data in the literature (Dunne & Leopold 1978).

Thus the final value for the areal depth in the bucket is represented by

Bucket = Balance – Exceedance (13)

Where

Bucket is the actual depth of water (mm) in the bucket.

9.14 LAND APPLICATION AREA IS CAPPED

Council has set a minimum cap of 15 m^2 per person for primary treated effluent and 10 m^2 per person for secondary treated effluent. This overwrites the calculated hydraulic area (or other limiting area) in cases where the LAA is very small.

10.0 THE NITROGEN SUB-MODEL

10.1 NITROGEN PROCESSES

There are four main forms of N involved in wastewater disposal, and transformations between them are biologically mediated by different suites of micro-organisms. The main transformations may be summarised as follows:

Ammonification: Organic N (urea etc) → Ammonia N (NH4+, NH3 (gas))

Nitrification: Ammonia N → Nitrate N (NO3-) (aerobic, during resting phase)

The main N losses during this process are as follows:

Denitrification: Nitrate + carbonaceous material → N2 gas +CO2 (anaerobic, during loading phase)

Plant uptake: plants utilise ammonia N and nitrate N

10.2 NITROGEN EQUATIONS

The equation to calculate the nitrogen area is shown conceptually in Figure 3.

Narea = 10000 x (1-Nlim / (Nload-Ndenit)) x (Nload-Ndenit) / Nplant (14)

where

Narea is the LAA based on TN loading

Nlim is the allowable TN export (kg/system.yr) out of the bucket

Nload is TN production of the household (kg/yr), assuming none lost in primary treatment.

Ndenit is combined TN losses via denitrification during secondary treatment and denitrification and ammonia volatilisation in the soil (kg/yr)

Nplant is TN plant uptake rate (kg/ha.yr). Plants growing in the disposal bed take up N at varying rates but, as Council encourages the use of mown grass, a default value of 200 kg/ha.yr for turf is adopted here (Martens, 1998).

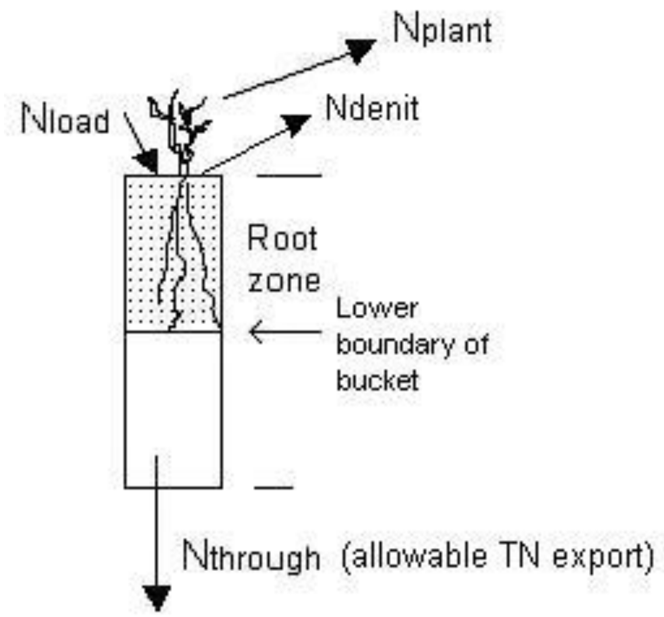

Figure 3 - Conceptual nitrogen model

Expansion of these terms follows:

Nlim = Nmax x (1 – exp(-kB)) (15)

where

Nmax is the maximum allowed TN release into the environment (kg/system.yr, currently set at 15). This is an arbitrary value, but one that is roughly equal to an estimate of the TN loss to the environment in a traditional primary-only absorption trench from a household of 3.6 EP (allowing for some TN loss in the system). Nmax is an asymptote. A value approaching 15 kg/system.yr is allowed on allotments of roughly 1 ha and larger.

k is a curvature factor (currently set at 3). This determines how quickly Nmax is reduced as the allotment size is reduced below about 1 ha. The curviness of the function facilitates a smooth reduction from the asymptote Nmax.

B is notional allotment size, reduced from its actual value if the LAA is within the buffer to a stream or gully. The algorithm used to do this scales the allotment size proportionally to 600m^2 (representing a "very small" block size based on LCC experience) at a point halfway into the buffer.

B = 600 + (Block – 600) x (Buf / 2 – Dist_into_buf) / (Buf / 2) Dist_into_buf < Buf / 2 (16)

or B = 600 x (Buf – Dist_into_buf) / (Buf / 2) Dist_into_buf > Buf / 2

where

Block is the actual allotment size

Buf is buffer width (e.g. 100 m for a stream)

Dist_into_buf is the distance measured from the edge of the buffer to the point in the LAA closest to the stream or gully

Thus, if a block size is 1600 m^2 and the LAA is 100 m from a stream, B will equal the actual allotment size of 1600 m^2. If the LAA is 50 m into the buffer (at buffer midpoint), then B = 600 m^2. If the LAA is 30 m into the buffer, then B = 600+(1600–600) x (50-30)/50 = 1000 m^2. Ordinarily a LAA would not be allowed more than halfway into a buffer. Thus, in the case of a 100 m buffer to a waterway a LAA would not normally be allowed 60 m into the buffer (i.e. 40 m from the waterway). However, when the positioning of the LAA is unavoidably closer to the stream than the midpoint of the buffer, then the second version of Eq. (16) is used. *The purpose of reducing B within a buffer is to encourage increased TN removal by more effective secondary treatment*.

Nload = No_persons x Annual_loading_rate_per_ person. (17)

The model assumes the N production (loading rate) is 4.2 kg/person.yr as measured locally (Davison *et al.*, 2002), a value in line with much international research. The 'number of persons' is proportionally adjusted when the wastewater stream is partial only (e.g. greywater only). It is assumed that greywater contains 30% of the TN load in the total wastewater stream (Table 2). The proportions of TN in greywater are allocated to kitchen, laundry and bathroom as follows, based on proportions cited by Witt *et al.* (1974), which are used cautiously. The adopted LCC values are adjusted as indicated, to preserve the proportion of greywater to blackwater (Table 4).

Table 4 - Nitrogen production in various in-house fixtures

Toilet	Greywater Kitchen	Laundry	Bathroom	Total grey-water	Total	Source
68%	15%	12%	5%	32%	100%	Witt *et al.*(1974)
70%	**14%** = 15/32 x 30	**11%** = 12/32 x 30	**5%** = 5/32 x 30	**30%**	**100%**	**Adopted in model**

Ndenit = (1 – Nloss_treatment) x (1 – Nloss_soil) (18)

where

> ***Nloss_treatment*** is the TN reduction in the treatment system. Some of this may be loss due to ammonia volatilisation, though all the N losses in the treatment devices are lumped together here. Nloss_soil is the TN reduction in the soil of the LAA. A certain proportion of N added to the soil may be released into the atmosphere via denitrification and/or ammonia volatilisation. A conservative 0.2 (i.e. 20%) reduction is adopted in the model (Geary & Gardner 1996).

11.0 THE PHOSPHORUS SUB-MODEL

11.1 PHOSPHORUS PROCESSES

There are three forms of phosphorus (P) involved in wastewater disposal. The main transformational sequence involves the slow hydrolysis of complex P-containing polymers to simpler forms:

Organic P (in nucleic acids etc.) → Polyphosphates → Orthophosphates (plant available P) (polyphosphates include triphosphates in detergents)

Plant available orthophosphates are a problem when entering waterways as they can stimulate toxic algal blooms. P is not of major concern to the environment in the RVC area in the presence of acidic P-adsorbing clay soils. P pollution is more likely where sand is the predominant soil type, since sand has very low P adsorbing capacity. Some areas in the RVC area have sandy soils, for instance around Coraki (Morand 1994). Here careful attention to the P loading capabilities of the soil would be necessary.

The model primarily views the soil as a sink for P via adsorption, although plant uptake is a minor P removal mechanism.

11.2 PHOSPHORUS EQUATION

A rearranged version of the Ryden and Pratt equation is used (Ryden & Pratt, 1980) to calculate the LAA based on phosphorus loading, shown diagrammatically in Figure 4.

Parea = (10000 x Pload) / [(Psorp x (W - B)) / Design_life + Pplant] (19)

where

Parea is the LAA based on TP loading

Pload is the P load in the effluent (kg/yr)

Psorp is P adsorbed in the soil per m of depth (kg/ha.m)

W is Water table depth or depth to bedrock (m)

B is Buffer to the water table (m), taken as 0.5m

Pplant is P removed by plants (kg/ha.yr), taken as 20 kg/ha.yr for turf or lawn (Myers *et al.* 1994).

Design_life is the time of accumulation of P (yr) within the volume of soil bounded by the P area and the depth from the soil surface to the top boundary of the buffer-to-water-table B, taken as 50 years (i.e. it takes 50 years to fill this volume with P) as suggested by DLG *et al.* (1998)

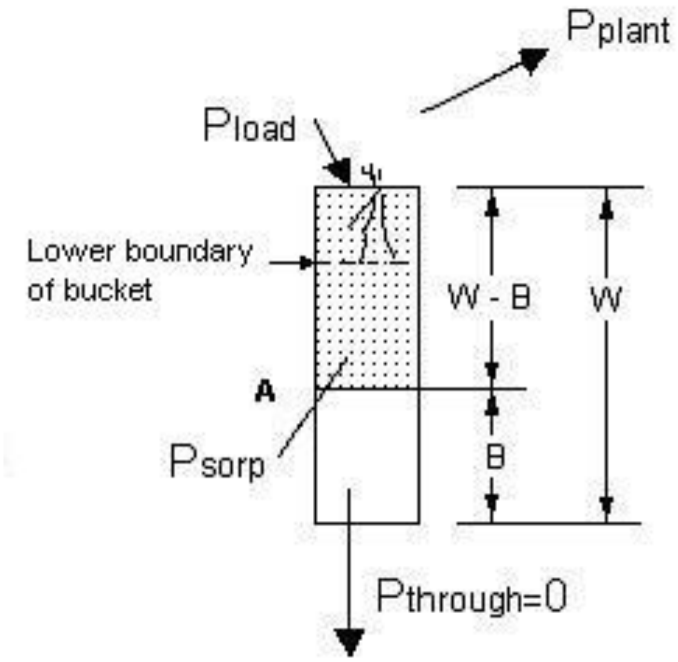

FIGURE 4 - CONCEPTUAL PHOSPHORUS MODEL

The parameters Water Table Depth (W) and Buffer to Water Table (B) define the depth of soil into which P is adsorbed, assuming that sorption begins at the surface and progressively fills the soil downwards, moving as a front. B is usually set at 0.5m to allow for rises and falls in W. In instances where bedrock is relatively close to the surface W may be replaced by depth of bedrock.

Forerunners of the model assumed that the P production (loading rate) was 0.6 kg/person.yr (Geary & Gardner 1996). A recent local study determined P production to be 0.5 kg/person.yr (Davison *et al.* 2002). The model currently assumes a compromise value of 5.2 kg/person.yr. The rationale for this reduced value is the reduced use in recent years of detergents containing phosphorus. Table 5 was used to supply proportional outputs for the TP component of the check boxes. P production component percentages (Witt *et al.* 1974) from the USA are somewhat outdated and are therefore used with caution. The toilet component is probably significantly less than the 40% (100%-60%) inferred from Table 2 for blackwater. This reflects an era when detergents contained more phosphates (Geary & Gardner 1996). Adopted RVC values are shown in Table 5, adjusted as indicated to preserve the proportion of greywater to blackwater (as shown in Table 2).

Table 5 - Phosphorous production in various in-house fixtures

Toilet	Greywater Kitchen	 Laundry	 Bathroom	Total grey-water	Total	Source
13%	30%	55%	1%	87%	100%	Witt *et al,*(1974)
40% (Table 2)	**21%** = 30/87 x 60	**38%** = 55/87 x 60	**1%** = 1/87 x 60	**60%** (Table 2)	**100%**	**Adopted in LCC model**

TP production is calculated in similar fashion to TN as follows. The 'number of persons' is proportionally adjusted when the wastewater stream is partial only (e.g. greywater only).

Pload = No_persons x Annual_loading_rate_per_person. (20)

Psorp is expressed as uptake per metre of depth in the soil below the disposal bed, P saturation being viewed as a front moving downwards. This soil acts as a P sink depending on the soil type chosen, as shown in table 7 is the data associated with the list box marked "Morand code" on the model's input page. Soil units (dp, ep etc.) are from Morand (1994) *Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet* and Morand (2001) *Soil Landscapes of the Woodburn 1:100,000 Sheet*. The soil units shown in Table 7 by the two-letter codes are examples of the soil types and are by no means a complete list.

Table 6 - Phosphorus Uptake by Soils. Source: Environmental Analysis Laboratory, Southern Cross University (LCC 1999)

Soils in Disposal Area	Average phosphorus sorption (kg/ha.m) for 15 mg/L effluent concentration
"Alluvial" Soils (dp, ep, le, nc)	10,000
Dark basaltic soils (ge, mc)	12,000
Duplex soils (ck)	8,000
Podzols (wr)	1,000
Humic gley soils	N/A to be tested

These values are indicative only, for the diversity of soil types is far greater than the handful of groupings listed. In the current version of the strategy, the main use of this particular soil classification is for determining P sorption. If a P sorption capacity value is required for a soil unit that is not listed in Table 7, the Psorption from Morand worksheet may be used to calculate a user-defined depth-weighted phosphorus sorption parameter for use in the main model. This worksheet sub-model requires P sorption data to be entered from Morand (1994) and/or Morand (2001). The depth of ETA bed or trench, depth to bedrock or water table, and thickness of the buffer to the water table (if present) are entered to determine the effective depth of the P sorption "sink". Then the Morand codes corresponding to the soil layers identified from bore logs taken at the site are entered for up to five consecutive soil layers along with their upper and lower depth ranges (converted from Morand's centimeter to the sub-model's meter units). Next, for each soil layer the source of the Morand data is entered as a number 1 (for Morand 1994) or 2 (for Morand 2001). The P sorption data from Morand (1994 Appendix 7.2.7) is entered as an upper case code from L = low to VH = very high. The P sorption data for Morand (2001 Appendix 7.2.7) is entered as actual P sorption values in units of mg/kg.

Finally, if the bulk densities of each soil layer (g/cm^3 or t/m^3) are known these values can be entered into the user-defined boxes for bulk density. If P sorption capacity is in units of mg/kg, as reported by Morand, and the LAA model requires P sorption capacity data in kg/ha.m then the bulk density of the soil must be taken into account. In its determination of P sorption capacity (kg/ha.m) the Environmental Analysis Laboratory at Southern Cross University assumes a generic bulk density value of 1.3 t/m^3 for soil, the default value provided by this sub-model. However, clayey soils often have a lower bulk density, so a more accurate estimate of the depth-weighted average P-sorption capacity in kg/h.m may be had by using actual bulk density data for the layers if available.

The sub-model undertakes the following steps to estimate the P sorption capacity (kg/ha.m).

Step 1. P load applied over the design life of the land application area for each layer is calculated

$Pload_{50}$ (kg/ha) = Layer_thickness (m) x Psorp (mg/kg) x Bulk_density (t/m^3) x 10 (21) where Pload$_{50}$ (kg/ha) is the mass of P adsorbed over the 50-year design life of the P area

Layer_thickness is the vertical thickness of a soil layer

Psorp (mg P /kg soil) is the P sorption capacity

Bulk_density is the soil's bulk density, assumed by Morand to be 1.4 t/m^3

10 is a factor to adjust the result to the correct units

Step 2. A depth-weighted average P sorption capacity for the soil profile (to the depth required) is calculated. If ETA beds or any other type of land application method is used that includes trenches, the soil profile notionally begins at the level of the base of the trench. For all land application methods the soil profile ends at the top of the buffer to the water table or at bedrock.

Psorb (kg/ha.m) = ∑ Pload_applied (kg/ha) / ∑ Layer_thickness (m)) (22)

where Psorb (kg/ha.m) is the depth-weighted average P sorption capacity for the soil profile.

12.0 Graphic Representation of the Land Application Area Layout

On a separate worksheet **Designer** a graphic representation of the LAA in rectangular form is presented. This facility is only available for ETA beds. The layout may be altered by increasing or decreasing the number of ETA beds by means of a spinner button, and by altering the width of the beds and the separation between beds.

13.0 Step by Step Examples

The following examples apply the computer model to situations which might be encountered in the Richmond Valley Council area. In order to demonstrate the effect of block size most parameters will remain as presented in the first example. This is not to suggest that these are necessarily parameters common to most sites. For example, while the Dark Basaltic soil used in the examples is found in the northern most area of the LGA about 10km north of Casino , many sites do not have the benefit of such a well-drained soil, even if they occur within a predominantly Dark Basaltic dominated landscape. Only soil tests can reveal the true nature of soil on a given site.

Example 1.

A household of five on a 1 ha (10,000m^2) block on a hilltop has the full wastewater complement, and its primary-treated (septic tank) effluent will be applied to an ETA bed on free-draining well-structured Dark Basaltic soil identified in the desktop study as part of the *Georgica* (ge) soil landscape (Morand 1994). Roof harvesting provides all domestic water. The LAA is to be grassed, with an expected root zone depth of 150 mm and depth of trench beneath root zone of 150 mm.

After pressing the **Clear** button to reset some defaults, follow these simple steps:

a. Enter the Block size as **10000** m^2 into the appropriate user-defined data entry cell.

b. The Buffer from the LAA is to a **stream** (chosen by activating the list box). This gives the default of >100 m (means 100m or more)

c. Water is from **Roof water harvesting** (120 L/person/day).

d. Persons is five (**5)**. Enter this in the appropriate user-defined data entry cell.

e. The check boxes for Wastewater components are **all ticked**.

f. Treatment System is **Primary only**.

g. Land application type is **ETA beds**.

h. Depth of soil above gravel layer (= root zone) is the default given (200 mm).

i. Depth of gravel layer is the default given (200 mm).

j. The Morand code is **Dark Basaltic Soils =...ge**

k. Phosphorus sorption is the default given (12000 kg/ha.m)

l. Depth to water table Depth is estimated at **10** m (because site is on a hilltop). Enter 10.

m. Texture/structure of the soil beneath system is **Clay loams - high/mod structured**.

n. Click on the **Calc Area** button. Each of the hydraulic, nitrogen and phosphorus areas are reported. Required LAA, **127m^2**, will be displayed.

The hydraulic area that results from this calculation is smaller than the N area. Repeat the example for a 5000 m^2 block. The result is the same for the hydraulic area whilst the N area has about doubled to 257 m^2.

Example 2.

This example uses the same parameters as the first example, except that the block size is smaller.

- Make the following replacement:

  Enter the Block size as **1000** m^2.

The LAA required is 646m^2. This is nearly 65% of the entire block! On this constrained site secondary treatment or the use of a composting toilet will be required to reduce the N load to improve effluent water quality.

- Make the following replacement:

  The buffer from the LAA is to a **stream** and is **50** m.

This means the site is within the 100 m buffer at 50 m from permanent water. The resulting LAA is 717 m^2, an increase over the previous 646 m^2 because it is now in a more sensitive area, close to permanent water. This larger area may not be acceptable and highlights the need to use secondary treatment or a composting toilet.

- Make the following replacement:

  The buffer from the LAA is to a **stream** and is >100 m (clear the user-defined value). We are now outside the buffer.

  Treatment system is **Secondary: AWTS**

The resulting LAA is still 478 m^2, which may not be acceptable.

- Make the following change:

  Treatment system is **Secondary: Reed bed**

The required LAA is now 74.8 m^2. Reed beds consistently reduce the N load by half or more when properly sized to allow at least 5 days residence time (Davison *et al.* 2002).

Another way of reducing the N load before land application is to remove the blackwater component from the wastewater stream by replacing the flush toilet with a composting toilet.

- Make the following changes:

  Wastewater component check boxes are **ticked** except for **Toilet** which is **not ticked**; and Treatment System is **Primary only**.

The land application required is 58 m^2. This represents a major reduction in area compared to secondary treatment, but one which depends on the owner's acceptance of a composting toilet.

Example 3.

Again using mostly the same parameters as the first example, this example increases the block size to 2000m^2, a common average block size in many rural subdivisions. Doubling the block size also increases the acceptable rate of N release to the environment, thus reducing the level of constraint.

- Make the following changes:

  Enter the Block size **2000** m^2 into the appropriate data entry cell;

  Wastewater component check boxes are **all ticked**, due to the presence of flush toilet; and Treatment system is **Primary only**.

The LAA required is 502m^2. This is over a quarter of the size of the entire block and may be viewed as an unacceptable impost on space.

The inclusion of secondary treatment results in better space utilization.

- Make the following changes:

  Treatment system is **Secondary: AWTS**

This reduces the area to 334m^2.

As previously, a reed bed will further reduce the area required.

- Make the following changes:

  Treatment system is **Secondary: Reed bed**

The LAA is now 24 m^2 on the 2000 m^2 block and the limiting area is now the hydraulic area. However, a cap of 10 m^2 per person for secondary treated effluent is imposed, giving a LAA of 50 m^2.

Example 4.

This example uses a different set of parameters. It is based on a real homestay example in the LCC jurisdiction which was proposed some time ago for a 10 ha hilltop site on a soil landscape type similar to the *Coraki (ck)* landscape unit (Morand, 1994). A family of four wished to open a bed and breakfast facility for up to five guests. The water supply was from roof harvesting (140 L/person/day). Composting toilets replaced the need to treat blackwater. Greywater was to be primary-treated in a greywater tank, and then secondary treated in a reed bed. All other normal household facilities were to be available to the hosts; however the laundry needs of the guests were to be out-sourced. The property was on a Duplex soil with Sandy loam topsoil and a subsoil texture of Clay loam with very poor structure. A pressurised sub-surface irrigation system was to be constructed on the level LAA which was grassed and had a root zone depth of 300 mm.

Click on the **Clear** button to reset the defaults.

a. Block size is **100 000** m^2 (=10 ha)

b. The buffer from the LAA is to a **stream**.

c. Water is from **Roof water harvesting**.

d. Internal wastewater sources are split – tick this checkbox.

e. Persons Group 1 is **4** (for the hosts) and Persons Group 2 is **5** (for the guests) in the appropriate data entry cells.

f. The check boxes for Wastewater components for Group 1 are **all ticked**.

g. Of the Group 2 check boxes in the Wastewater components, only **tick** the **bathroom** and **kitchen** (since the laundry needs of the guests are out-sourced).

h. Treatment System is **Secondary: Reed bed**

i. Land application type is **Subsurface drip irrigation**

j. Depth of root zone is the default given (300 mm).

k. The Morand code is **Duplex Soils =...ck..**.

l. Phosphorus sorption is the default given (8000 kg/ha.m).

m. Depth to the water table is probably about **10** m (because the site is on a hilltop).

n. Soil texture/structure beneath system is **Clay loams – massive** (lower level of borehole).

o. Click on **Calc Area**.

The minimum required LAA is 333 m^2.

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Appendix 6 - (Local) Native plants suitable for Land Application Areas.

Scientific Name	Height	Common Name
Sedges, Rushes and Reeds		
Baumea articulata	1m	Jointed Twigrush
Baumea rubiginosa	1m	Rush
Bolboschoenus fluviatilis	2m	Club Rush
Carex appressa	1m	Sedge
Carex fasicularis	1m	Tassel Sedge
Carex gaudichaudiana	1m	Sedge
Cyperus exaltatus	1m	Sedge
Eleocharis equisetina	1m	Spike Rush
Fimbristylus spp.	50cm	Sedge
Gahnia clarkei, G. sieberiana	1.5m	Sawsedge
Juncus polyanthemos, J. usitatus	1m	Reed
Juncus krausii	1m	Salt Rush
Lepironia articulata	2m	Grey Sedge
Lomandra hystrix	1m	Creek Mat Rush
Lomandra longifolia	1m	Long Leaf Mat Rush
Scirpus mucronatus	50cm	Triangular Club Rush
Schoenoplectrus validus	1m	Lake Club-rush
Typha orientalis	1.5m	Bulrush
Grasses, Ground covers and climbers		
Bacopa monniera		Water hyssop
Centella asiatica	20cm	Pennywort
Oplismenus ameulus	30cm	Grass
Oplismenus imbecillis	30cm	Grass
Paspalum distichum	50cm	Water Couch
Pollia crispata	80cm	Pollia
Pseuderanthemum variable	50cm	Pastel Flower

Themeda triandra	80cm	Kangaroo Grass
Vetiveria filipes	1m	Native Vetiva
Viola betonicifolia	30cm	Arrow-leaved Violet
Viola hederaceae	30cm	Native Violet
Penniselum clandestinum* *(exotic)	30cm	Kikuyu
Setaria spacelata* *(exotic)***	30cm	Setaria species
Forbs and Small plants		
Alocasia brisbaniensis	1m	Cunjevoi Lily
Alpinia caerulea	1.5m	Native Ginger
Callistemon pachyphyllus	1m	Wallum Bottlebrush
Cordyline rubra, C. petiolaris	3m	Palm Lilies
Crinum pedunculatum	1m	River Lily
Enydra fluctuans	50cm	Marsh Herb
Helmholtzia glabbristylis	1m	Stream Lily
Melastoma affine	50cm	Blue Tongue
Persicaria spp.	50cm	Knotweeds
Philydrum lanuginosum	1m	Frogsmouth
Pipturua argenteus	50cm	White Nettle
Tetragonia tetragoniodes	50cm	Warrigal Greens
Ferns		
Blechnum indicum	1m	Bungwall
Blechnum cartilagineum	1m	Gristle Fern
Christella dentata	1m	Binung
Cyathea australis	3-5m	Tree Fern
Cyclorus interruptus	80cm	Swamp shield-fern
Shrubs and Small trees		
Banksia ericifolia	3-5m	Heath Banksia
Banksia robur	1-3m	Swamp Banksia

Callistemon salignus	5m	White Bottlebrush
Callistemon viminalis	5m	Weeping Bottlebrush
Evodiella muelleri	3m	Little Evodia
Ficus coronata	5m	Creek Sandpaper Fig
Hibiscus diversifolius	1.5m	Swamp Hibscus
Leptospermum flavescens	3m	Common Ti Tree
Leptospermum liversidgeii	1m	Lemon Ti Tree
Melaleuca nodosa	3m	Paperbark
Melaleuca stypheloides	5m	Prickly-leaved Paperbark
Myoporum acuminatum	3-5m	Mangrove Boobialla
Omalanthus nutans	3-5m	Bleeding Heart
Trees		
Acacia melanoxylon	15-20m	Blackwood
Acmena smithii	5-10m	Lilly Pilly
Archontophoenix cunninghamiana	10-15m	Bangalow Palm
Casuarina glauca	10-15m	Swamp Oak
Commersonia bartramia	5-10m	Brown Kurrajong
Glochidion sumatranum	5-10m	Umbrella Cheese Tree
Hibiscus tiliaceus	5-10m	Cottonwood Hibiscus
Livistona australis	15-20m	Cabbage Palm
Lophostemon suaveolens	5-10m	Swamp Box
Melaleuca quinquenervia	10-15m	Broad-leaved Paperbark
Melicope elleryana	10-15m	Pink Euodia
Syzygium australe	5-10m	Scrub Cherry
Tristaniopsis laurina	10-15m	Water Gum
Waterhousea floribunda	5-10m	Weeping Lilly Pilly

* Exotic grass species. RVC does not promote the use of exotic grasses. However, if these grasses are already on site then they can be utilised in the land application area but not for planting out reed beds.

Appendix 7 - Sub-surface Drip Irrigation Design Checklist

Property Details

Street or Road Number ....

Street or Road ....

Town ....

Lot Number ....

DP/SP/NP Number ....

Owner Details

Owner/s Name/s

....

Full Postal Address ....

....

Contact Details

Telephone ....

Mobile Phone ....

Business Phone ....

Effluent report provided by ....

Irrigation System Designer

Individual ....

Company ....

Design Reference No ....

Irrigation System Installer

Company ....

Individual ....

Irrigation design certifier

Company ....

Individual ....

CID Number...

CID **Stamp**

ITEM	**UNITS**	**RESULT**
Number of Persons	EP	
Total Daily Output	l/day	
Nutrient Loading Area	m^2	
Hydraulic Loading Area	m^2	
Soil type	texture/structure	
Average Site Slope	%	
LTAR Allowed	mm/day	
Vegetation	type	
Lateral Spacing	metres	
Lateral Length (Average)	metres	
Lateral Length (Maximum)	metres	
Gross Application Rate	mm/hr	
Number of Irrigation Zones		
Holding Tank Volume	litres	
Pump Out Volume	litres	
Quantity Applied/Irrigation Event	mm	
Irrigation Duration	minutes	
Irrigation Interval	hours	
Lateral Flushing Velocity	m/sec	
Distribution Uniformity (Spray only)	%	

Flush Pit	**Volume (m^3)**	**Porosity (%)**	

PIPEWORK	**Material (PE, PVC)**	**Diameter**	**Class**	**Length**	
Mainline					
Sub-main					
Flush-line					

Flushing Main					
Laterals		**Manufacturer**	**Description**	**Emitter Flow**	**Emitter Spacing**
PUMP PERFORMANCE	**Type**		**Model**		
Pump					
IRRIGATION DUTY	Flow			l/min	
	Pressure			metres	
FLUSHING DUTY	Flow			l/min	
	Pressure			metres	
Accessories	**Manufacturer**		**Model**	**Qty**	
Control Valve					
Air Release Valve					
Flush Valve					
Vacuum Breaker					
Indexing Valve					
Filter					
Root Intrusion Inhibitor					
Check Valves					
Pump Starter/Controller					

Appendix 8 - Richmond Valley Council CID Checklist

CID Requirements and Responsibilities

This Appendix relates to sub-surface drip irrigation designs by someone other than a CID who has forwarded a design to a CID for certification.

- It is the responsibility of the CID to ensure the irrigation design is fit for purpose i.e. the design is appropriate for the site.
- Design needs to be consistent with Effluent Management report – Copy of report with sub-surface drip irrigation design must be provided to CID for cross reference
- Council's preference if for a CID or their representative to attend the site to confirm site/relevant detail are correct for irrigation design purposes

Before certifying an irrigation design the following information is to be provided to the CID.

- A copy of the Effluent Management Report is to be provided to CID for reference.
- The report must contain an accurate site plan with the following:

TICK RELEVANT BOXES	
Contours @ no less than 1.0 metre intervals	☐
Aspect	☐
A designated Land Application Envelope	☐
Upfront acknowledgement of any constraints which in turn will affect the overall irrigation design i.e. distance to buffers, slope %, drainage, trees, soil profile/groundwater etc.	☐
Soil profile details including soil type, texture and structure along with the DIR	☐

The irrigation system design must meet the following requirements.

The design must complement OH&S and ease of maintenance i.e. filters above ground and bracketed to tank, appropriate warning signage, etc.	☐
Irrigation system must be designed to achieve effective flushing velocity of 0.8 - 1m/s to remove build-up of bio-film and other contaminants.	☐
Pump efficiency – high frequency watering to be avoided.	☐
Irrigation system must be matched to a suitable pump – certification must assess proposed pump against irrigation and flushing duties.	☐
The irrigation design/s and Appendix 7- Sub-surface Drip Irrigation Design Checklist (must contain a reference no. and CID stamp).	☐
Provide two lots of A3 plans: one plan with detail for installation and another plan showing the whole land parcel with irrigation zone relative to house, driveway and any other features/constraints. Both plans @ 1:250.	☐

Owners Name ....

Address - ....

Effluent Report Reference ....

Design Reference Number ....

Certified By ....

CID Number ....

CID
STAMP