DPI&F note

Sub-surface drip irrigation:

System components

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Figure 1 represents the basic components and organisation of a SDI system. These components are necessary to properly manage and maintain the system for continued optimal performance. They are a guideline only as the specific site and system conditions for your installation must be considered when designing your system.

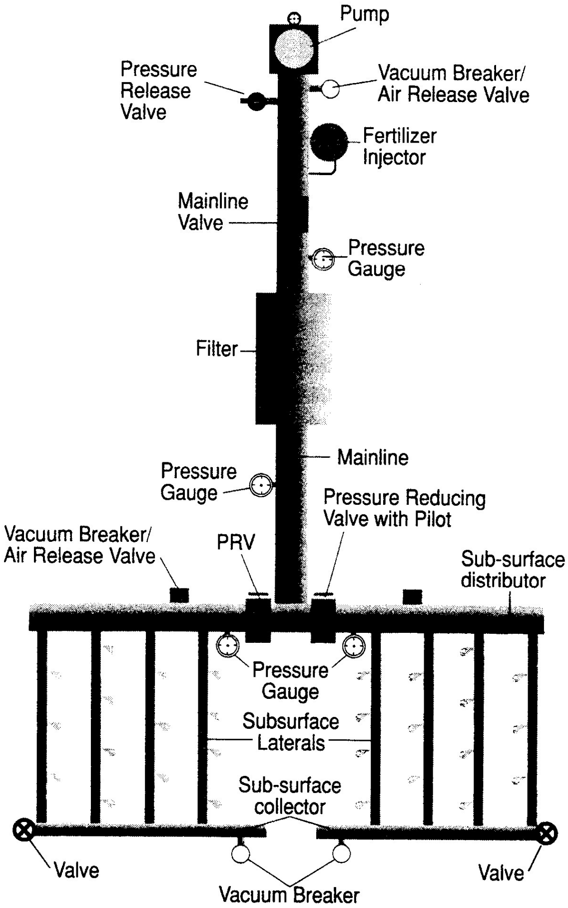

Figure 1: Sub-surface drip system layout (Source: Netafim Australia)

Pump

The size of pump depends on the required flow rate and total head requirement of the system. The total head requirement includes pumping lift, friction losses, elevation changes, system pressure and pressure loss across the filter and other structural components (control valves, flow meter, check valves, main and

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sub-main supply lines). SDI systems have a low-pressure requirement and the minimum input pressure should be at least 100 kPa, with the maximum pressure dependent on the lateral wall thickness. Pumps should be chosen on the basis of their performance (with a “flat” pump performance curve) and safety.

For your installation the size of the pump depends on:

- water supply capacity
- system pressure needs
- block size (the area to be irrigated at one time)
- filter and flushing manifold flushing requirements

Filter system

There is a range of filter types with sand media or disc filters the most common. Most have automatic backflushing capability. The filtration system is the most important part of the SDI system and shortcuts on filtration to reduce installation cost is a sure path to system failure. Considerations in deciding on your filtration system are:

- water quality – the amount, size and type of particles (organic or mineral) to be removed. Surface water usually has much higher organic matter content than groundwater.
- emitter requirements – this is determined by the manufacturer. Usually filtration must be adequate to prevent the passing of particles 1/10 the size of the smallest passageway in the emitter.
- system flow rate – filters can be grouped in parallel to increase total flow rate, or in a series to improve filtration.

Pressure gauge

Functioning pressure gauges are essential in managing the SDI system. They should be located at:

- beginning and end of the system, fitted on the flushing manifold. The flow rate from the flowmeter and pressure readings of the system indicates any problems with emitter performance and clogging.
- At the inlet and outlet points if the filter(s) to show the pressure differential value at which flushing should start.

Backflow preventer

Used to prevent the backflow of fertilisers or particulates into the water supply. Installed between the water supply pump and the fertiliser injector. Options include an atmospheric vacuum breaker, a pressure vacuum breaker, or a double check valve. All State and local regulations must be adhered to.

Pressure regulator valves

These are used to maintain proper pressure in the system. They ensure that the pressure at the emitter meets the manufacturers specifications and the specified flow rate is achieved. Pressure checkpoints required either side to set valve and check system performance.

Fertiliser injector

The basic types of injectors are constant rate pumps (diaphragm, piston or gear) or variable rate systems (venturi pressure differential injectors). The choice depends on:

- The types of products to be injected
- Rate of injection
- Method of injection
- The precision required

A fertigation line check valve should be installed between the injector and the water source to prevent backflow into the fertiliser supply tank.

Flowmeter

A flowmeter should be installed. It measures the volume of water applied through the system and provides useful information on system performance.

Block (or zone) valve

These valves are open or closed to control the flow to the block (or zone) within the field being irrigated. Usually these are manually operated but they can be automatically controlled with an electronic control system.

Air and vacuum release valves

These valves prevent soil being sucked back into the emitters on system shutdown or when the drip tape laterals are drained. They should be installed on all high elevation points in the system downstream of valves, and at all ends of sub-mains and flushing manifolds.

Main line

Usually PVC and used to deliver water to the sub-mains into which the drip tape laterals are inserted. System pressure, flow rate, water hammer and cost all need to be considered.

Sub-mains

Usually PVC and delivers water to the laterals – as for mainlines the chief considerations are system pressure, flow rate, water hammer and cost. They are positioned after the pressure reducing valves

Flushing manifold

The collection pipe at the tail end of the block into which the lateral drip tapes are connected. The three purposes of the flushing manifold are:

- Flushing of sediments and contaminants from the lateral drip tapes to a centralised location
- Equalisation of pressure in the lateral drip tapes
- Allow positive pressure on both sides of a drip tape break to prevent soil “suckback” into the drip tape

Connectors

In most SDI installations a blind tube or take-off riser is used to connect the sub-main and flushing manifold (at a lower depth than the laterals) to the drip tape. There are several types of connectors available and include glued, grommet, barb or compression types. Connection to the take-off riser is by specific connectors or stainless steel wire. It is important that these are properly installed otherwise serious water distribution problems will occur in-crop.

Lateral drip tape

The lateral drip tapes are a polyethylene tape with built in emitters. They are available in a variety of diameters, wall thicknesses, emitter spacings and flow rates. The choice of emitter spacing and flow rate is determined by crop demand and soil-water holding capacity. Tape diameter, available flow rate and elevation changes determine the maximum lateral length that can be used – this should not be exceeded as emitter flow rate variation will increase and this will affect crop performance. It is also important that there is a sufficient flushing velocity (at least 0.3 m/sec) so that adequate flushing can occur.

Wall thickness is important in minimising tape damage from chewing insects – in general the thicker walled tapes are more resilient to damage.

Emitters

Most emitters are the turbulent flow types that have a flow path that creates turbulence in the water as it makes its way from the drip tape to the emitter orifice. This turbulence allows for lower flow passages that are less likely to become clogged. Emitters can be fairly short and welded on the inside of the tape, or can be quite long and part of the tape seam. There are also in-line emitters in some hard-walled tube. Pressure compensating emitters are now also available for SDI installations. These are useful for long lateral lengths or where there are large elevation changes in a field.

In choosing an emitter consideration must be given to:

- Clogging resistance – large passages and high emitter flow rates are associated with less clogging. The shorter the labyrinth the more turbulent the flow and easier to clean the emitter.
- Emitter coefficient of variation (Cv) is found by testing a batch of emitters and using the formula:

$$Cv = \frac{\text{Standard Deviation of Emitter Flow Rates}}{\text{Average Emitter Flow Rates}}$$

The relationship between emitter Cv and distribution uniformity (DU_{CV}) is summarised in Table 1.

Table 1 Classification of emitter Cv and effect on DU_{CV}

Classification	Cv	DU_{CV}
Excellent	Less then 0.03	Greater then 96%
Average	0.03 to 0.07	91 to 96 %
Poor	Greater then 0.07	Less then 91%

- Emitter exponent (x) - a measure of the sensitivity of the emitter to pressure variation. The higher this value the greater the flow variation due to a pressure change. For example, an emitter exponent of 0.5 means that a 20% pressure variation will result in a 10% flow variation. A low emitter exponent is important where there are large variations in pressure due to elevation changes on undulating ground or long tape runs are required. Where the system will have only slight pressure variations (short tape runs on flat ground with large diameter sub-mains and pressure regulating valves) then a lower emitter exponent is not as critical and effort to select a low Cv product is more important.

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Further information

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There are an increasing number of commercial irrigators experienced with SDI within Australia across a range of crops. If considering SDI you should discuss this with experienced growers as well as the experienced field staff of the major SDI system suppliers who can put you in contact with experienced SDI irrigators.

Information is also available on the World Wide Web through the Trickle-L Discussion List. This list has over 650 members (irrigators, manufacturers, resellers, researchers, extension personnel) in 35 countries. Details on joining this list can be found at the Microirrigation Forum Web site at www.microirrigationforum.com . This site contains archives of discussions related to drip irrigation (and SDI in particular) that you can readily examine.

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