

Design Guidelines for On-site Sewage Management for Single Households

APPENDIX B

Land Application Systems

Appendix B – Land Application Options

The E&HP Guidelines (1998) and AS/NZS1547 (2000) describe the various systems that are available for land application areas in some detail. The intention of this section is not to reproduce information that is readily available elsewhere but to expand and highlight points that are particularly relevant to the Byron Shire. Byron Shire features large variability in micro-climates and soil conditions and much of it overlies vulnerable groundwater resources (DLWC Groundwater Vulnerability Map, 1997), and different land application systems will be more appropriate in different localities.

Subsurface land application systems are preferred as they minimise the potential for human contact and rapid release to the environment (Stewart et al., 1983). Evapotranspiration mechanisms are considered the most environmentally means of managing treated effluent because of the ability of the plants to reduce pollution loads while at the same time enhancing the beauty of the locality. The subtropical climate allows a large range of plants to be selected for this purpose compared to other parts of NSW (refer Appendix D).

Land application systems can get overloaded with effluent and fail over time, and an alternate land application area must be designated and set aside for future use should the primary application field become less able to accept effluent or its contained nutrients over time. It is recognised that some existing properties do not have sufficient room for an alternative application area. In these cases it is important that a higher level of effluent treatment be performed, and preferable to be able to alternate the available land application areas, thereby allowing each area to “rest” in an unsaturated state for significant periods each day.

B1. Absorption Trenches

Absorption trenches rely on infiltration of effluent into the ground beneath. Historically this was the only wastewater dispersal method used in the region, irrespective of the soil type. Absorption trenches do not provide for substantial re-use as the effluent is concentrated below the root zone, forcing most of the water downwards to potentially pollute underlying groundwaters. They are also prone to failure due to clogging and hydraulic overloading. For these reason traditional absorption trenches are not generally considered an acceptable or sustainable form of long-term land application system in Byron Shire.

Because absorption trenches offer almost no opportunity for vegetation to pump-out and reuse nutrient-rich effluents, comprehensive justification and secondary effluent treatment prior to dispersal would need to be provided should an absorption system be proposed. Even with secondary treatment, Council generally views absorption trenches as only a short-term solution to an existing problem. If trench designs are to be submitted, they should as a minimum be designed in accordance with AS1547 (2000).

On highly permeable soils which are located a sufficient distance above the standing water table beneath, it may sometimes be acceptable to use a “discharge control trench”, in which the trench beneath the distribution pipe is deepened and filled with washed sand. A standardised design for this type of trench is provided in AS1547 (2000).

B2. Mound Systems

Mounded systems are effluent dispersal devices constructed above the land-surface from imported fill material, usually sand capped with soil. These raised beds are used in situations where drainage of the natural soil is a problem, or where the underlying groundwater seasonally reaches a height of less than 1.2 m below ground level, or areas where flooding occurs periodically. Water dispersal is by evapotranspiration and some soil absorption. Denitrification can be achieved within mounded land-application systems by using intermittent loading.

Careful consideration needs to be given to the installation of this type of effluent dispersal system due to the high rainfall of this region, difficulties in construction and the adverse environmental consequences of system failure. Poor success rates have been experienced with mounded dispersal systems in Byron Shire, and for this reason Byron Shire Council does not recommend their use. If a mounded application bed is proposed, the design and sizing of each mound shall be in strict accordance with AS/NZS 1547 recommendations.

If they are to be used, mounded beds must be carefully constructed and turfed to prevent erosion and to maximise shedding of rainfall off the bed. The down-hill side of the mound should not exceed a slope of 1 in 3 (33%), which can become difficult to achieve even on moderately sloping sites. To enhance maintenance capabilities and to assess the risk of surcharging or other forms of failure, Byron Shire Council requires that observation ports (e.g. made from capped and slotted 50 mm PVC riser pipes) are placed in at least 4 positions per mound to enable regular evaluation during maintenance visits.

B3. Evapotranspiration/Absorption Beds (ET & ETA beds)

An evapotranspiration (ET) bed disperses effluent somewhat like a sand and gravel sponge with a large surface area and shallow depth, sealed at the base and sides to prevent absorption into surrounding soils. Whilst sealing the base is potentially advantageous because it limits pollution of neighbouring soils and underlying groundwater, the high rainfall and limited evapotranspiration experienced in the North Coast region means that sealed-base ET beds are prone to becoming over-filled and periodically surcharging over downstream areas during the wet season.

Evapo-transpiration/absorption (ETA) beds are essentially the same as ET beds but are not sealed at the base and sides. ETA beds allow effluent to be taken-up by evaporation and transpiration mechanisms above the bed as well as allowing some of the effluent to percolate through the permeable base of the bed.

As well as providing treatment and reuse of a proportion of the effluent through evapotranspiration, ETA beds can be quite robust and needing relatively little maintenance when properly designed and installed. However, ET and ETA beds are relatively expensive and difficult to install properly, and they consume large volumes of non-renewable, imported resources - particularly sand, gravel and transportation energy. In operation, it is extremely difficult to achieve even distribution of effluent over the full width and length of the bed for maximum uptake by plant roots, and both ET and ETA beds also suffer from a propensity to fill up with rain-water during wet periods with consequent risk of periodic over-topping of effluent. For these reasons, ETA beds are discouraged in Byron Shire.

If ETA beds are to be installed, the following design features are required unless sufficient justification is provided for alternative designs:

- Design and installation must comply with the requirements of AS/NZS1547 (2000).
- Distribution of effluent is to be via a minimum of two distribution pipes per 1.5 m-wide bed, with one extra pipe required for each additional metre in width.
- Distribution pipes are **NOT** to have geotextile socks fitted to them as this may lead to the pipes clogging.
- The beds must be installed completely flat, and checked by means of laser level or super-saturating the ground and adjusting any puddle areas.
- Maximum length of each bed shall be 20m, and central-feed systems are preferred.
- The distribution system must be designed and installed to ensure even distribution throughout the beds. Splitter boxes must be accessible and stably installed. Distribution pipes must be installed absolutely flat and should be drilled on the sides rather than the bases, so that effluent wells out evenly rather than seeps out the first few holes.
- Monitoring ports (e.g. slotted and capped PVC pipe) must be installed in at least 2 locations per bed,

- Beds must be mounded and grassed to reduce rainfall penetration and encourage evapotranspiration.
- Shrubs are recommended to be planted no closer than one (1) metre from the sidewall of the ETA bed or trench and small trees no closer than five (5) metres. Large trees, such as, eucalypts, figs or mangoes should be planted a minimum of 20 metres from the beds, to avoid root damage in the distribution system and reduce shading of the ETA beds.
- On sloping sites of up to 10%, ETA beds shall be terraced along the slope and reinforced as required to ensure that they will be stable in the long term. Qualified geotechnical advice should be sought if beds are to be installed on slopes of greater than 10% or on unstable soils.
- Adequate run-on diversion mounds or trenches must be provided to prevent run-on onto the beds. On highly sloping or constrained sites, Byron Council further recommends that a swale be constructed downstream of the beds and planted with vetiver grass or other high-nutrient loving plants to assimilate any occasional surcharges from the beds.

Maintenance requirements for ETA beds, including annual maintenance checks, are provided in Appendix G.

B4. Irrigation Dispersal Systems

The most dependable and most popular means of dispersing effluent in a way that maximises uptake by plants within the land application area is by means of pumped irrigation. Appropriate design of pumped irrigation systems for domestic wastewaters requires a good understanding of pumps, pipes and emitters. For this reason, sub-surface irrigation (SSI), spray irrigation or surface-irrigation-under-mulch systems submitted to Council for approval are to be designed by a person with suitable experience in irrigation design. Byron Shire Council recommends that designers of pumped irrigation systems should be accredited by holding a “Certified Irrigation Designer Agriculture/Micro” certificate. Irrigation designs are to include all the information set out in the Irrigation Design Check List (Appendix E). Sub surface irrigation, spray irrigation or surface irrigation under mulch designs are to be installed by a suitably qualified person with experience in irrigation installation.

All effluent dispersal by irrigation including subsurface, surface drip or spray is to be maintained on a regular basis in accordance with their conditions of approval for the installation. An Irrigation Maintenance Report (refer Appendix F) is to be submitted by the service-provider to Council within 7 days of servicing the irrigation area.

B4.1 SUB-SURFACE DRIP IRRIGATION (SDI)

Sub-surface drip irrigation (SDI) systems, also commonly referred to as sub-surface irrigation (SSI), are the preferred means of dispersing effluent in the Byron Shire due to their precise and even distribution capabilities. Sub-surface drip irrigation is particularly appropriate where there are site or soil limitations or limitations, such as steep slopes or on heavy impermeable (often termed “puggy”) soils, and can even be used with care and greater spacing on highly permeable sandy soils.

The sub-surface drip irrigation dispersal method is discussed in the E&HP Guidelines (1998) and AS/NZS1547 (2000, Pages 122-126) in some detail.

On some small and highly constrained sites, it is sometimes advantageous to distribute effluent in carefully laid “micro-trenches”. These micro-trenches comprise narrow, shallow, gravel-filled trenches in which sub-surface irrigation pipes are installed. The advantages of micro-trenches is that by shallowly laying them along the contour, they can distribute effluent reliably, evenly and intermittently using a dosing siphon or pump. Assuming that stormwater is adequately diverted, micro-trenches provide a good opportunity for reuse by plants and only a low risk of effluent surcharging during wet periods.

Laterals in gravel-filled trenches are to be spaced 600mm apart unless otherwise justified. Sub-surface irrigation which is installed without the benefit of distribution trenching will be required to have a dripper spacing of 300 mm and will typically need to have three times the density of and linear length of pipework compared to trench-based designs.

Sub-surface irrigation systems must be designed and installed by suitably qualified persons, and must be flushed to remove sediment/slime at least once per year, and preferably quarterly, by a qualified professional as part of the maintenance requirements. Suitably located pressure-release valves and flush pits must be provided to allow this regular flushing maintenance without causing pollution.

There are a number of different types of proprietary SDI systems on the market. Council requires that all new installations use pressure-compensated emitters, and strongly prefers the use of “non-drain” varieties. “Non-drain” emitters have the dual advantage of not draining out after the pump cycle has finished and are also much less prone to root invasion.

The following design features shall be integrated into SDI designs, unless sufficient justification is provided for alternative designs:

- Design and installation must comply with the requirements of AS/NZS1547 (2000).
- The maximum size for a single sub-surface irrigation field is 500 m². If a bigger application area than this is required to reliably disperse the household effluent, it should be broken up into smaller fields and the effluent load should be alternated through the fields via an indexing valve (refer Section 4.6).
- Pumps must be sized to match the hydraulic characteristics and requirement of the irrigation system, including friction losses through pipes and filters.
- Flushing velocity in all flush lines shall be between 0.8 m/s and 2 m/s.
- Gravel-filled flushing pits should be adequately sized to accept design flush loads and be located below the bottom point in each field. If return lines are to be provided to the septic tank, they must be inserted below the crust level so as not to disturb the crust.
- Discharge rates from emitters should be matched to the permeability of the soil.
- Pump-out volumes shall be sufficient to charge pipe system for durations of between 15 and 30 minutes, twice to four times per day.

Maintenance requirements for SDI systems, including annual maintenance checks, are provided in Appendix G.

B4.2 SURFACE SPRAY IRRIGATION

Within the Byron Shire the use of surface spray irrigation even of disinfected effluent is discouraged due to public health risks (NSW Health) and the much higher risks of uncontrolled run-off of effluent or effluent-contaminated rainfall. Consideration for surface spray irrigation will be given for those on-site systems on large acreage where the dispersal area is a considerable distance from dwellings. Other possible applications might be for flat sites on heavy clay soils, provided that sufficient isolation from residents and neighbours can be demonstrated. The system must be designed in accordance with AS/NZS1547 (2000) recommendations and installed by a suitably qualified person (refer Appendix G for care and maintenance requirements).

If used, above-ground irrigation should be by heavy droplet sprinklers placed in soil-conditioned garden beds with appropriate warning signs to keep children and others away. Detailed stormwater controls must be installed, and **effluent will require adequate disinfection before being sprayed above-ground.**

B4.3 SURFACE DRIPPER UNDER MULCH IRRIGATION

Surface dripper-under-mulch options are considered appropriate in some agricultural applications, for example where dripper lines can be usefully placed under mulch between rows of trees in a

location remote from the house and waterways. In these cases, drippers are placed on the ground surface at the tree base, organic mulch is placed over the dripper lines, and a mound is usually placed around each tree to keep the water at the roots. In some instances owners have also used this type of system to regenerate bushland areas. Such situations, even with appropriate warning signs, are not suitable for children to play in. In plantations, provision should also be made to allow for disconnecting the irrigation line in times of heavy machinery use on the plantation to minimise pipe damage.

Surface dripper-under-mulch options may also be considered for rural domestic situations in Byron Shire. In these cases, higher maintenance and monitoring conditions than sub-surface irrigation options will be required to ensure that the mulch remains in place over the drippers and that casual access by children, vehicles and livestock is restricted by a vegetative border, fence or similar device.

Effluent must be disinfected prior to the dripper system and be designed and installed by a suitably qualified person in accordance with AS/NZS1547 (2000) recommendations. Care and maintenance requirements are provided in Appendix G.