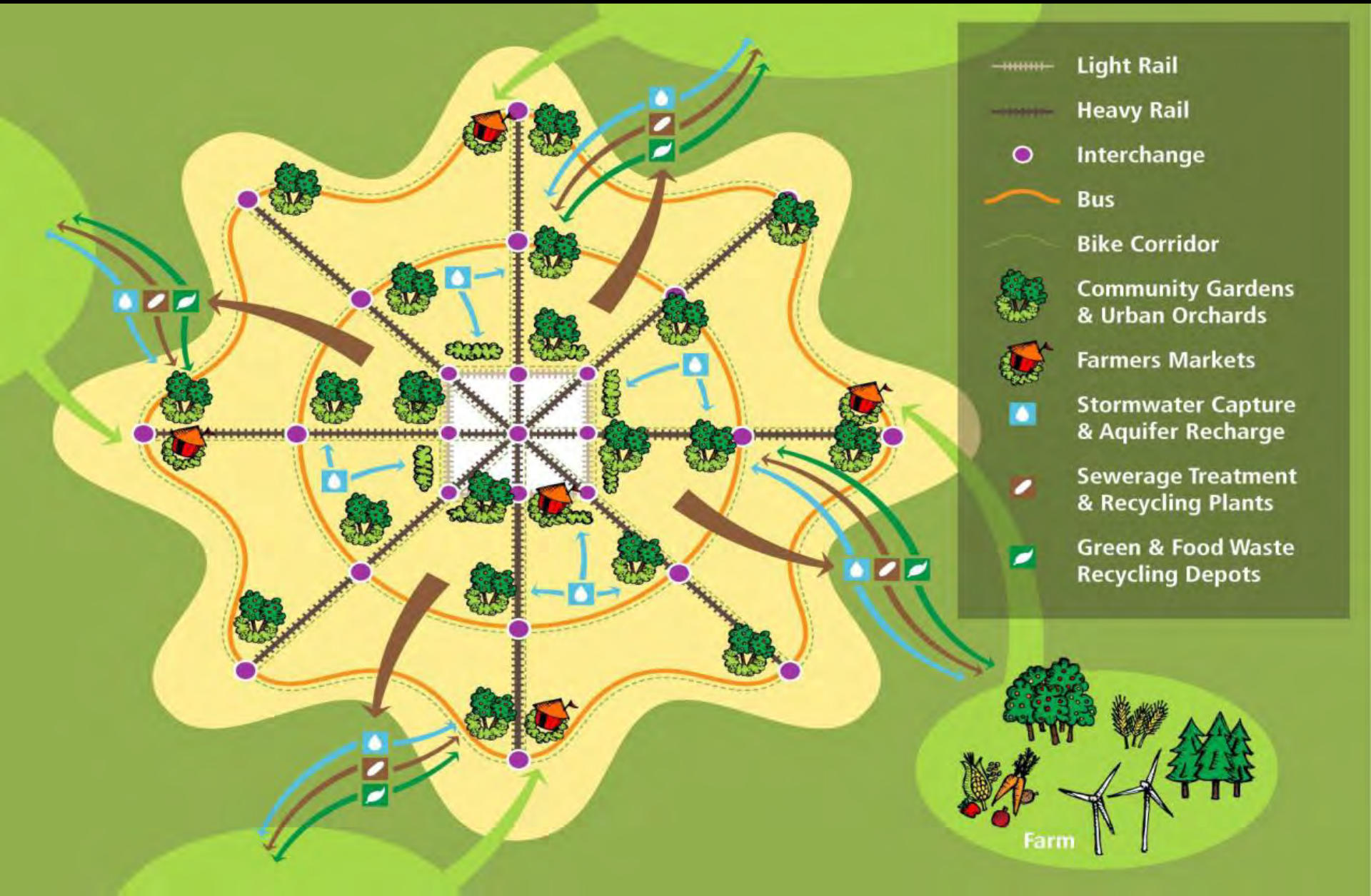
Waste and water systems

We came second to America…again

Aussie households produce about a tonne of domestic waste per year, 60% of which is compostable, but most of which goes to land fill (USA 2 tonnes)

Through the use of green bins, recycling bins, & resource recovery systems SA diverts 70% of its domestic, construction and commercial waste from landfill saving 5 million tonnes of CO_2 emissions annually

The city is a goldmine of water and nutrients

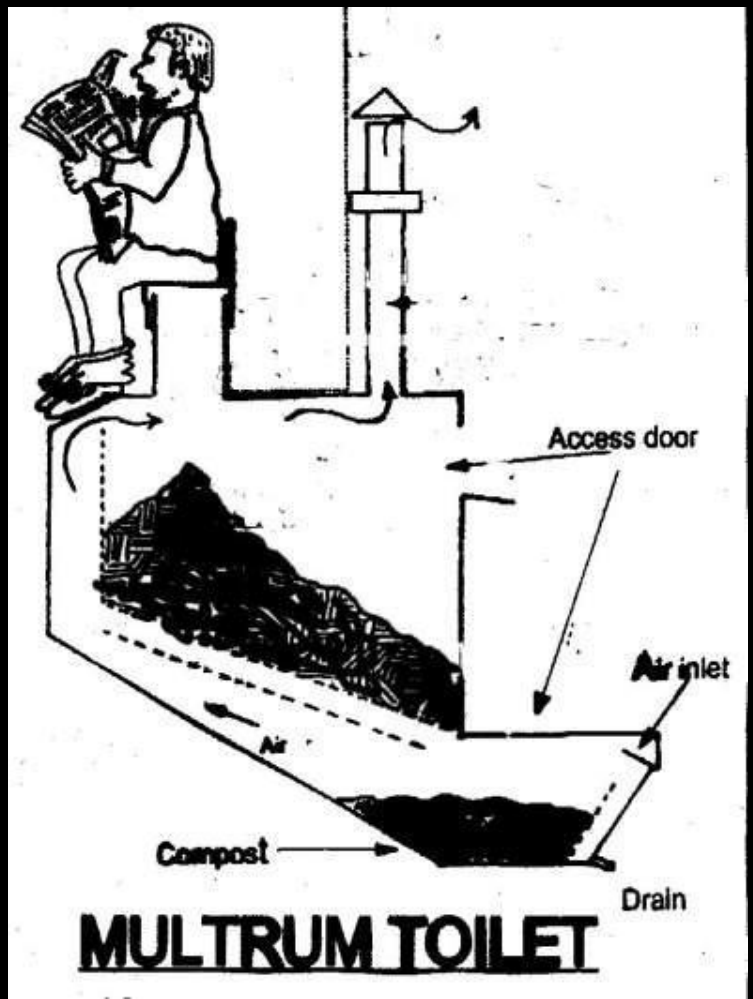


Through good policies and industry leadership 85%+ of SA's organic waste is composted and returned to ag &garden production

Recovery of nutrients from sewerage

- Sewerage contains nutrients used in ag production
- The Canadian Ostara treatment process reclaims nutrients from the black water and converts them into a commercial fertiliser, Crystal Green 5 N - 28 P - 0 K +10% Mg representing 90 per cent of the phosphorus, 40 percent of the ammonia & 75% of magnesium
- This saves pipe clogging, waterway and marine contamination and provides fertiliser , requiring only 14% of the energy required for fertilser manufactured from non-renewable mineral sources

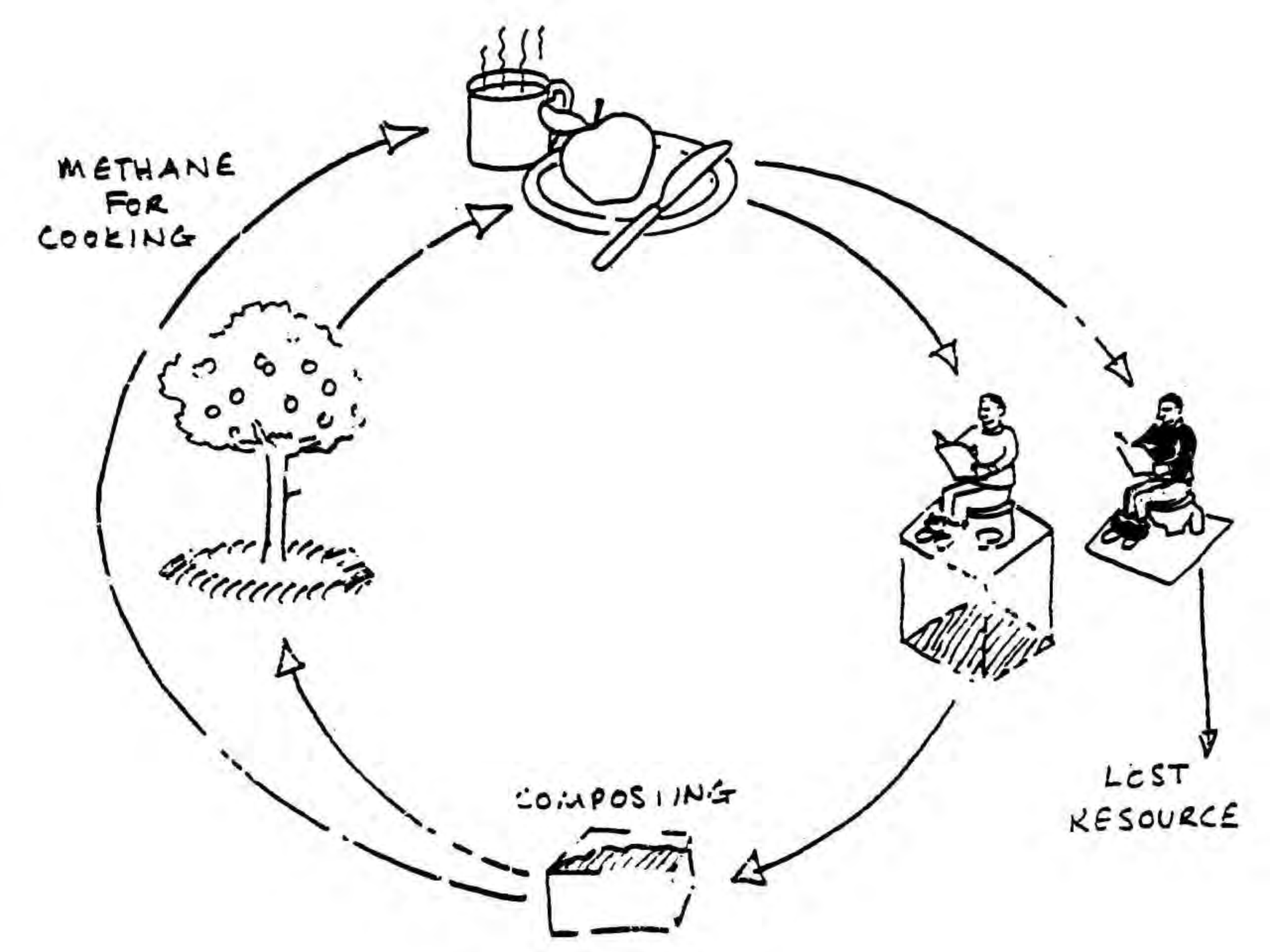
- **COMPOST TOILET& REEDBED**
- **Saves & re-uses water**
- **Composts human waste**



Compost Toilet is NOT:

Composting in the field

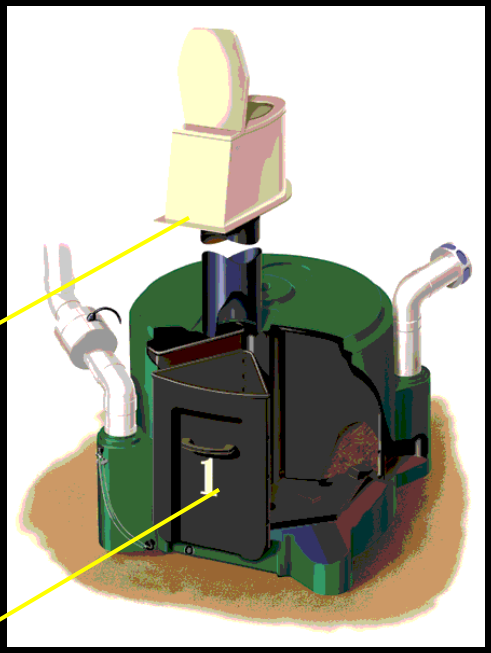
A long drop


METHANE
FOR
COOKING
COMPOSTING
LOST
RESOURCE

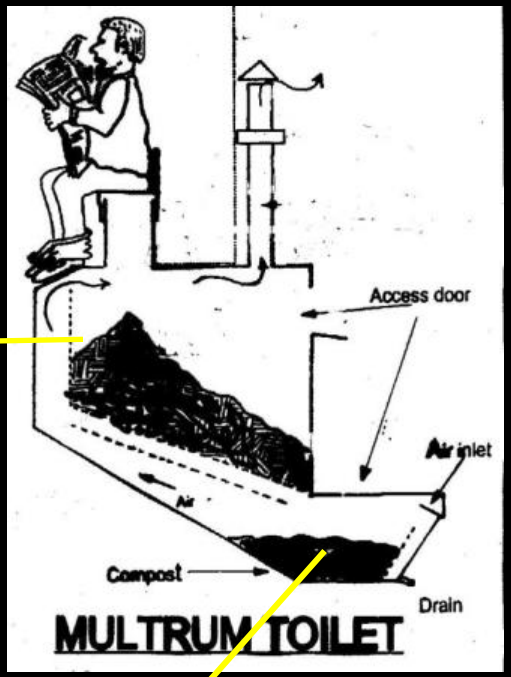
Design:

Landscape, Placement

Access from both inside and outside



Rota loo



Compost

39 degrees and windy – is this responsible water use in the World's driest inhabited continent?

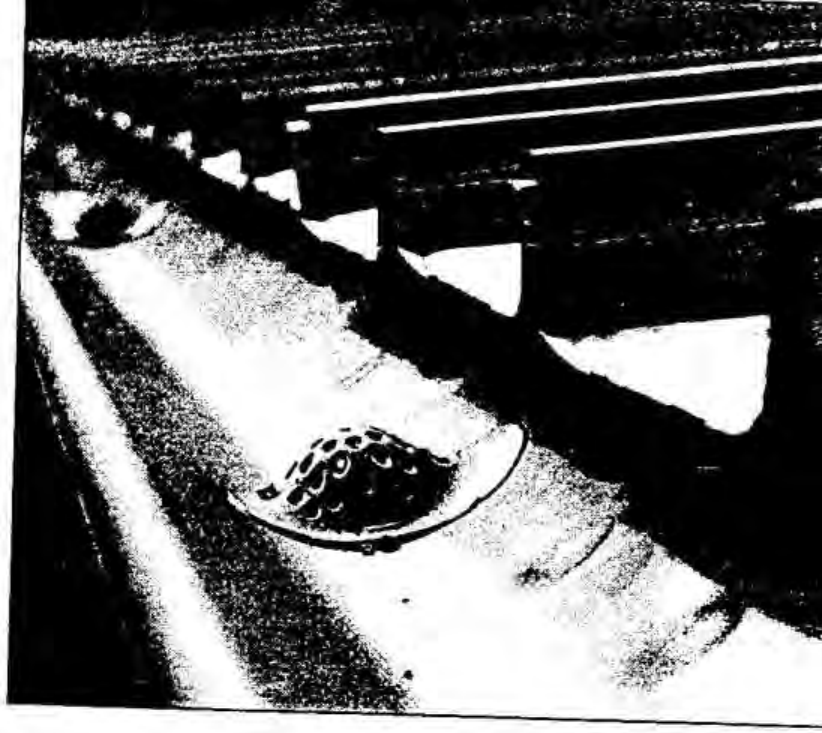
Catching and storing water

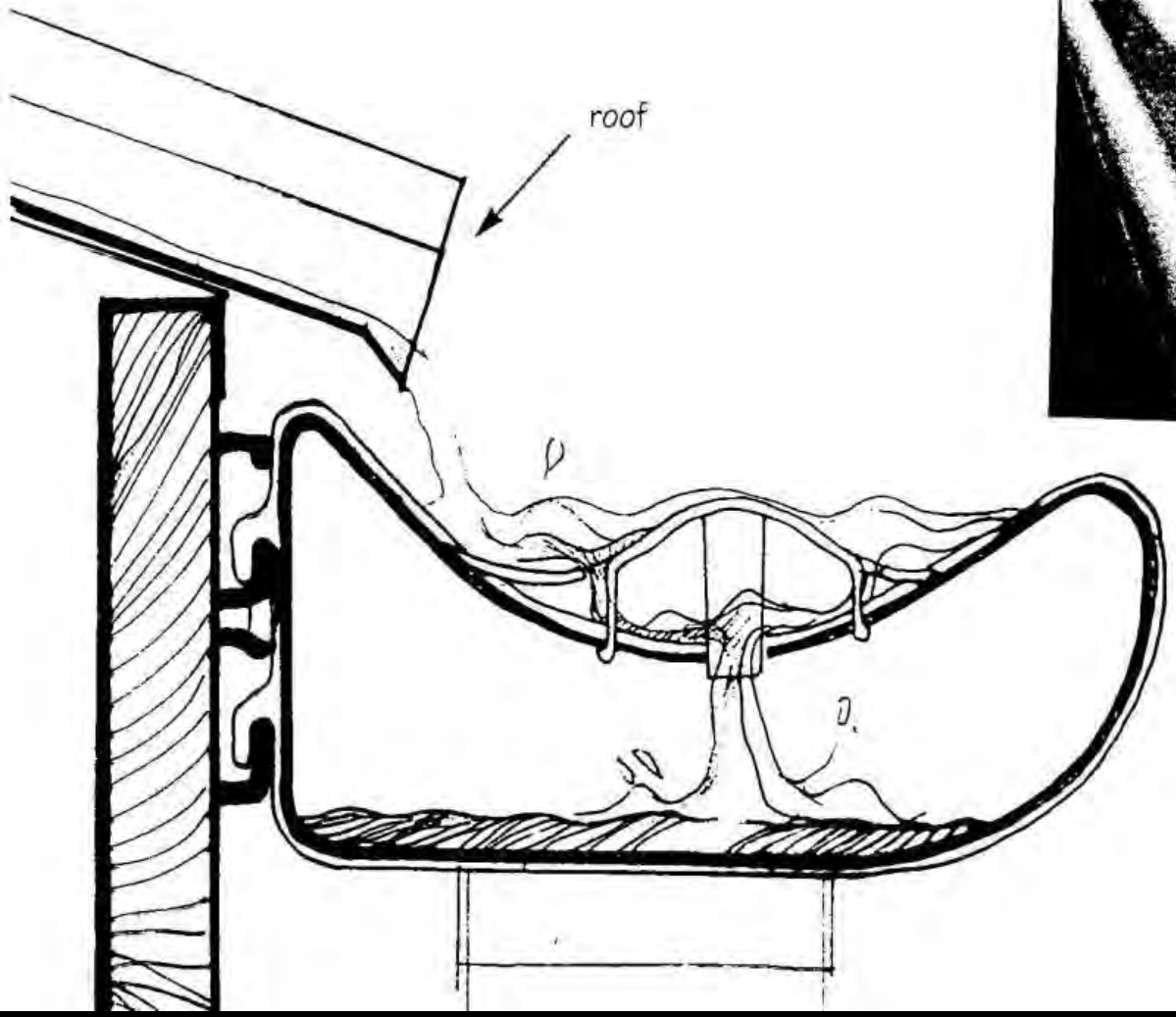
Get the best out of your current supply through:

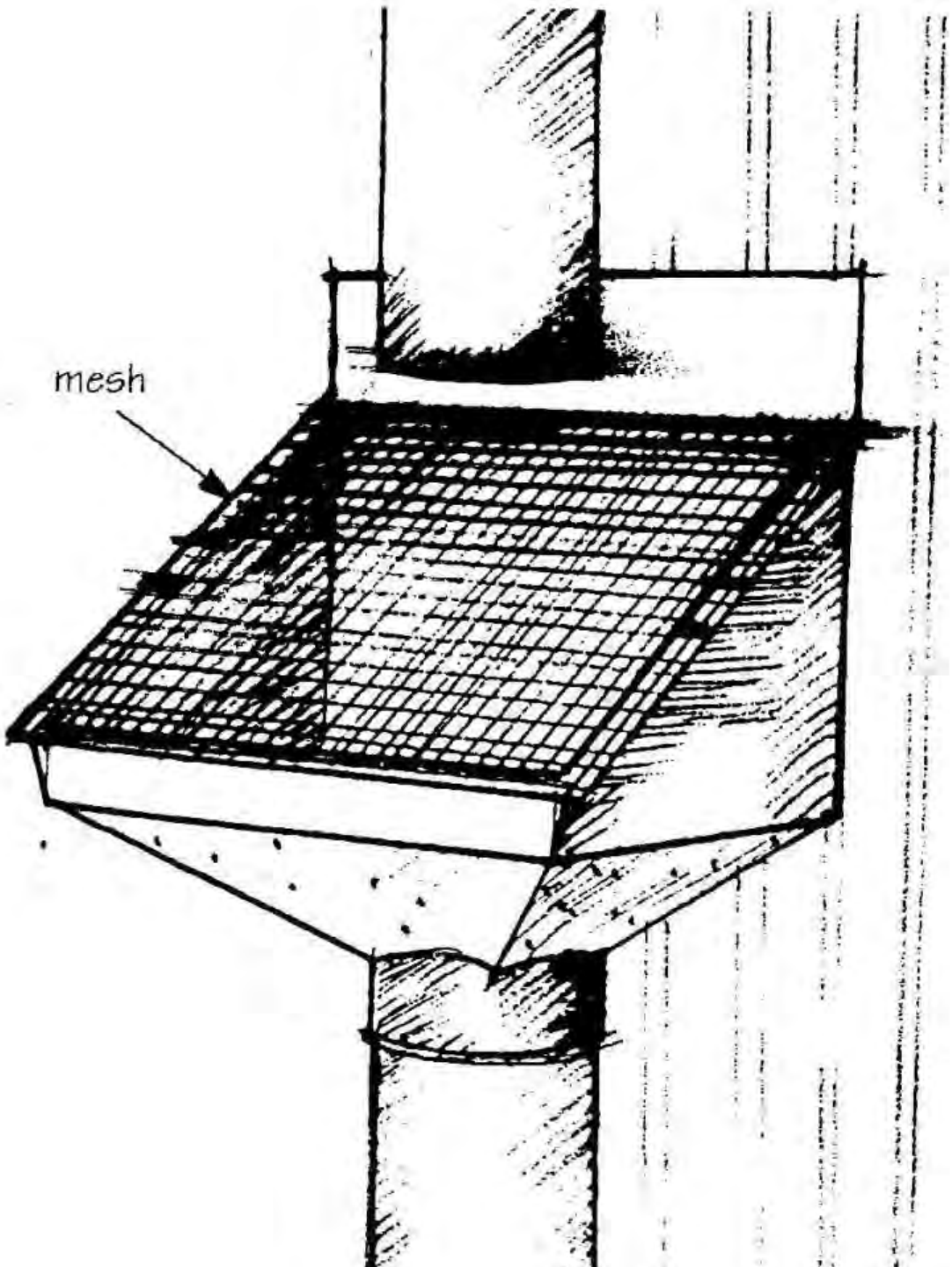
- Drip irrigation (effective delivery may rise from 50% to above 90%)
- Soil improvement
- Deficit irrigation
- Mulch
- Weed control
- Windbreaks
- Different crops
- Aquifer Storage and Recharge with ‘spare’ water

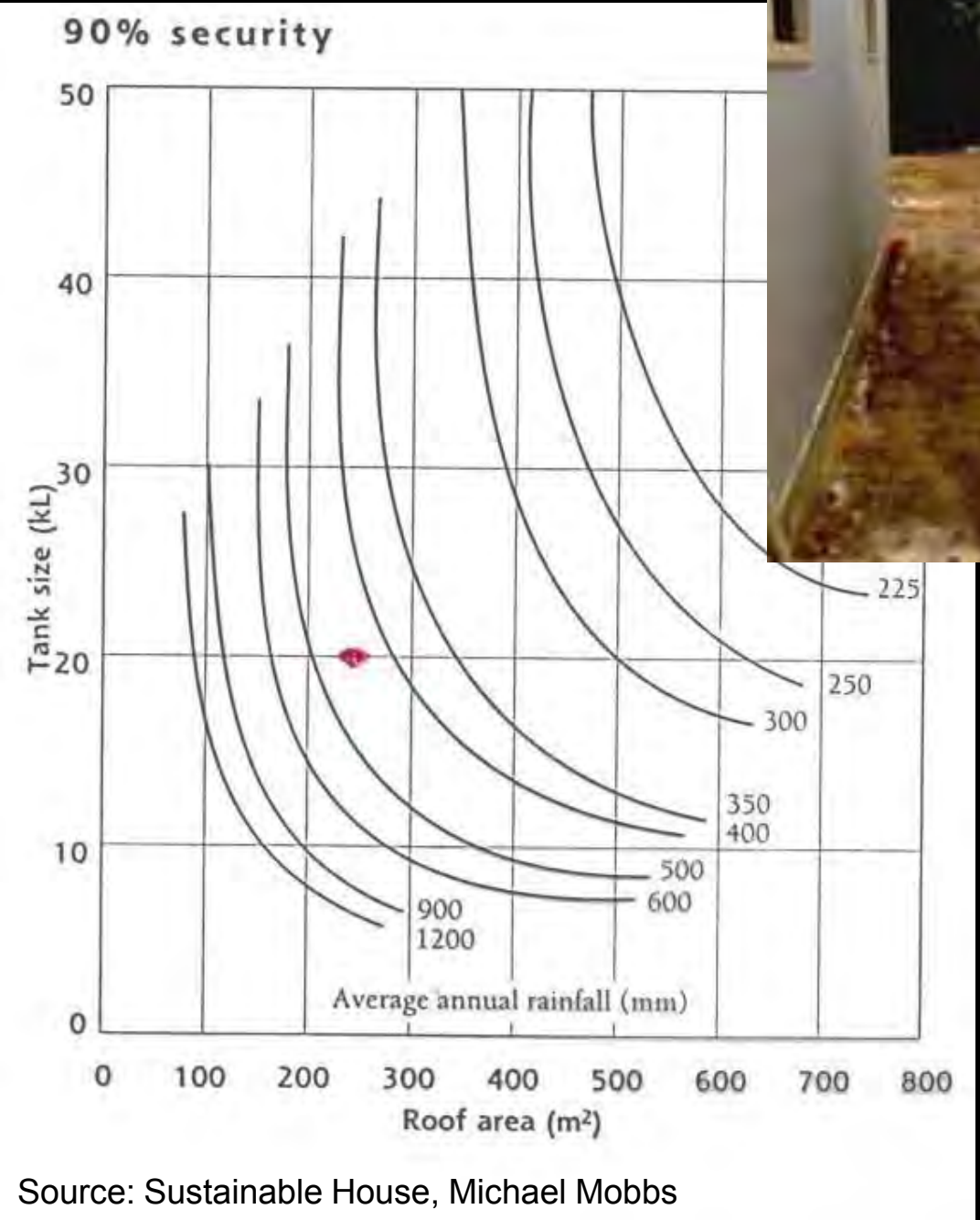
WATER CATCHMENT

Water should be captured on site and stored for use.
Rebates are available for tanks and plumbing




roof


mesh



Source: Sustainable House, Michael Mobbs


Image © 2013 DigitalGlobe

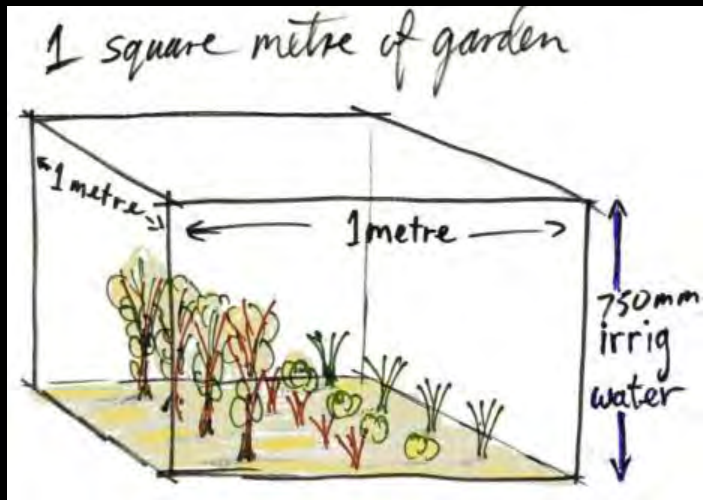
Rainwater - the Maths

- Rainwater catchment
  In Adelaide with a rainfall of about 530mm, 250 square metres of roof generates about130 kilolitres of water annually but the bulk falls in winter.
  If captured, 53 kilolitres can be used in the house and then flow through the greywater treatment system to the fruit trees.
- The rest is available for vegetable growing and would support a garden of about 50sqm (37 kilolitres req)
- Significant storage would be needed as only 33 kilolitres would be captured on average over summer; perhaps 50 kilolitres of storage may provide fair water security
- A larger roof area would provide more water security

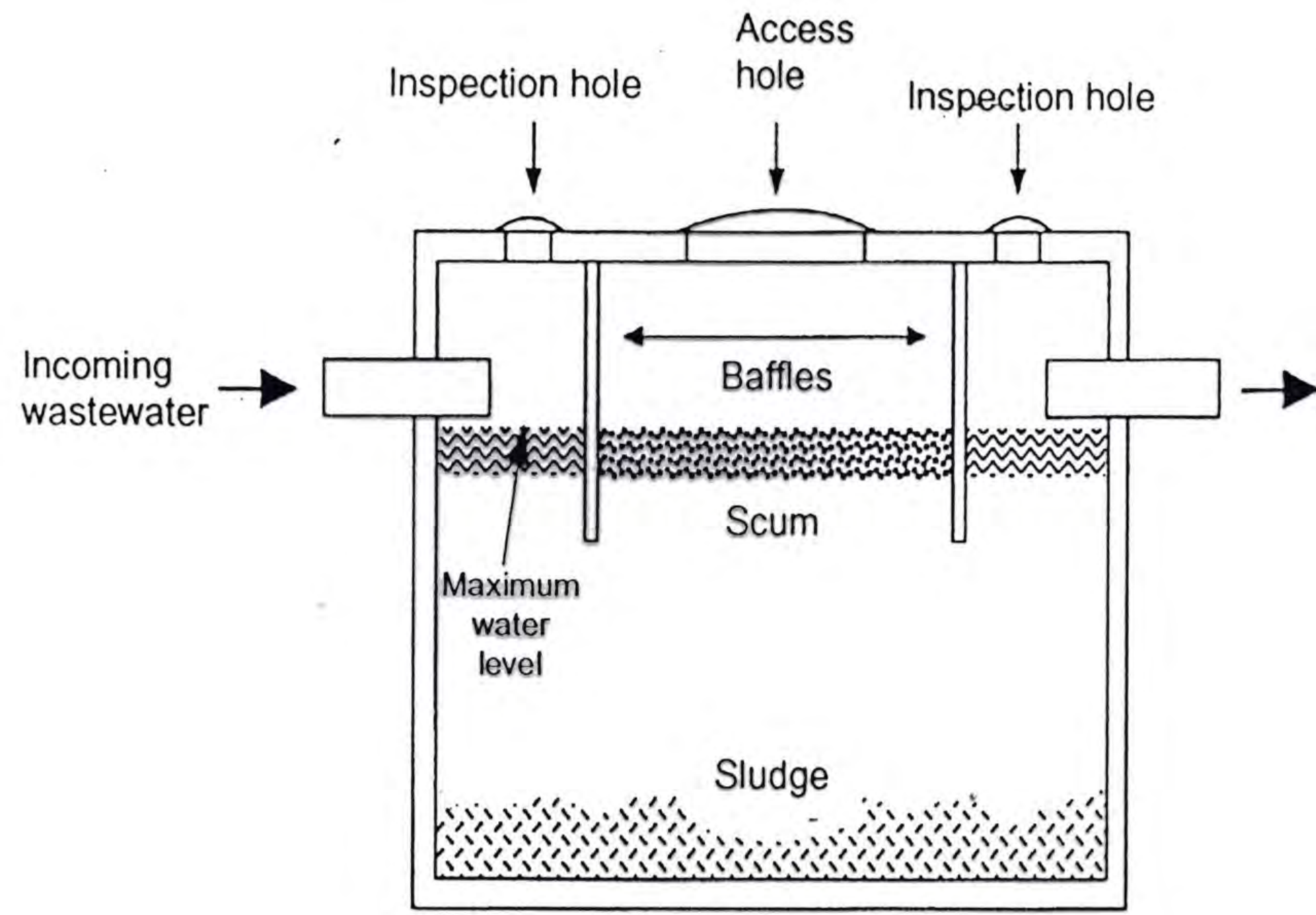
Annual needs of a 1x1m square vegetable garden in Adelaide

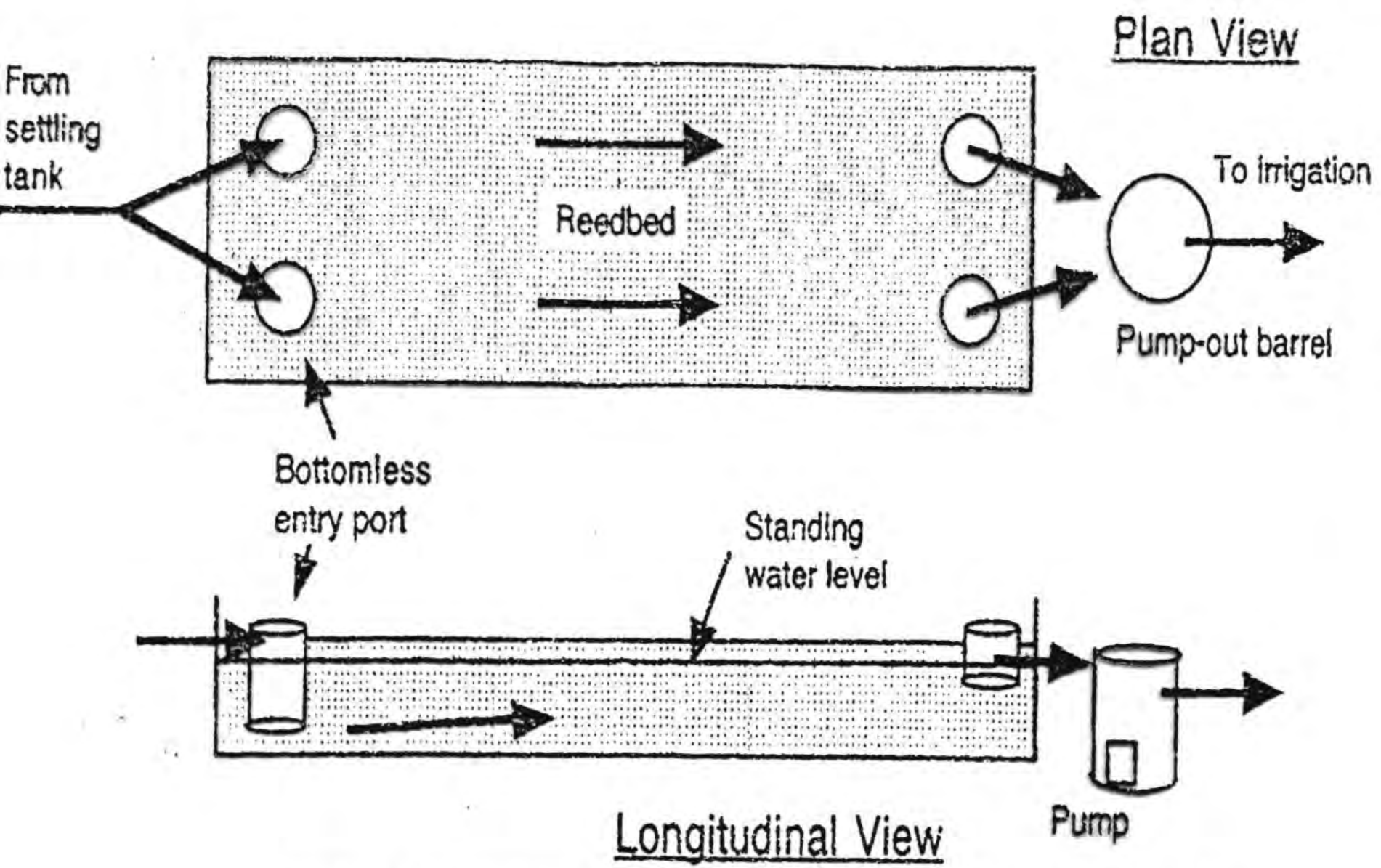
- Water: Up to 0.75metre of irrigation water (=0.75kilolitres)
  Cost: ~ 80c if using mains, but could be rain water
- Compost: ~ 2kg. Cost: ~15c
- Mulch: 0.3 bale of cereal straw. Cost: ~$1
- Seedlings: ~ $2.00
- Total Cost: ~ $4.00

Note:
Figures assume using mulching techniques in summer & drippers
Prices assume bulk buying/ commercial quantities of seedlings, mulch and compost



Using watewater

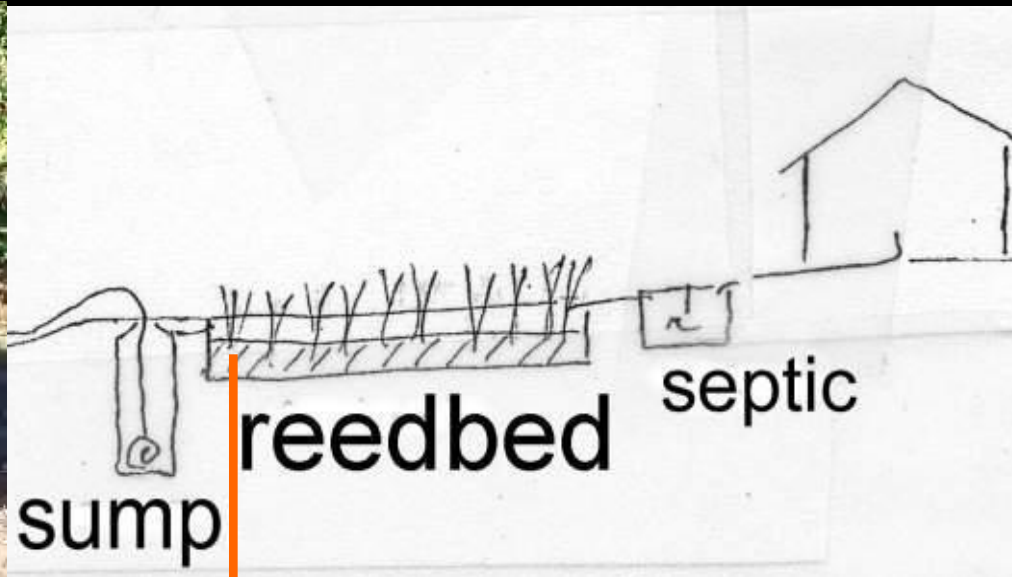

Inspection hole
Access hole
Inspection hole
Incoming wastewater
Baffles
Scum
Maximum water level
Sludge



Design of reedbed for Enhanced Effluent Treatment System

Recycling wastewater at home

Trees irrigated by recycled water



The average family's domestic reedbed enables the growing of 10-20 fruit trees on recycled water

Reedbed at the house, 2000

7.2m long

Not a good idea!

Typha domingensis

Bulrush

Cumbungi

Propagation of Nile Grass (Cyperus involucralus)

Cleaning Agents


SAIL

Waste Water - the maths

- Reasonably frugal Australians each generate about 50 litres of waste water per day
  If it all goes through a black water treatment system such as a septic tank and reedbed or an aerated septic system, it can be used to grow fruit

- A family of four generates 200litres per day..ie 53kilolitres per year, which will water and fertilize 20 fruit trees. This will provide more than enough fruit for the family
  (It is not legal in SA to use grey or black water for vegetable growing unless specially treated)

Other water availability

Dams and creeks

Beware

- badly made dams. Get a highly experienced dam builder
- small volumes and shallow storages; soakage and evaporation may take lots
- salty springs and soaks feeding into farm dams
- incorrect assumptions about run-off

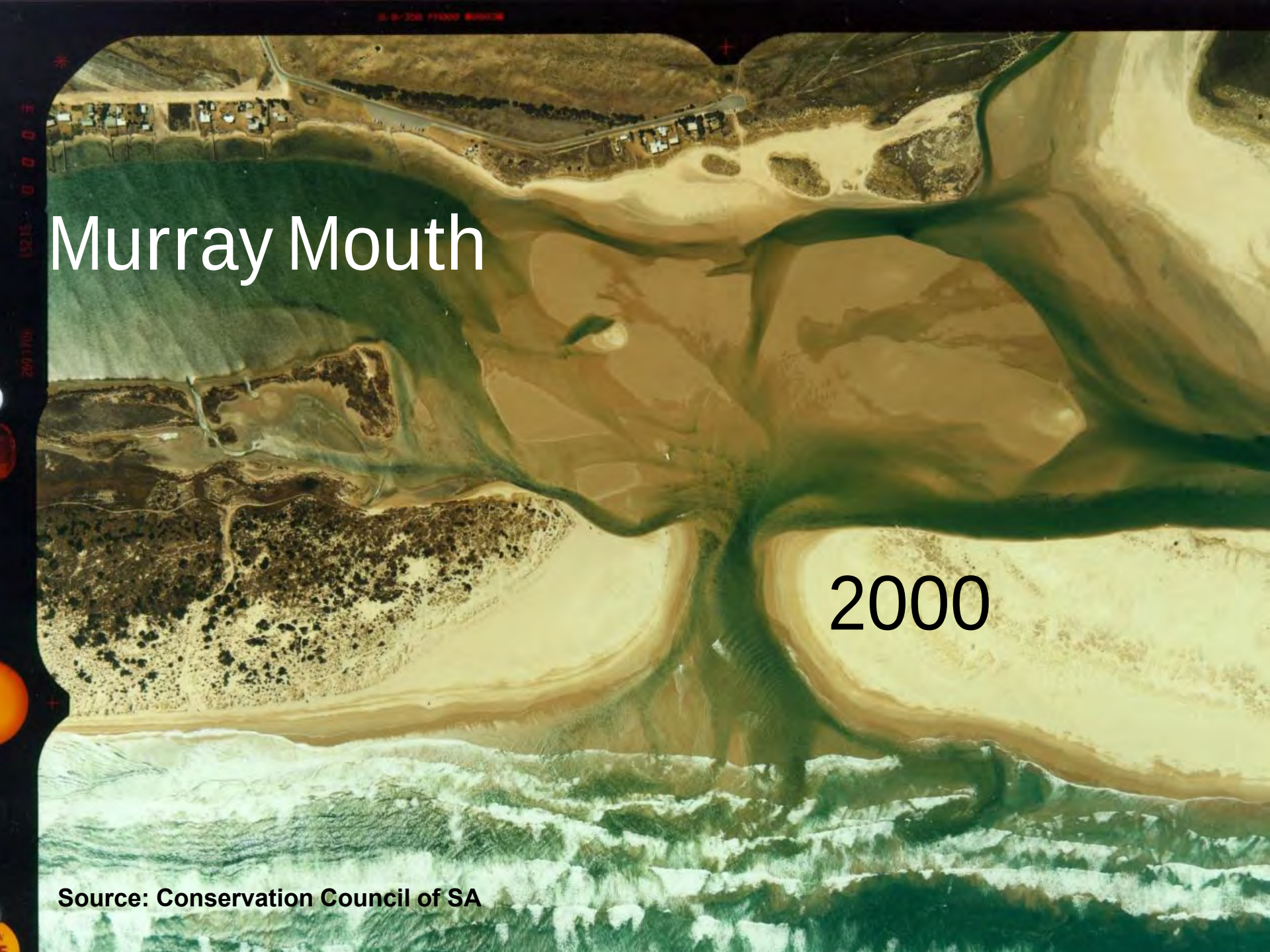
Consider

- access to power for pumping
- elevation for provision of gravity feed
- dam liners

Rivers

- Security of supply? (will a reservoir be built above you)
- Floods and your pump (glug glug glug)
- Is water available when it is useful, or….?
- Aquifer recharge
- Will the river just die

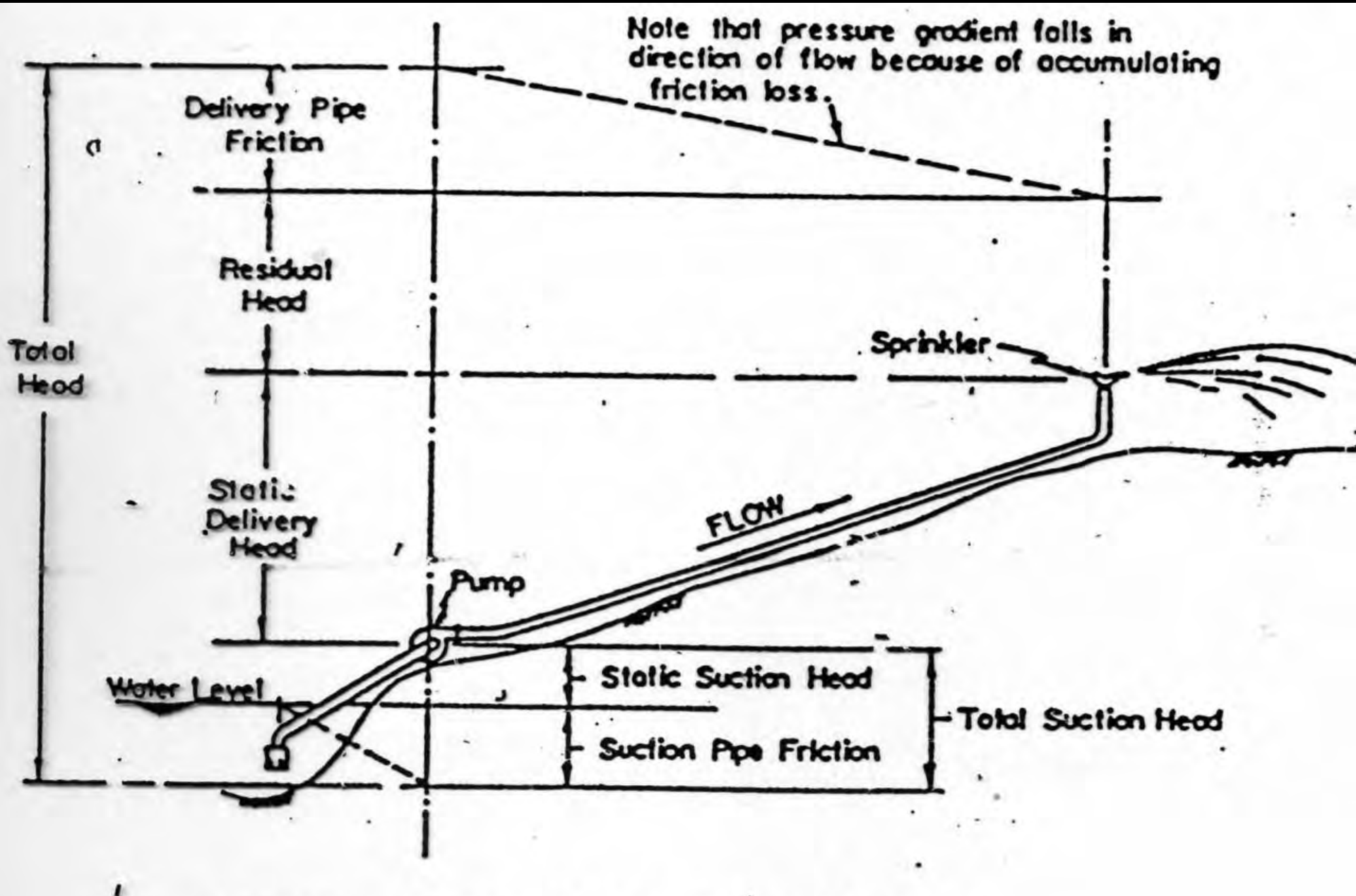
Source: Conservation Council of SA



Source: Conservation Council of SA

Source: Conservation Council of SA

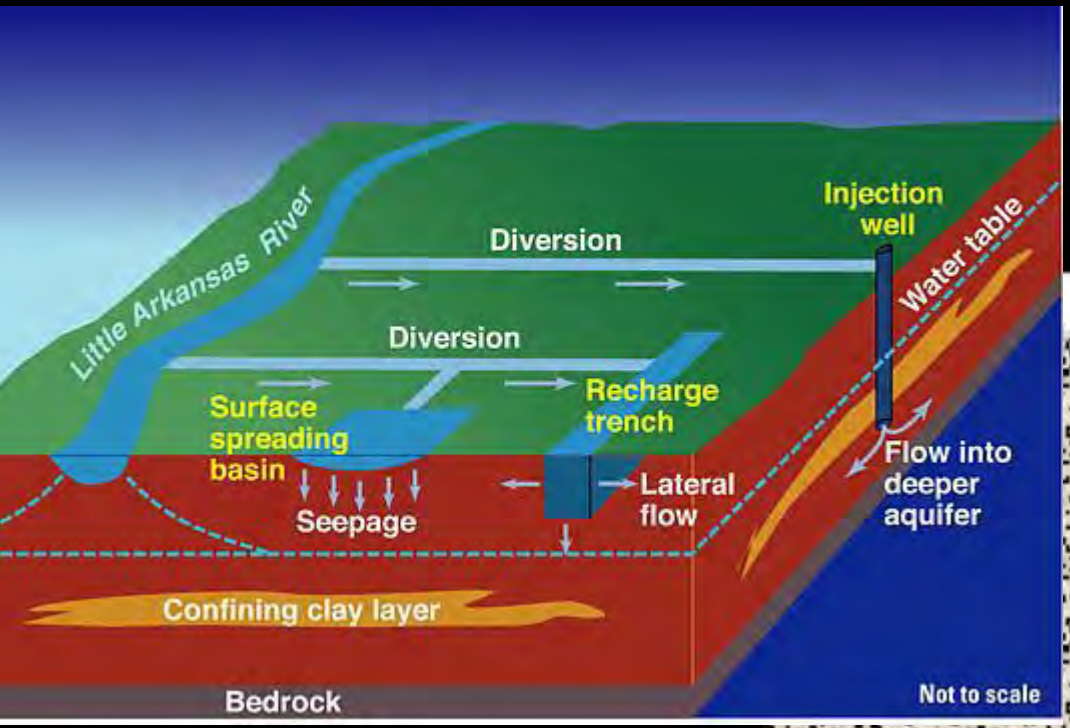
Hydraulic heads in irrigation

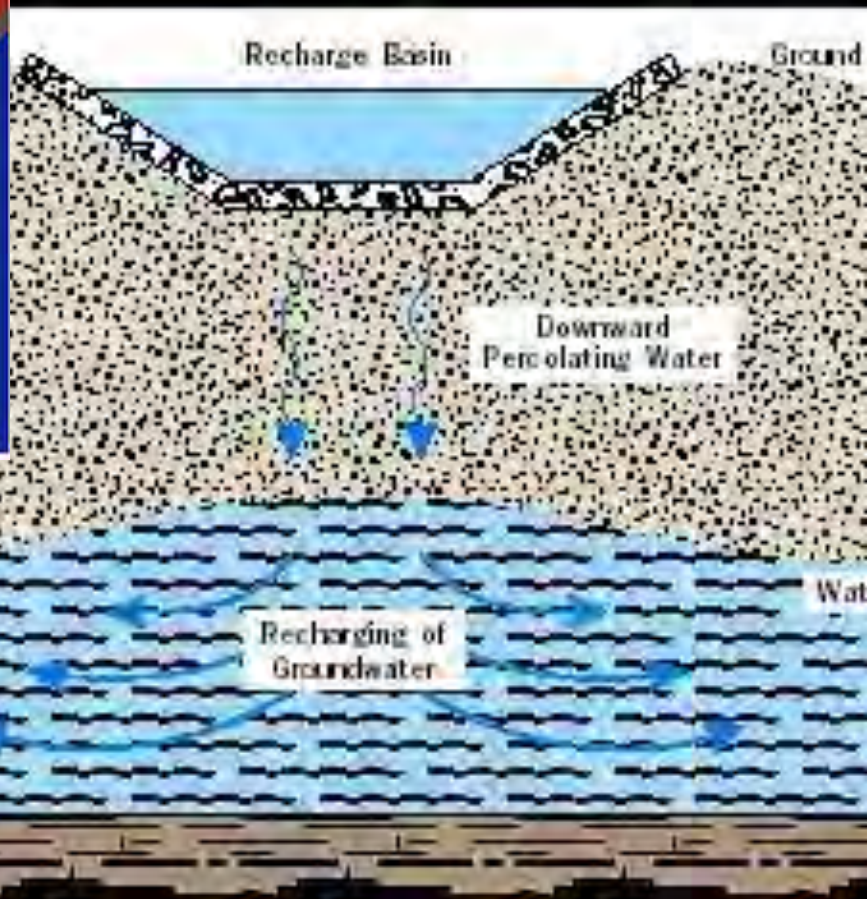


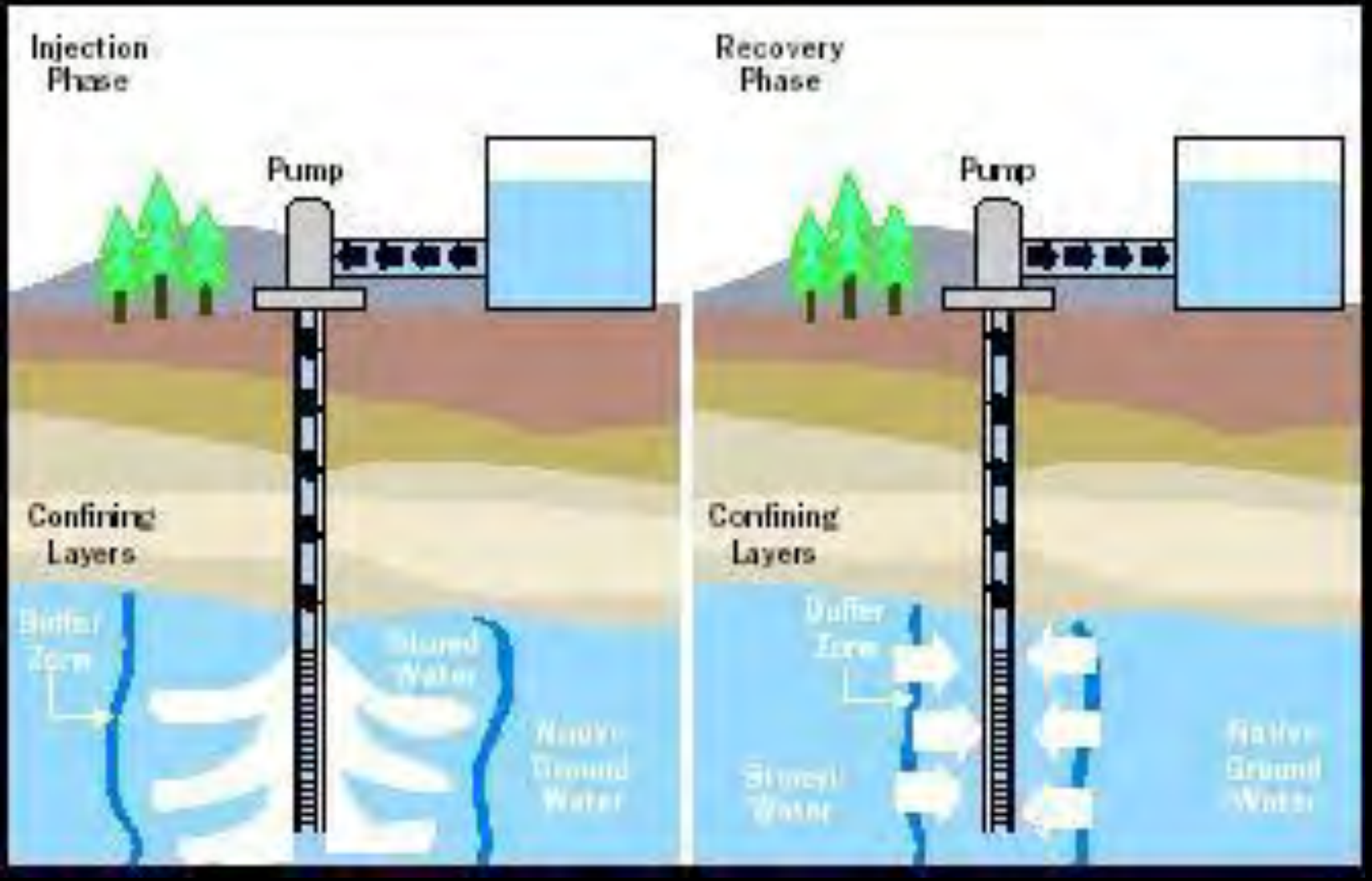
Bores

- Finding water
- Getting an allocation
- Drilling licence
- Charges and electricity

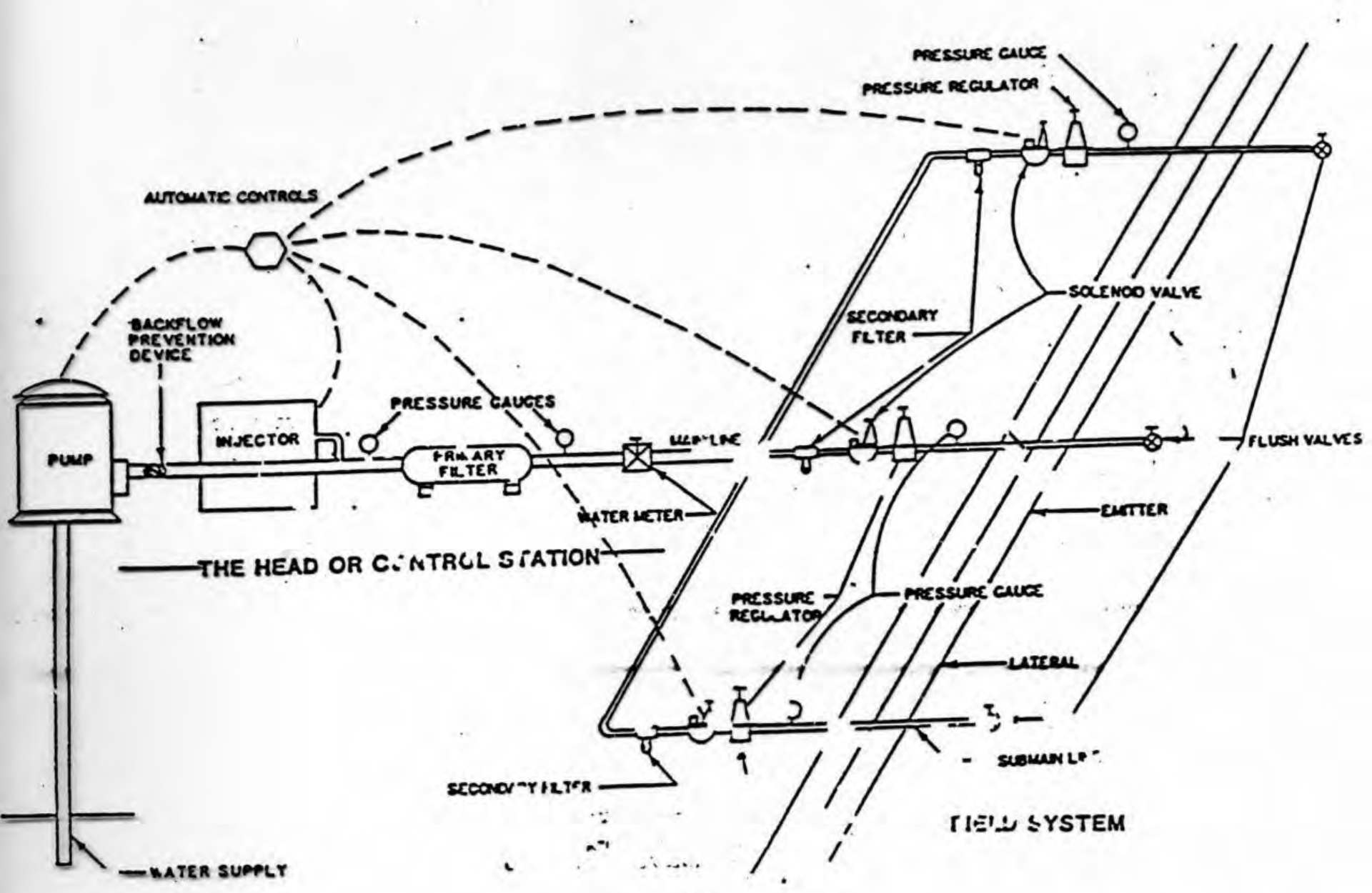
Aquifer storage and recharge





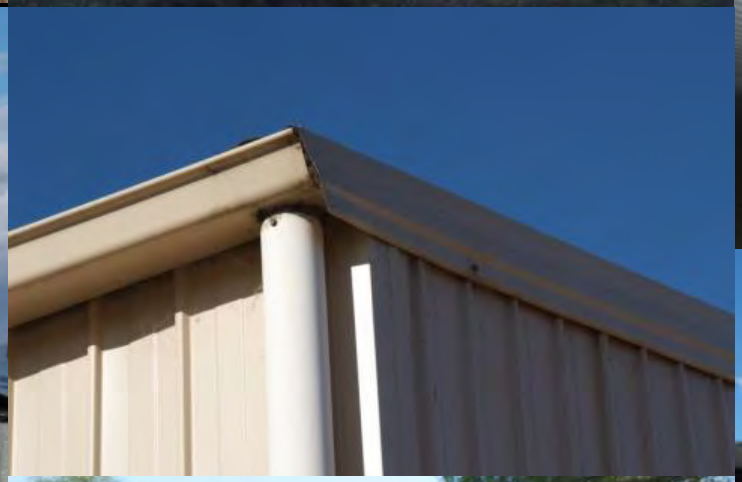

Injection Phase
Pump
Confining Layers
Recovery Phase
Pump
Confining Layers

Irrigation system layout







Mains

- access
- volume and pressure
- storage
- chlorine

Recycled water

- Access
- Volume
- Storage
- Chlorine


VIRGINIA IRRIGATION SCHEME
A joint initiative of the Government of South Australia,
South Australian Water Corporation, the Virginia Irrigation Association
and Earth Tech.
Reclaimed water used on this property is rated
Class A and is approved for unrestricted irrigation.
Its use for irrigation is safe and sustainable.
DO NOT DRINK
Government of South Australia
SA WATER
VIRGINIA IRRIGATION ASSOCIATION
EARTH TECH


VIRGINIA IRRIGATION SCHEME
DO NOT DRINK

Water Quality

- Salinity (good salt and bad salt)
- Turbidity
- BOD
- Contamination
- Algae
- Chlorine

HORTICULTURAL CROPS AND GARDEN PLANTS

SALINITY (maximum)	VEGETABLES	TREES	ORNAMENTALS
	Ultra Sensitive		
	(Completely intolerant of salt)		
300 mg/L		Loquat	Violets
	Sensitive		
700 mg/L	French beans Strawberry Peas (not above 575)	Walnut	Bauhinia Gladiolus Fuchsia Camelia Azalea Begonia Dahlia Poinsettia Aster Rose Zinnia
	Moderately Sensitive		
850 mg/L	Beans (broad & field) Celery Lettuce Potato (sweet) Radish Raspberry	Apple Apricot Almonds Lemons Orange Grapefruit Quince Peach Pear Prune, Plum	Coprosma Vinca Bougainvillaea Hibiscus Carnation
	Moderately Resistant		
1300 mg/L	Onions Broccoli Cantaloup Cauliflower Cereals Carrot (after 3-4 fern leaves) Gherkins Cucumber Potatoes (must have	Grape vines Fig Olive Pomegranate	Chrysanthemum Stock Oleander

Climate change impacts

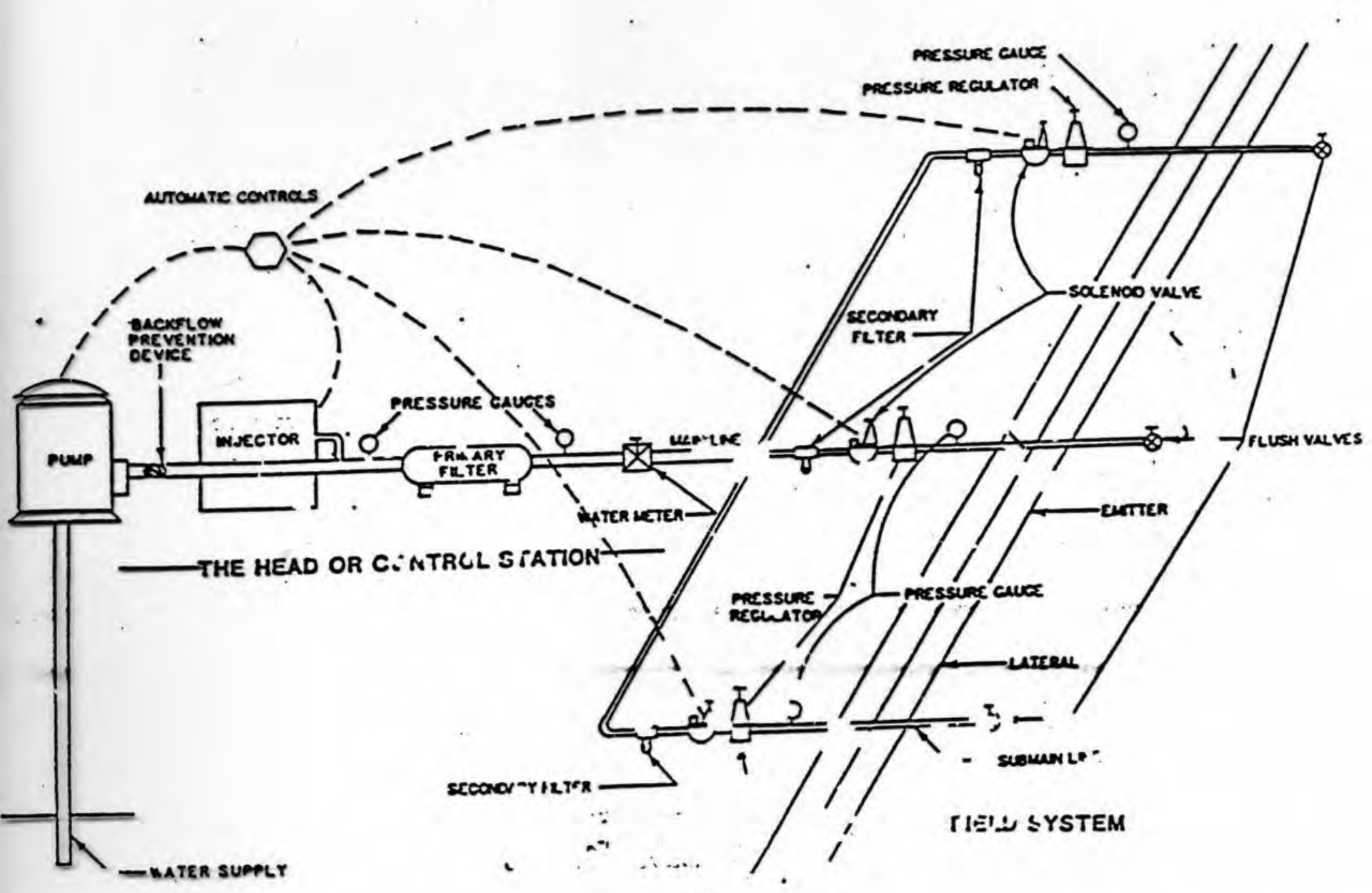
- With a 10-15% decline in rainfall, run-off can reduce by 50%
- Plants will require more water and/or shade as temperatures rise
- Evaporation is heading towards 2m per year
- Salt is more likely to build up in soil

Application methods

Pumps

Fuel powered
- Portable
- Expensive to run and maintain
- High volume
- Variable pumping rate

Irrigation system layout



Pumps

Electric
- Cheap to buy and run
- Fixed in place (flooding a problem?)
- High volume

Solar
- Low volume
- Expensive

Pumps

Windmills

- Low volume
- Maintenance can be tricky
- Generally used with a header tank

Pump Types and control systems

- Submersible
- Centrifugal
- Piston
- Other (Turbines,…….)


DAVEY


OPEN
CLOSE
FLOMAX


AUSTRALIAN MADE
DAVEY
5

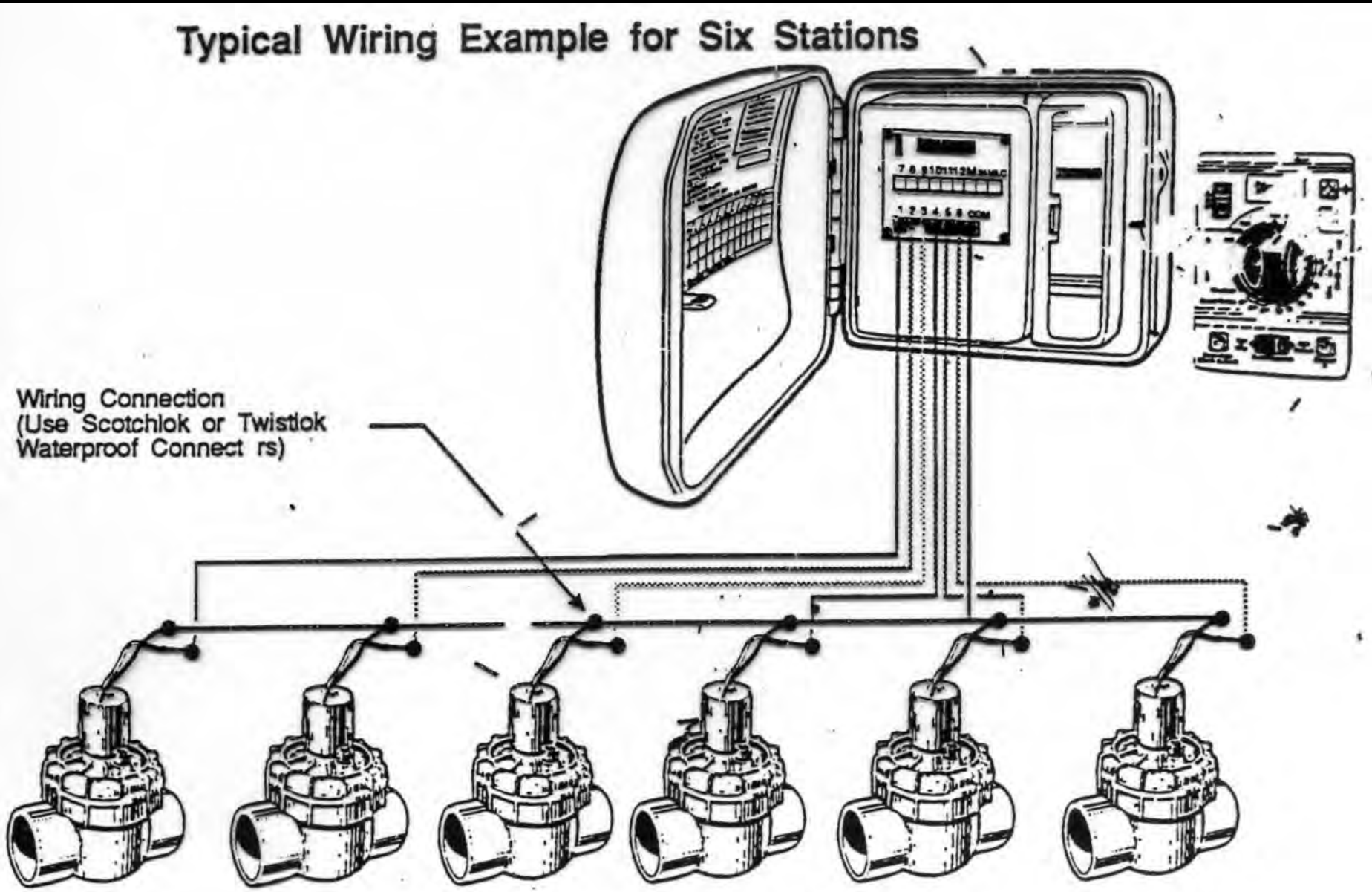
Filters

- Non return valve
- Sand
- Disc
- Basket

Pipe-work and emitters

- Pressure pipe – PVC and Poly mains and submains
- Control systems – sensor-linked, auto, semi auto and manual
- Solenoids manifolds trenching and wiring
- Low density pipework – submains and mains
- Low density laterals – sizing, types
- Drippers, sprinklers and micro-sprinklers

Irrigation controller



Lateral tube and fittings

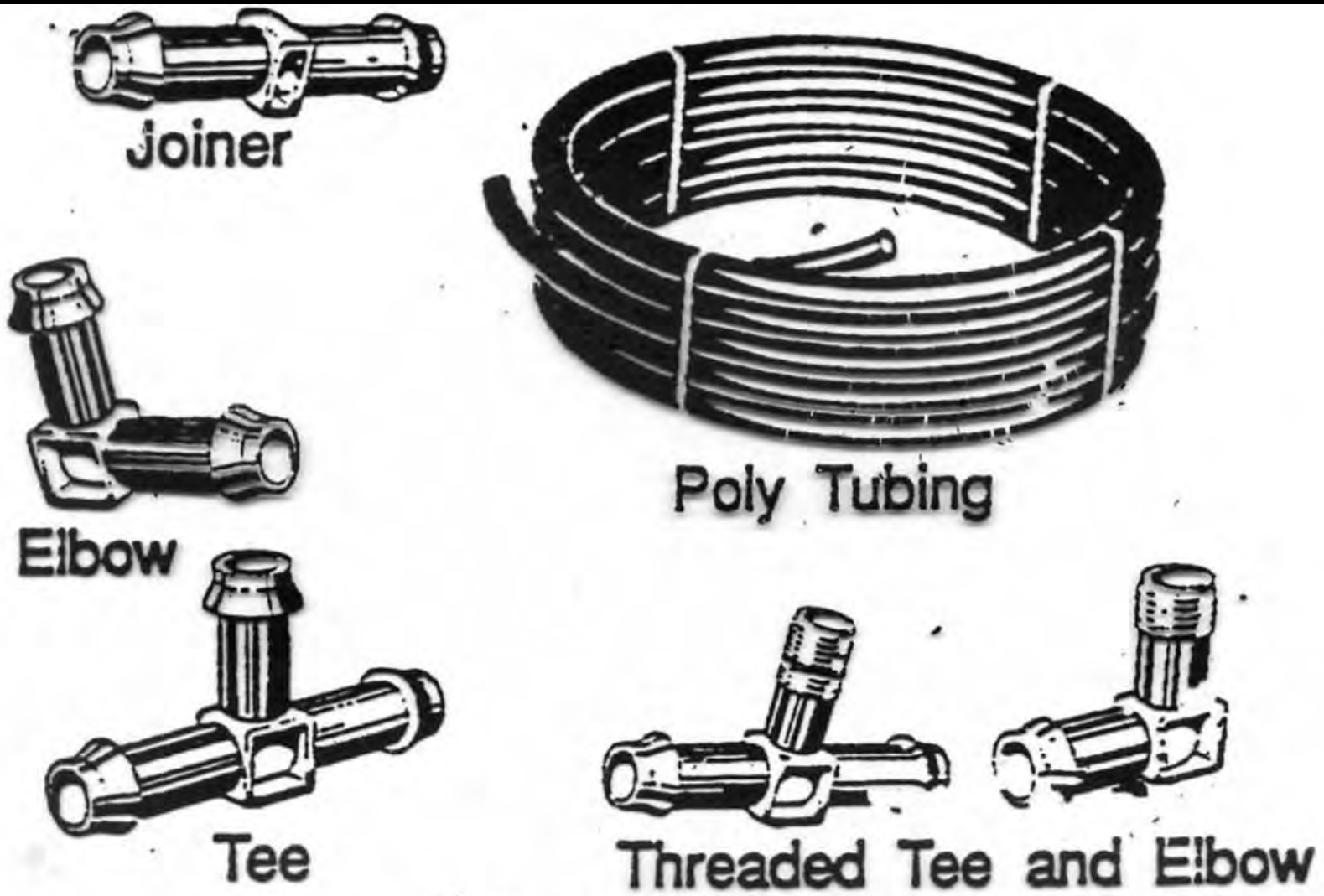
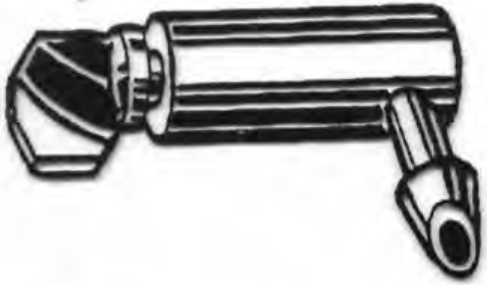


Fig.1-5 - Typical Lateral Pipework and fittings.


HARDITUBE
CLASS9


Drip
Eze

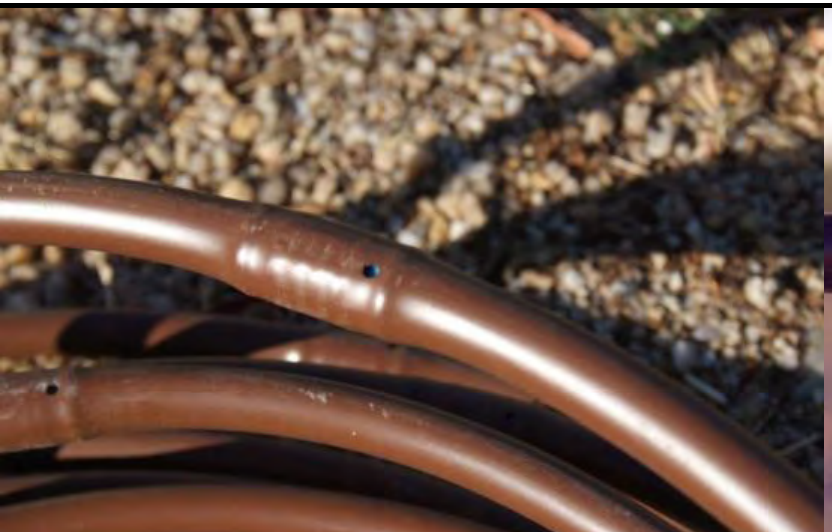
Emitters

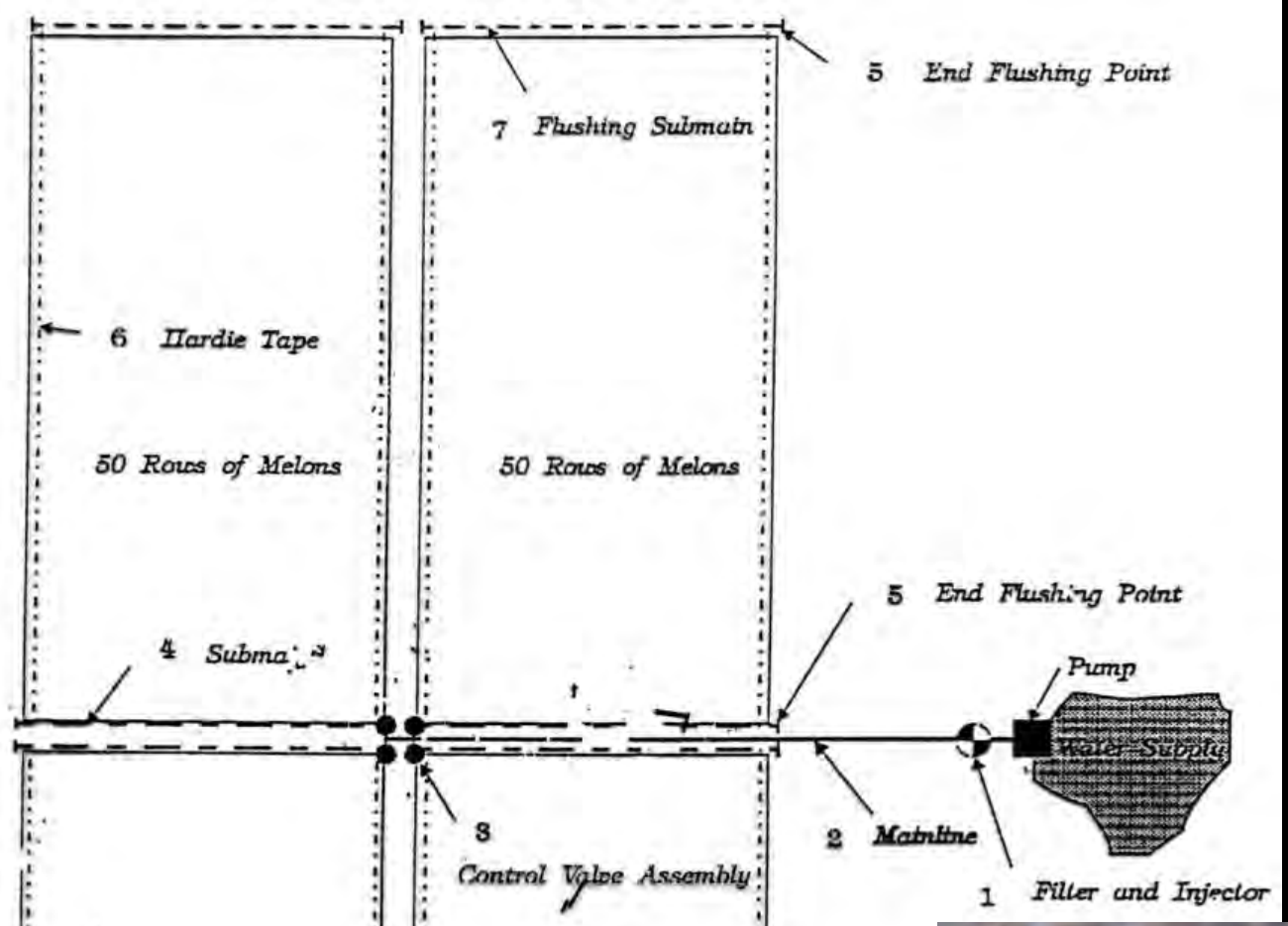


Snap

Turbo-K y.

Trickler




5 End Flushing Point
7 Flushing Submain
6 Hardie Tape
50 Rows of Melons
50 Rows of Melons
5 End Flushing Point
4 Submain
Pump
Water Supply
3 Control Valve Assembly
2 Mainline
1 Filter and Injector
50 Rows of Melons
50 Rows of Melons


pecan nuts
homestead
pome fruit
veg.
scrub block
learning centre
agroforestry
bush tucker
carob block
cereals
experimental
pistachio nuts
Gawler River
forest
yabby ponds
walnuts

Impacts of soil type on water infiltration, storage and water repellence

- Good soil preparation with deep ripping prevents waterlogging and improves infiltration
- Using the same drip system, the wetted area in clay and loamy soils is 50% greater than in sandy soils
- There is a strong correlation between an increase in soil carbon and water holding capacity

Soil type influences wetting pattern

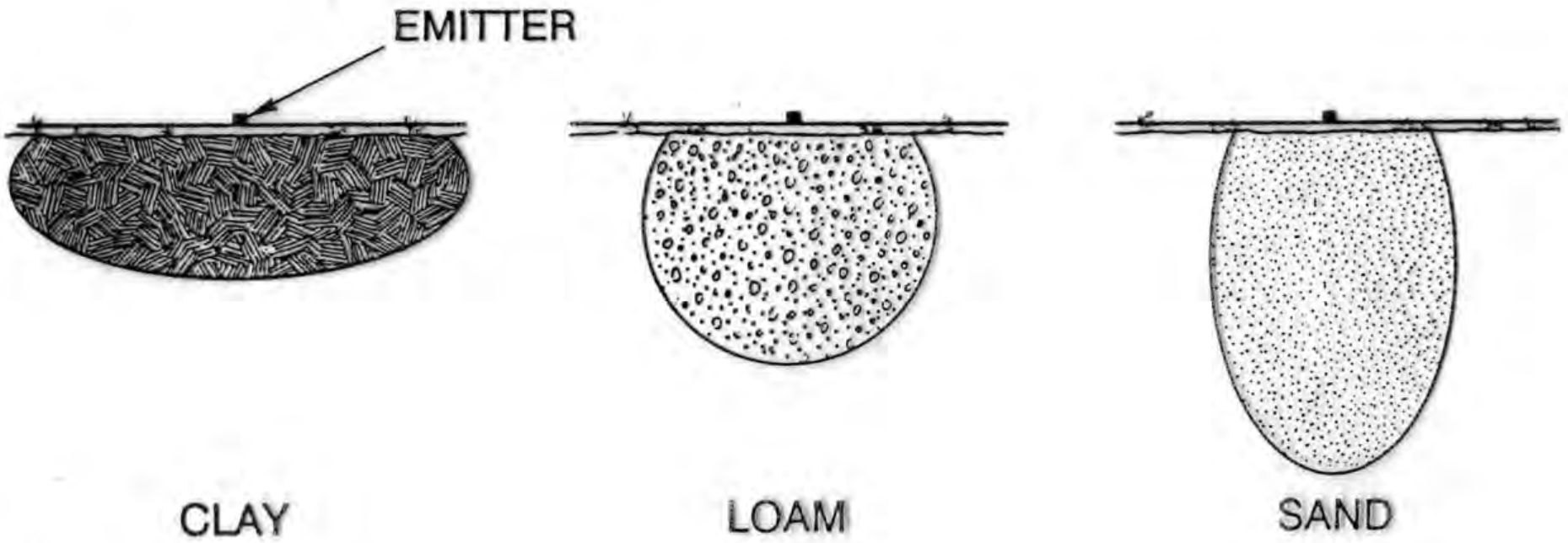
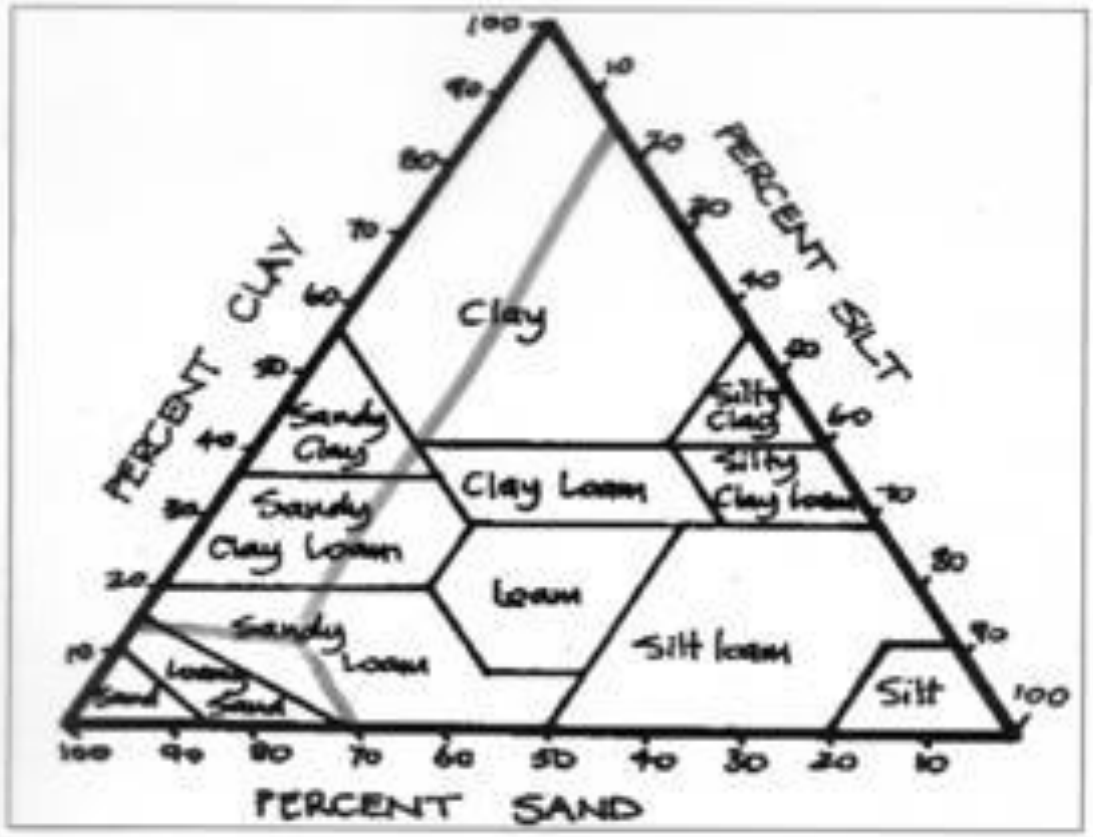


FIGURE 2-3: WETTING PATTERN SHAPES FOR CLAY, LOAM, AND SAND



The Soil Texture Triangle

Using the proportions derived from your Jar Test you can place your soil on the Soil Triangle; so if you had a sample with 15% clay, 70% sand and 15% silt you've got a sandy loam. (the imaginary line representing the **clay is drawn across parallel to the Sand Axis**, the **sand percentage is drawn parallel to the Silt Axis** and the **silt percentage is drawn across parallel to the Clay Axis.**

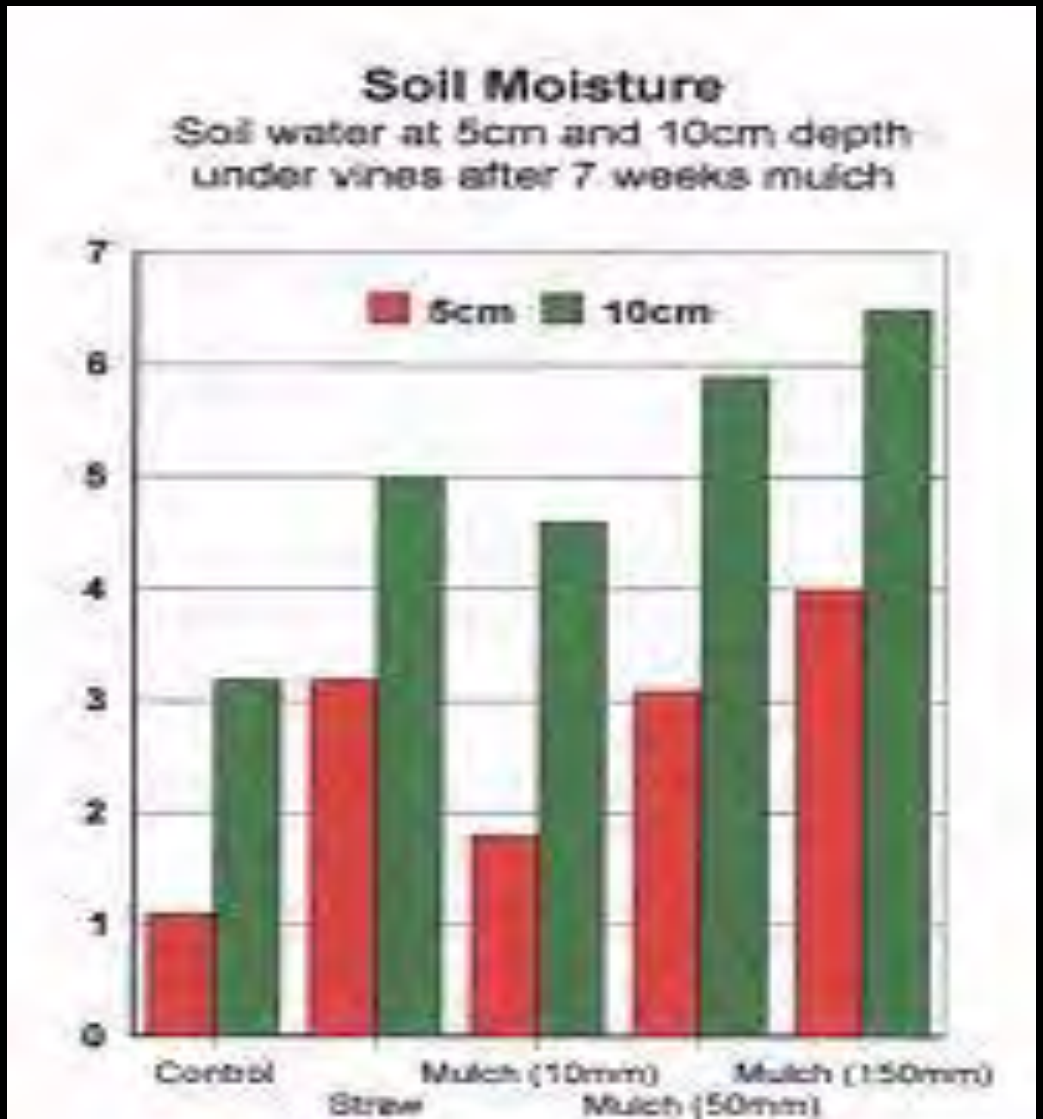
Water-holding and carbon

Changes in soil water-holding capacity with increased soil organic carbon

Change in OC level	Change in OC (kg/m^2)	Extra water ($litres/m^2$)	Extra water (litres/ha)	CO_2 sequestered (t/ha)
1%	3.6 kg	14.4	144,000	132
2%	7.2 kg	28.8	288,000	264
3%	10.8 kg	43.2	432,000	396
4%	14.4 kg	57.6	576,000	528

Note: Based on a soil depth of 30 cm and a soil bulk density of 1.2 g/cm^3
OC – Organic carbon
Source: Jones (2006)

Composted mulch improves soil water utilisation



Mulch spreading

Compost improves soil water utilisation

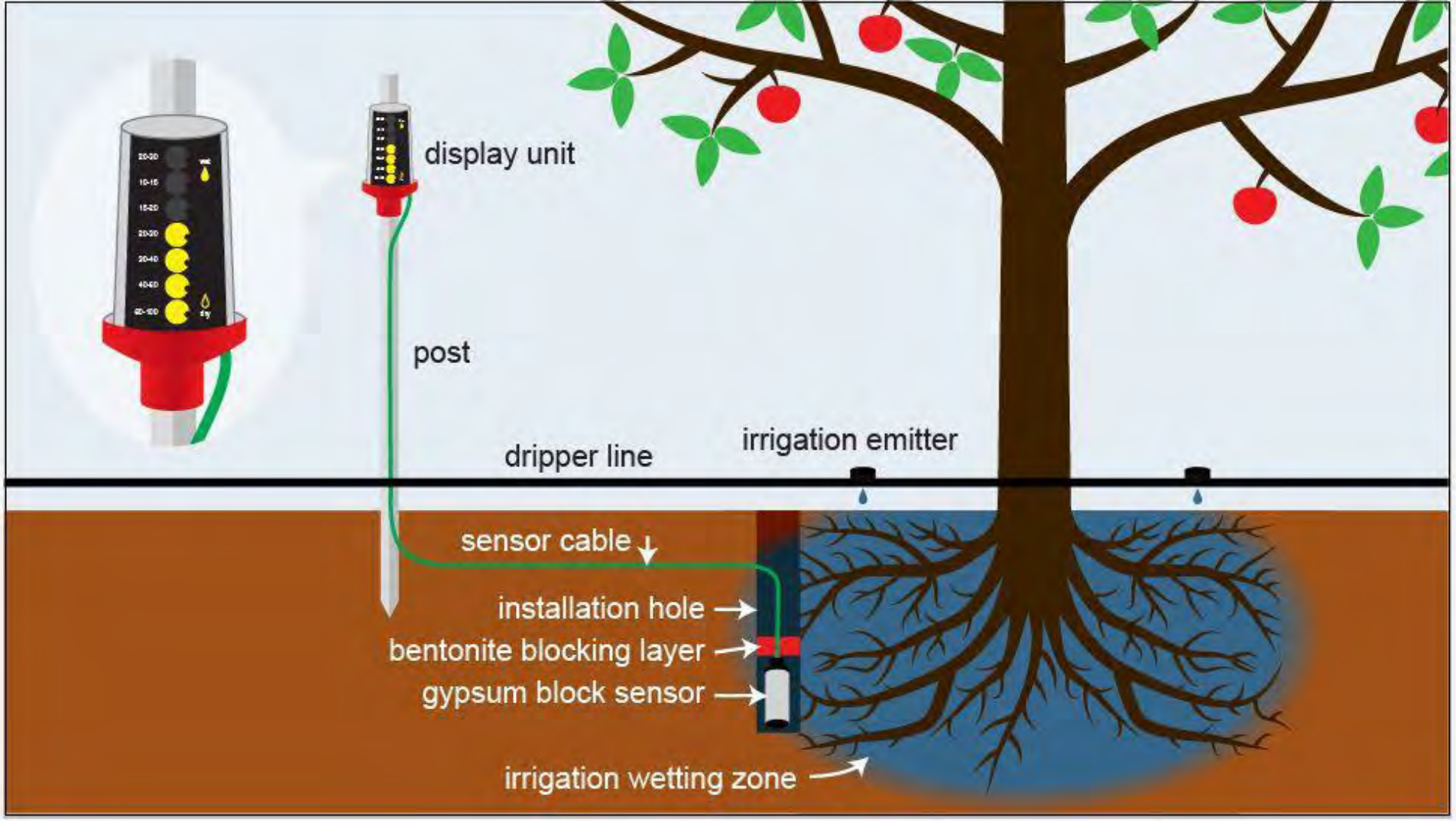
•Rosemount regional vineyard manager Kym Ayliffe says ‘We put it on vines that were struggling at Langhorne Creek; with the compost we had a 30pc increase in bunch weight. That means we've paid for half the capital outlay in one year ‘

How much water?

- Depending on the type of fruit, climate and soil, the requirement for irrigation water can vary from 0.5 -10 megalitres per hectare of mature trees or vines.
- Some authorities are limiting entitlements for vineyards to 100mm of irrigation (1megalitre per hectare)
- Over-watering is a cause of plant diseases and leads to contamination of waterways and reservoirs, eutrophication and loss of native organisms in ecosystems

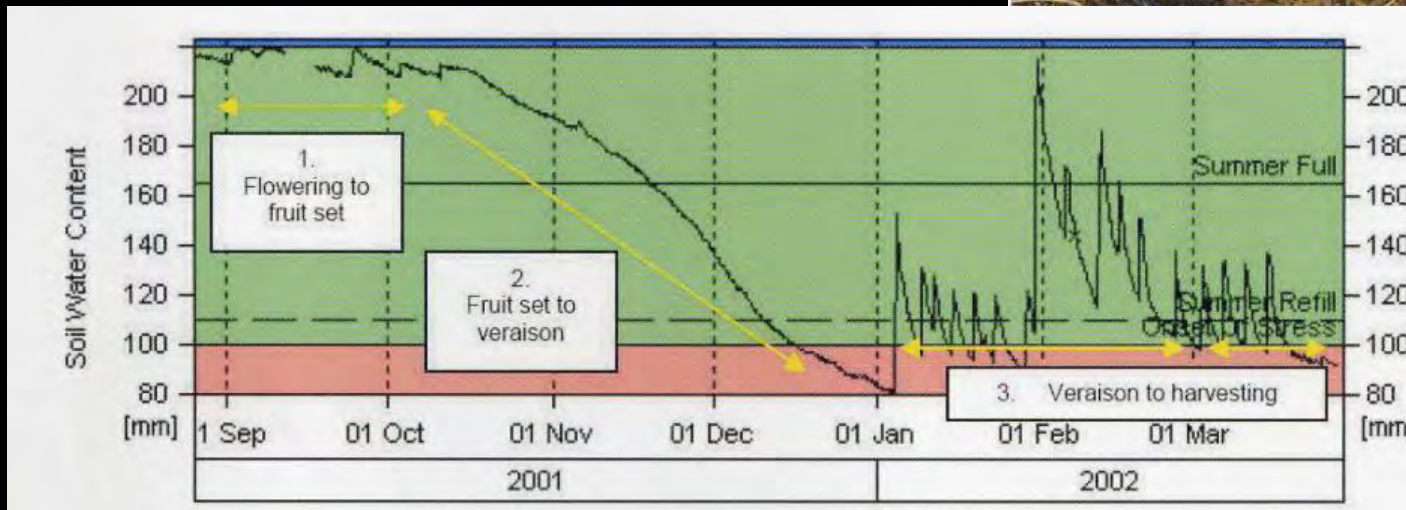
Irrigation Scheduling

- Ensure vigorous flowering and early fruit growth by maintaining good soil moisture during September and October.
- This involves irrigation, weed control and mulching. In areas where frost is prevalent, mulching is delayed by some weeks
- Prevent major water stress in the crop during the growing season
- Step up irrigation in the last month of ripening to grow the size and quality of fruit



Economical and easy-to-use gypsum block sensor to measure soil moisture tension, by MEA

Soil moisture monitoring equipment (Sentek)



Provide controlled growing conditions

Externally shaded ‘glasshouse’

Retractable shade + wind shelter

TYPE	CONSTRUCTION	SHADE	ENERGY SAVING
OLS 50		51%	25%
OLS 60		66%	30%
OLS 70		75%	35%

KEY — Aluminium strip — No strip

eg with Svensson thermal fabrics

Potential water savings

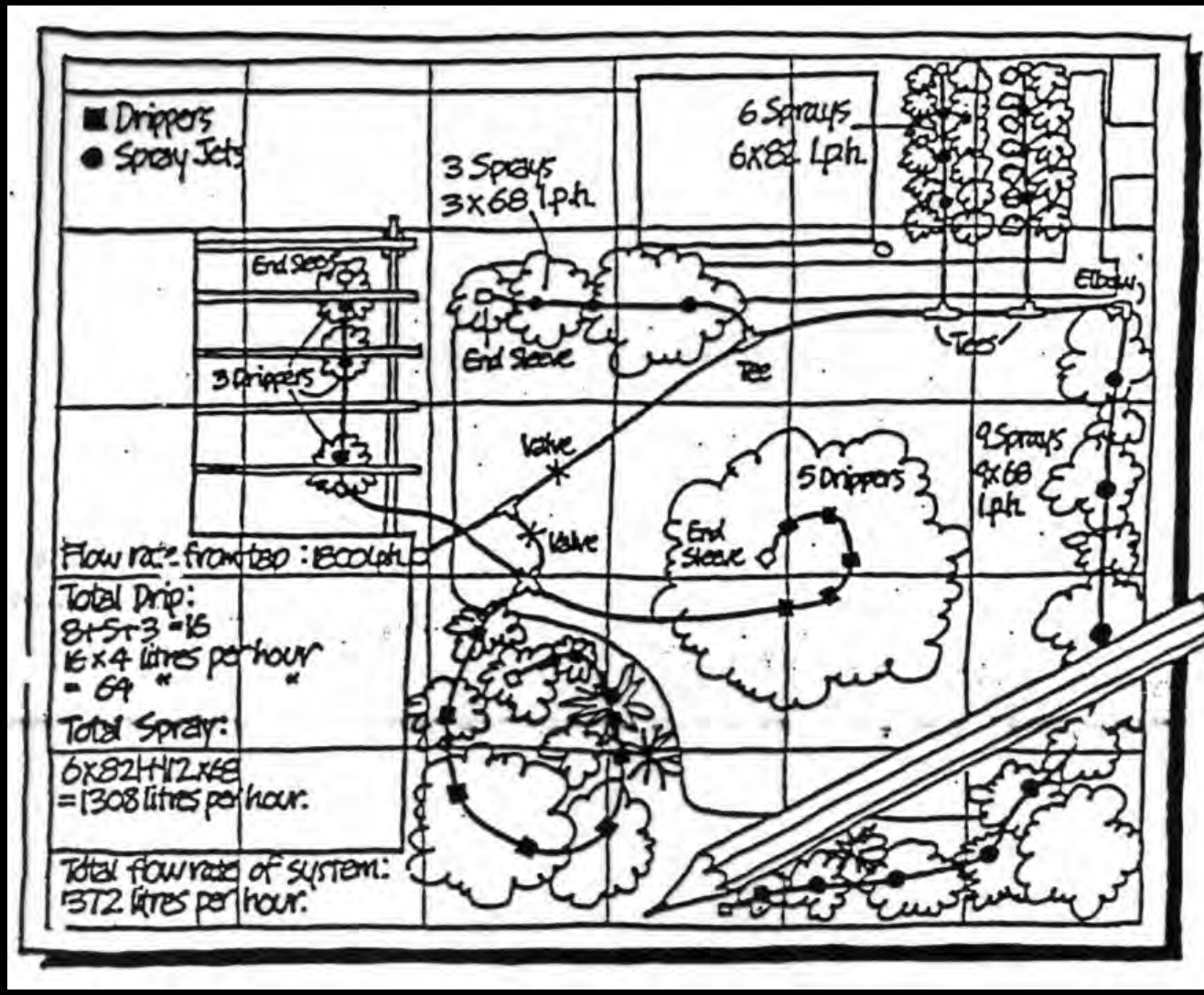
Savings of up to 40% have been achieved in hot environments with no loss of yield and an increase in quality

Fertigation

- A system for adding nutrients through the irrigation water
- Solutions or fine suspensions can be sucked or pumped into the irrigation main at a known rate
- Applications are usually done late in the watering
- Urea, liquid fish, trace elements and beneficial microbes can all be applied in this manner

Fertigation and filtration

- Venturi



Draw a scale diagram and enlist the help of a good supplier