

***SAFE-T-FLO* – AN ALTERNATIVE TO OTHER SUBSURFACE WASTEWATER DISPERSAL SYSTEMS**

Lisle Butler
BUI Ebb & Flow Technologies, Rouse Hill NSW

Abstract

Safe-T-Flo is a system of dispersal of sewage effluent and wastewater using the natural biodynamics of soil. It uses a unique subsurface irrigation technology to evenly disperse treated sewage under the ground as irrigation water.

Household waste is passed through the treatment tank where the solids and liquids are separated and the first stage of treatment occurs. This liquid is pumped through a filter and then to the *Safe-T-Flow* subsurface system. Naturally occurring soil microbes further treat the wastewater reducing odours while the *Safe-T-Flo* distributes the water evenly throughout the approved area.

Safe-T-Flo is a unique combination of polyethylene, geotextile and drip tapes. It provides an even spread of the fluids at a rate that the soil can adsorb.

Keywords

biodynamics, geotextile, irrigation, subsurface, *Safe-T-Flo*, sewage, wastewater

1 Introduction

Safe-T-Flo was designed, patented and manufactured by BUI Ebb and Flow Technologies at Rouse Hill in Sydney. The system combines best technology of drip tube and geotextiles to create a large absorption area for the soil instead of a single point source from an aerated wastewater treatment system (AWTS). *Safe-T-Flo* can also be used to disperse greywater.

The CSIRO Division of Land and Water Resources, Queensland University, University of Western Sydney and Charles Sturt University completed three years of research and development with BUI to develop the first subsurface system. A further two years by BUI and Dr Geoff Cresswell resulted in *Safe-T-Flo*.

On-site wastewater treatment systems have traditionally been viewed as the septic tank and soil absorption system. Modern AWTS, which include pump application systems, offer improved treatment and greater options for disposal.

Subsurface irrigation (SSI) has been around since the 1950s and began as holes drilled in poly pipe for under-tree irrigation. Today SSI is far more sophisticated with pressure compensating drippers and a wide range of thicknesses in pipes and dripper size and spacing. Land application of on-site wastewater by subsurface irrigation is the innovative technology. Subsurface slow-rate treatment is achieved through an underground drip absorption system, with a geotextile as a slow biofilter. This system enhances organic treatment and phosphorus fixing in the soil over a greater cross-sectional area. The loading rate is designed for soil characteristics, water and nutrient balances.

BUI has enhanced subsurface drip technology with combinations of geotextiles to spread the water more evenly through the soil, and allow the soil to distribute it uniformly by capillary action.

2 Description of *Safe-T-Flo*

- *Safe-T-Flo* is a 100 mm wide three-layered combination of polyethylene and geotextile hot-melted together, enclosing a low flow emission drip tape.
- The base layer is polyethylene, which stops downward drainage of fluids.
- The drip tape is covered with a 100 mm wide geotextile that takes water from the dripper via mass flow and therefore allows the soil to absorb the water over a large surface area.
- The drip tape is fixed in the middle and delivers wastewater at 4.2 L/hour.
- The width of the wetting pattern depends on the capillarity of the soil but in sandy loams it can reach 1.5 m wide and in clay loams and clays 2 m wide.
- All materials are inert, have no cation exchange capacity and will last indefinitely in the soil, as ultra violet radiation is the main cause of degradation.
- The system requires a 140-mesh filter and a pressure of 2 kPa (14 psi). BUI packages the required parts as a kit, which can be supplied to installers.
- The system also contains a check valve to stop back flow of water down the line, air relief valves if on a slope and a flushing valve.
- The system can be inserted into existing turf with no trenching, leaving a 20 mm scar.
- A typical four-bedroom house requires 230 m of *Safe-T-Flo* to disperse 1200 L of waste per day on average, and 50 L of water can be dispersed in less than 3 minutes.
- Soil testing is done on every site prior to installation to determine the capillary lift of the soil and the depth of installation required.

3 Installation

BUI has constructed an implement that can be attached to the front of a bobcat or behind a tractor. The implement is lowered to the depth specified by the soil report and then pulled through the turf. At the front of the implement, a coulter slices the turf and soil and a plough folds the 10 mm wide material into a flat plane. As it reaches the bottom of the plough, it unfolds into the soil and the soil folds down onto the *Safe-T-Flo* and the turf left with a cut of 20 mm. *Safe-T-Flo* can be installed at walking pace and is usually installed at 1.5-2m centres. An example of the cross section of the *Safe-T-Flo* is given in Figure 4.

4 Layout of Disposal Area

The following plans illustrate three ways a *Safe-T-Flo* system can be used to service a disposal area of 450 m². The first example is for a site where there is a dedicated area away from the home (Figures 1 and 2) and the second where the effluent is to be discharged around a home utilising an enlarged building pad (Figure 3). Both plans are based on 1.5m spacing between drip lines. Less material will be required for wider spacings.

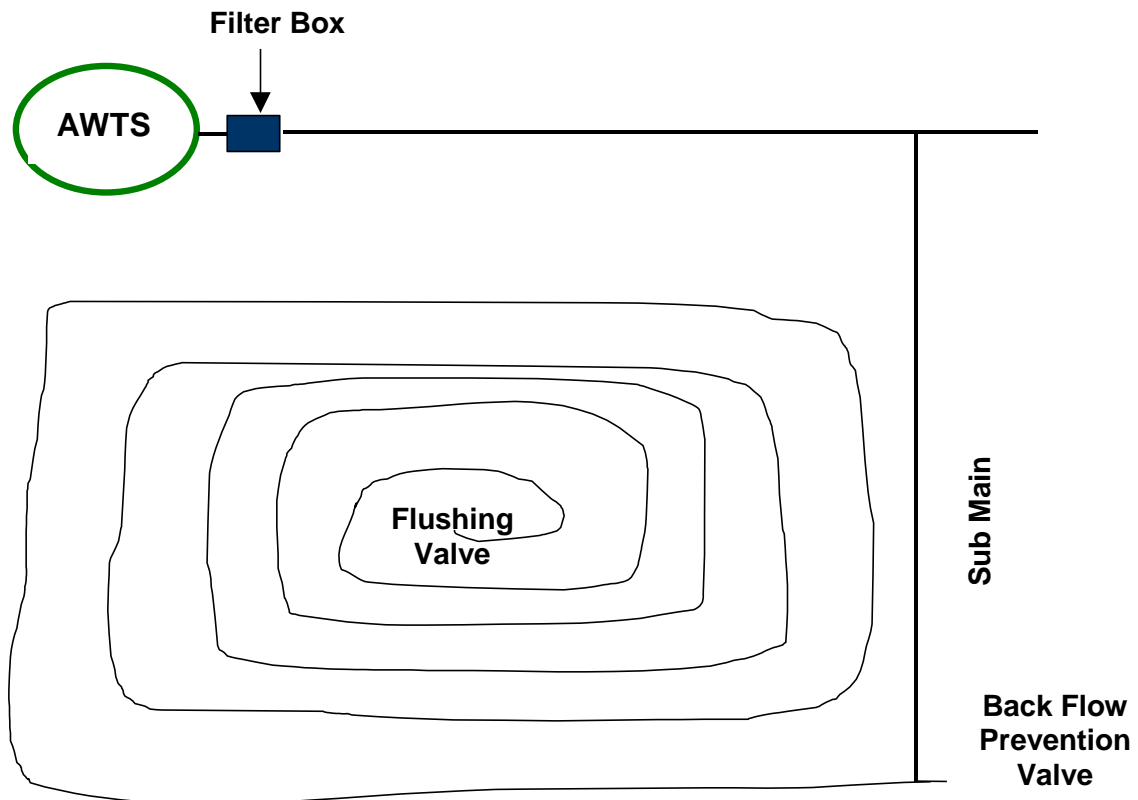
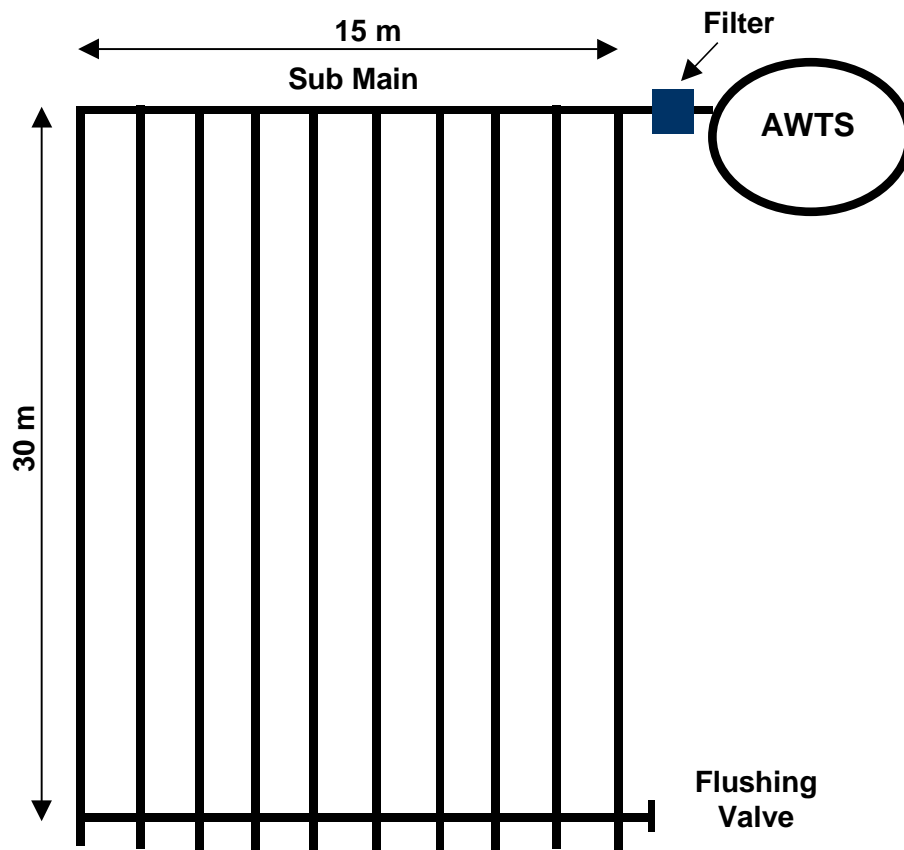
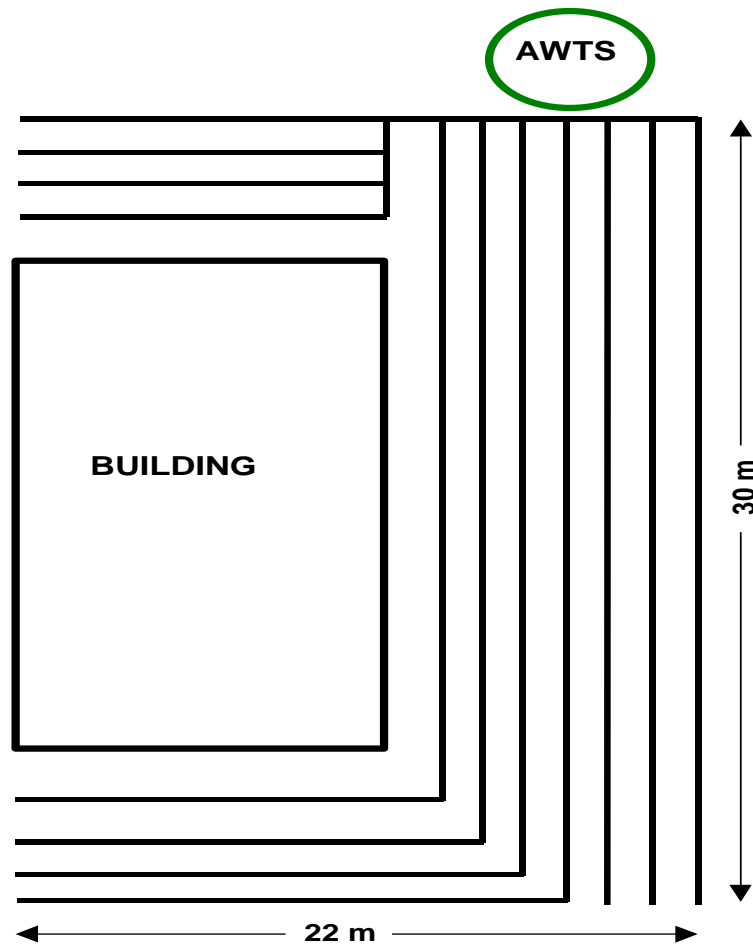
Figure 1- Typical Layout using the *Safe-T-Flo* Implement**Figure 2- Typical layout for a Site with a Dedicated Disposal Area using Either Trencher or *Safe-T-Flo* Implement**

Figure 3 - Possible Layout Using an Enlarged Building Pad

5 Operation

Once the system is installed, the pump is activated. Fluid fills the line and slowly drips away from the emitters by mass flow at a controlled rate of 4.1 L/m/hr. It is quickly absorbed by the geotextile surrounding the drip tape. All the pore spaces of the fabric are filled within minutes, and the soil absorbs the fluid by capillary action.

Instead of one emission point from a drip tube, the geotextile has thousands of emission points. These allow the soil to absorb the fluid slowly, inhibiting downward drainage of fluid to the subsoil. The soil has time to absorb and treat the fluid and at the same time allow for evapotranspiration at the surface or absorption by plant roots and transpiration to the surface.

BUI uses winter evapotranspiration rates for dispersal calculations. Because *Safe-T-Flo* has literally thousands of emission points per square metre, the P sorption rate is spread over a very large soil area and not confined to one point. Figure 4 shows the wetting area from an operating *Safe-T-Flo* system.

6 Suitable Soil Type

Safe-T-Flo can be used on any soil texture class, but a soil capillary test is done at every site to establish:

- Soil capillarity
- Soil texture class
- Proposed depth of installation
- Any ameliorants required to enhance capillarity

A 1kg sample of the soil profile is sampled, and a soils report generated within one week by BUI and emailed to the distributor including:

- Soil texture analysis
- Wilting point
- Field capacity
- Bulk density
- Saturation point
- Saturated hydraulic conductivity
- Available water
- Capillary properties including height of wetting front absorption
- Recommendation on soil treatments and depth of installation

7 System Requirements – Standard 4-Bedroom House

- Soil test and installation recommendations
- Adaptor from the tank to the manifold
- Non-return valve
- 140 mesh filter
- Pressure gauge and fittings
- 5 m of 19 mm diameter poly pipe
- 230 m of *Safe-T-Flo*
- Elbows
- Flushing Valvae
- Clear tubing for flush valve
- Valve Box

8 Wetting Patterns

In most soils, the wetting pattern is elliptical in shape, as shown in Figure 4, and continues for the length of the system. *Safe-T-Flo* has an impermeable base layer which prevents the initial downward movement of water by gravity. This allows the soil time to absorb the water at a sustainable rate. The width of the wetting pattern depends on environmental and soil conditions, but typically is:

- 1.2 m-1.5 m for sandy loams
- 1.4 m-1.8 m for clay soils

9 Maintenance Requirements

Like all sub surface systems the *Safe-T-Flo* has some basic maintenance requirements.

Filters

The system requires a 120-140 mesh filter and this should be cleaned at least every 6 months (quarterly if possible) depending on water quality. This is done simply by unscrewing the filter cover and removing the discs and washing them clean.

Flushing Valves

Each time the filter is cleaned the line should be flushed. This is done by opening the gate valve at the end of the line and allowing the line to run for a few minutes to remove any solids that may have accumulated in the line.

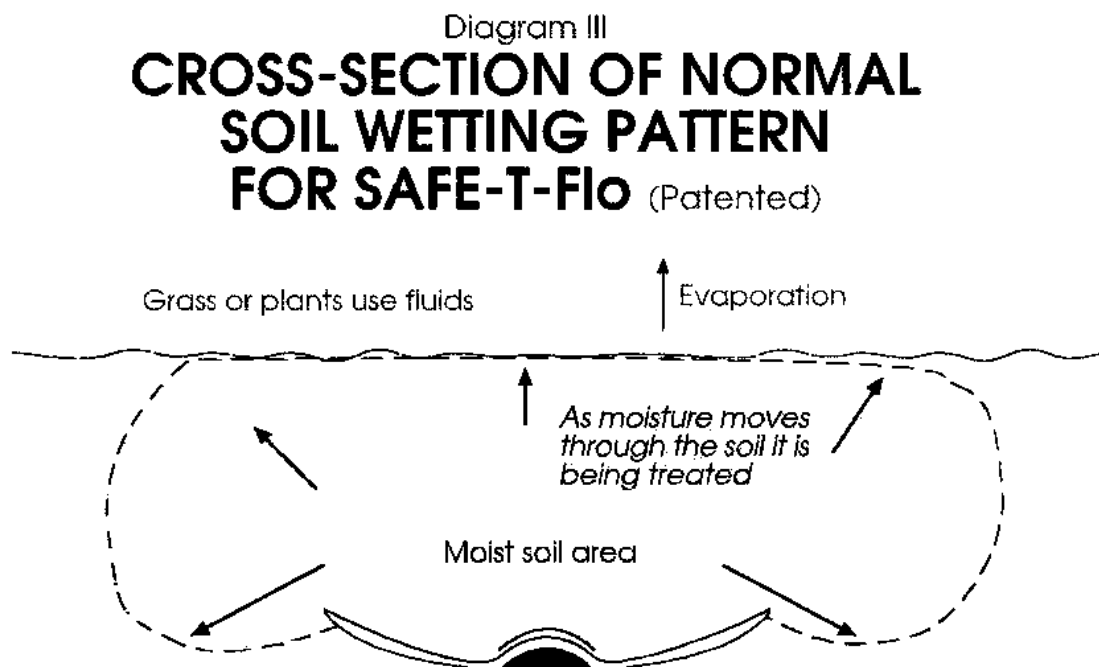
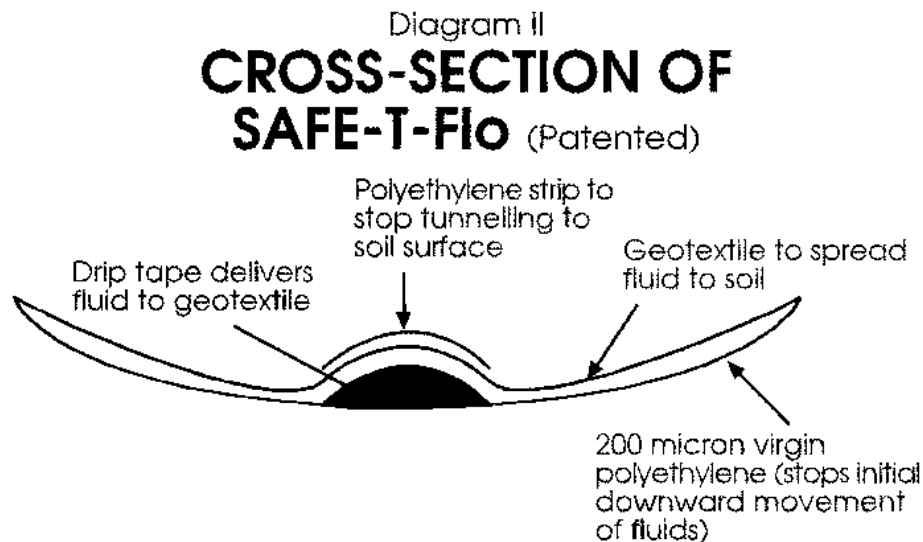


Figure 4: Cross-sections and Soil Wetting Pattern

Pressure

The system comes with a pressure gauge attached and this should be read whilst the system is operating to see if the pressure has changed dramatically either indicating that the filter is full of matter and needs cleaning or the pump is not functioning correctly.

10 Main Advantages

Reduced Health Risks

- Effluent is discharged below ground and must pass through at least 200 mm of soil to reach the surface. Evidence is available that pathogen and parasite levels in the effluent decline in the soil, presumably as a result of filtering and biological suppression.
- The health risk due to inhalation of spray droplets, ingestion of soil especially by children and contamination of vegetation is either eliminated or significantly reduced.

- Subsurface disposal of effluent results in less odour production.
- Effluent can be discharged when the disposal area is occupied without risk to the public.
- *Safe-T-Flo* can be used to irrigate garden beds and lawns around a house without compromising health.

Improved Efficiency

- Effluent distribution is not influenced by wind and surface runoff.
- Effluent is distributed more uniformly than with surface sprinklers. *Safe-T-Flo* has a geotextile layer that rapidly spreads the effluent over the full length of the irrigation line, ensuring even distribution within the root zone.
- With point-source emission systems, the rate of emission from the pipe must be less than the capacity of the soil near the emitter to absorb water or else there will be heavy drainage losses or tunnelling. Tunnelling is a process where contaminated water appears at the surface soon after the irrigation has commenced.

Increased Service Life of Disposal Area

- Standard drip or perforated pipe systems give point source emissions and cause deep drainage losses where application volumes are highest. In these areas, a soils' capacity to retain nitrogen and phosphorus will be stretched.
- Where sprinklers are permanently located, early saturation of nutrient binding sites in soil hot spots can reduce the service life of a field by more than 50%.

11 Conclusion

The majority of older style septic systems are failing due to poor management by the householder and the physical inability of the transpiration /soil absorption trench to cope with the effluent. There is a growing need for the 300 000-odd septic tanks around NSW to be upgraded, or replaced with better on-site wastewater systems. *Safe-T-Flow* is one product that can meet a part of the problem with existing septic systems in the area of improved on-site disposal of effluent.

BUI's goal is to trial *Safe-T-Flow* in a number of situations, and develop a cost-effective secondary filtration and pumping unit to provide a low-cost, low-maintenance system for existing on-site septic systems. To this end BUI is seeking distributors and joint venture partners. The product is now patented in 13 countries worldwide.