Low Cost, Low Tech, High Efficiency Irrigation

Second Edition

By Nev Sweeney

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1.0 Introduction

I have been using the ideas in the low cost low tech irrigation series for a while, some for years, and they all have their merits and their down sides. I started out making ollas from scratch and it was my intention to fill our 14 veggie patches with them (4 or 6 per patch depending on size), but it was a slow and expensive process, all I could manage was two every three weeks. Having said that I did manage to make over 30 of them before quitting.

The low cost low tech irrigation types I have been working on include –

- Ollas, both made from scratch and made from commercial terracotta pots,
- Buried pipe,
- Buried capsule,
- Deep pipe,
- Leaky Tube
- Bucket and tube
- Bottle and wick
- Self-watering PET Bottle Pot

Of these, the ones I have installed in the back yard veggie patches are ollas (of both types), buried capsules and buried pipe. The deep pipe, leaky pipe and bucket and tube are more designed for the perennials so they are used in the front yard for fruit trees and shrubs etc,

and the bottle and wick I use with pots, and the self-watering PET bottle pot speaks for itself.

General Comments

The reason I made and used these different irrigation techniques is because here in western Sydney the summers are getting hotter and drier. I think climate change is catching up with us but that is for smarter minds than mine to debate! Nevertheless I find myself watering more and more in summer (as well as other times) to keep the food coming, so it made sense to do it the most efficient way possible.

The irrigation methods, while having their own peculiarities, do all seem to reduce the amount of time and water spent on irrigation, while putting the water exactly where it needs to go. There is no substitute for rain, but these irrigation methods do allow me to still get a harvest in the hot, dry times. These new methods have also allowed me to go for longer in the dry times, watering from the tanks rather than town water, but we are now having to go months without rain and we just don't have enough water storage.

Here are some introductory thoughts on what of learned through experience with the low cost/low tech irrigation techniques -

From scratch vs terracotta pot ollas

Apart from the obvious production difficulties if you are not a potter and/or have no access to kilns and such, from-scratch ollas will take more time to produce. I can make two dozen ollas from commercial pots in a few hours but from scratch ollas would take me almost 2 hours each, plus drying and kiln time. Mind you, while I did get lots of production experience I would not call myself a skilled potter so someone more skilled in the art (as they say) would be quicker.

Also, I was using a technique called coiling, which tends to be slower that say, throwing on a wheel or even better, slip casting so again, someone with more skill/experience than myself in these alternative techniques could do a quicker job.

My from-scratch ollas have thicker walls, 10-12mm or so whereas the commercial terracotta pots have walls half that thickness or less. The result is that water will move through the walls in a terracotta pot olla in a day or two but may take a week or more for a from-scratch olla to completely empty. The amount of veggie patch watered by each is a bit difficult to estimate but you get a quick watering with the terracotta and a longer slower watering with the from-scratch one.

Plug vs no plug

All of the from scratch ollas have a purpose build lid to keep crap and bugs (including mosquitos) out and water in, because they have a wide opening at the top, sometimes big enough to get my hand in. The opening in the bottom of a terra cotta pot is much smaller and some are of a size which can be fitted with plugs (bought from the 'irrigation fittings' section at the hardware), again to keep the water in and crap out. To simplify watering, I tend to leave the plugs out, which makes it quicker and easier to get the water in, the plug will be refitted before the chooks get access to the area. Due to the quicker emptying of the plant pot ollas, mozzies seem to be less of a problem.

Watering

Putting water into the irrigations systems by hand (any automatic system would need to be completely removed before the chooks got access) can be a bit slow, although it is still a lot quicker than standing there with the trigger nozzle set on “shower” and hoping the water gets where it needs to go! Also, with experience I have come up with a way which makes watering reasonably bearable. Hoselink (look ‘em up) have an item on their inventory called a “Root Waterer and Soil Breaker” which is essentially 840mm of 15mm diameter metal tubing fixed onto a trigger nozzle. The idea is you can push it into the ground and water roots of plants directly into the soil and while I haven’t tried to, you could probably make one yourself (or just buy one of theirs).

What I have found is that it is perfect for going into the filling holes of both types of olla, the hole in the top of the buried capsule reservoir as well as the filler area of the buried pipes and deep pipes. It even fits the filler necks of our self-watering pots. The end of the tube is bevelled so most of the time I can lever it up under the cap of the from-scratch ollas, fill them with water, then pull the tube out allowing the cap to fall back into place.

In most cases it also allows you do the watering from a standing position (unless you are hugely taller than me), easing the strain on your back while delivering the water directly to where it is needed. We have it set up so that it will work on the hose (through a pump) on our main rainwater tank or on the town water if our tanks are empty. The town water is a bit higher in pressure so reservoirs are a bit quicker to fill than when we use the tank. Having said that, even with the tank water it only takes a bit over an hour to fill all irrigation points in the backyard, every few days.

Reservoir vs Direct Water Use

While all of these techniques direct the water to where it is needed most, some provide an amount of water storage, while others just direct the water flow under the ground, thus minimising water wastage. Ollas (of either type) and buried capsules provide some level of water storage while all of the other irrigation methods supply water but do not store it. This just means that reservoir type will provide a longer time between irrigations, although it is better to refill the ollas at least when they are half full to ensure the amount of water available is sufficient.

Installation

Most of the irrigation methods discussed will require to be dug in to be most effective. While this is easiest at the construction stage of the garden when beds, trees, shrubs and herbs are being put in, retrofitting is always an option.

Ollas and buried capsules can be dug in using an auger post hole digger, they usually come in 150mm or 200mm size, which is a good start even if your olla has a greater diameter.

The deep pipe can be installed by making a soil hole borer out of some 50mm galvanised steel pipe (as laid out in the article about deep pipe waterers).

Unfortunately the leaky pipe and buried pipe need to be dug into the bed they are going to irrigate and that is all there is to it. I did it when the beds were vacant after being cleaned off by the chook tractor. That way I was only doing one at a time rather than a whole stack at once.

The tube part of the 'bucket and tube' irrigation technique can be run on top of the soil (preferably under mulch, or dug into the soil a small amount.

The bottle and wick, of course, is just made and put into action as required when planting new pot plants or repotting old ones.

Final Comments

Putting all of the different irrigation methods into practice has been a lot of fun and taught me a lot. It has been good to look at my food growing systems with new eyes, to work out which methods will do best where and if you have knowledge of your options before putting a garden together it makes things easier. I didn't design my garden, it developed over more than 40 years, so being able to retrofit was important to me, but if you are looking at putting a garden together, cover your water issues first!

If you are in a place where your climate is likely to become warmer and drier and sadly that seems to be a lot of Australia, take a good look at these ideas, try them out and work out which ones are for you. At the very least you will save time and water!

2.0 Ollas

2.1 Ollas from Scratch

In dry parts of the world such as North Africa or Sri Lanka they have used unglazed terra cotta pots to irrigate their crops, the so-called pitcher irrigation. These pitchers were round bellied pots with a short neck and they were buried up to their lip in the soil and then filled with water and covered. The theory goes that the water then travelled through the unglazed terracotta slowly and into the soil, keeping the growing plants well irrigated.

Back in 2012 I bought some thin-walled clay plant pots and turned them into ollas to keep one of the veggie beds watered. They worked reasonably well but the genuine olla, because of its shape, would take up less space at the surface and provide a greater area moist water exchange area under the ground. The problem is that I could not find an unglazed pot that looked anything like I wanted, so I decided that I want to make my own.

They seemed to work well enough overseas that the concept was proven so I wanted enough ollas to be able to install four to six, staggered throughout each of my veggie patches. That adds up to somewhere near 70 ollas! Digging and refining the clay would add too much time to the project, so I am using commercial clay.

The Mould

Because ollas have a rounded bottom, you can't make them sitting directly on the flat surface as you would a flat bottomed pot, so the best thing to do is to make a round mould that the bottom can sit in and still maintain its shape while the clay is soft. It also supports the body of the olla so you can keep building the layers of clay up without any danger of it collapsing due to the soft clay.

Find a ball or sphere a bit bigger than you want the belly of the olla to be, remembering the clay will shrink during drying and firing somewhere between 5% and 10% so making your mould oversize will take that into account. Get hold of some plaster of Paris, (possibly quite a bit if you want to make large ollas) the mould I use weighs about 10 kg, so that gives you an idea of the sort of amounts you might need. The mould is 330mm x 330mm and 160mm deep and the diameter of the half spherical shape in the mould is 270mm.

To make the mould, find or make a box the right size, probably a bit deeper than you think it needs to be to allow for over filling. Mix the plaster with water (it's probably best to follow the directions on the packaging, the manufacturer goes to a lot of trouble to work them out) and then pour the plaster into the box you are making the mould in. Place the ball as close as you can to the centre of the mould and push down so that the "equator" of the ball is level with the surface of the plaster. You will need to hold it there until the plaster has set, then pull the ball out and leave the plaster mould a day or two to fully cure and dry out.

The Olla

The olla is made by coiling so the first thing to do is make the base. To do this knead up some clay and pat it out to roughly the diameter of the base you want, place a stick the thickness that you are looking for (I usually use sticks 10-12mm thick) on each side and then roll it out with a rolling pin if it will sit on the sticks. If you don't have a rolling pin long enough a piece of thick dowel or some 50mm diameter PVC pipe the right length will also do the trick. Once you have a base of uniform thickness place a shape to cut around on your clay. To save hassles I use the lazy Susan that I use to turn the pot on which is 250mm in diameter and as luck would have it, it makes a great template.

With your base now ready, get hold of a large "hair net" and place it over the top of the mould before placing the base in it. The hair net material prevents the clay sticking to the

mould and makes it very easy to get the olla out when you need to. You can then place the base in the bottom of the mould and gently form it so that it fits the bottom of the mould snugly. The process will be made easier from here on in if you place the mould on the lazy susan so it rotates freely, this will allow easy access to all sides of the pot as you build it up.

Next, roll out some clay to about 10 – 15mm thick roll and loop it around the edge of the base, against the mould and smear the edge of the base and the roll until you can no longer tell where they join. Repeat this process until the sides of the pot reach the sides of the mould. You can continue to build up above the edge of the mould a couple of rolls, but as you place each roll on top, give it a few hits all round with a wooden bat to consolidate the rolls and smear both sides of the top roll onto the one below.

Now lift up the hair net so that one side of the pot is exposed. You will still be able to see the shape of the rolls all the way down to the base. Work your way around consolidating all of the rolls by smearing them into each other to make the surface denser, give the sides a few firm hits with the bat. Once all of the rolls have been consolidated slide the hair net around so that the pot is sitting upright again. Now is a good time to scrape the inside of the pot with a rubber kidney to smooth out any imperfections and make the surface denser and harder.

The next roll you lay should be a bit smaller than the one before, but continue the process with the bat and smearing and patting the outside with the bat to keep it smooth and dense. As you continue this process you will need to support the soft clay with your hand on the inside of the pot when hitting it smooth with the bat. Keep this process up until you have a hole a bit larger than your hand, then put your hand in and use a rubber kidney to smooth out the lop layers of clay. The keep going until you have a hole in the top about 100 to 120mm across. It is now time to start building the neck.

To build the neck, place a roll of clay around the outside of the hole, on top of the pot and consolidate as you have been. Using the bat to hit the top will help it key and make the top nice and flat but may make the centre of the pot sink down if the clay is too soft. If this happens you may wish to leave the pot for a couple of hours to harden up a bit.

When it is ready to go keep up the practice of putting one roll on top of the other and consolidating them by smearing and using the bat around the outside and the top and the rubber kidney around the inside if you have space. Even a plastic ruler can help smooth and consolidate the inside of the neck of the pot and fits easier!

How long the neck is, is up to you, because that will determine how far underground the main body of the pot will be. Mine are about 100mm long from the body to the lip; to make measuring easier I have made a mark on one of my wooden pottery tools that shows me how long to make the neck. Once the neck is completed, use the bat to make the top surface flat and smooth, it will make the lid fit better.

The Lid

While not strictly essential, I wanted a lid for my olla to reduce evaporation and keep the water in while keeping out insects, small rodents and dirt.

To make the lid, I rolled out some clay to about 10mm thick in the same way I did the base, and then used an empty margarine container about the same width as the neck to cut out a circle using my high tech, recycled butter knife. I then peeled away the surrounding clay to leave the disk for the top, cut some 10mm wide clay strips from that remaining clay and then placed them on the disk in a circle at the same diameter as the inside diameter of the neck. I gave the circle a couple of belts with the bat to secure it and made a small (2-3mm) roll of clay. I placed some of this roll on the inside and the outside of the circle and used my finger to smear it around, securing the circle even more to the lid. Check for size regularly to ensure the lid will fit.

If you have intentions (as I do) of making a stack of these things, it can be very handy down the line if you inscribe a number on the top of the neck of each olla and the underside (or wherever) of each lid. The making of ollas and lids by hand means that each one will be a little bit different and not necessarily interchangeable. Following Murphy's law, if it is

possible to confuse the lids, it will happen and by numbering them now it will allow you to keep track of them later and ensure you are not left over with one lid and olla which absolutely won't go together!

Final Points

After some practice it now takes me about 2 – 2.5 hours to make an olla from start to finish, but sometimes you don't have that much time in one sitting. If this is the case, when you have to stop lift the pot using the "hair net" and slide a plastic garbage bag underneath, and then sit the pot back into the mould. Fold the garbage bag over to keep the moisture in and then if the weather is likely to be hot, place another garbage bag over the top. This should keep you pot workable for a couple of weeks. If you need to go longer, the weather has been particularly hot or the bag wasn't closed properly you may need to "score and slip" when you start work on your pot again.

To help the pot dry evenly once you have got it where you want it, push a rolled up sheet of newspaper down inside the pot to absorb some of the moisture. You can change it every few days but if it gets left in for the firing it won't matter it will just burn out. Once the olla and lid are fully dried, fire to between 1000°C and 1150°C which is usually referred to as earthenware or bisque temperature.

2.2 Ollas – Using Commercial pots

Ollas (Spanish: pronounced oyyas) are unglazed terracotta pots, filled with water and then buried so that the water moves out of the pot over time and into the soil, thus irrigating plants. I was making them from scratch, moulding and firing them as part of a pottery group, and while I had made almost half of the number I needed, it was a slow process and was getting expensive. I was also second guessing myself, did they really work that well?

That was until one day towards the end of summer in 2016, at the tail end of a 4 month dry spell. I was inspecting a couple of veggie patches, one was lush and quite productive, and the other one just wasn't happy, with the plants growing in it looking decidedly wilty. When I worked it out the difference between the two veggie plots was that the lush one had ollas and the wilty one had no installed irrigation, just watering with the hose. Time to go full steam ahead on the olla project!

To reduce costs and improve the turnaround time I decided to buy in traditional terracotta pots (unglazed of course) and use them to make the ollas. A word of caution, though if you intend to do a similar thing – having identified your supplier of pots, buy two, make an olla, and then fill it full of water ie test the pots out before committing cash to buy a stack of them. Make sure the water will move through the terracotta that makes up the pots. If you are making them from scratch then you have some control over firing temperatures but you will have no idea about ones which you buy premade. If the firing temperature is too high they might not be porous enough so try before you buy.

Assuming you have sampled and tested the pots and found them to be acceptable, the process for turning them into ollas is fairly simple –

1. You will need 2 pots to make an olla, take the one which will become the bottom one, cut a piece of thick plastic (I use thick polythene bags we get as packaging), sit it on your working surface and place the hole in the pot on top of it. Fill the hole in with waterproof silicone material, dispensed from a cartridge gun is easiest. Allow 24 hours for the silicone plug to cure.

2. Get hold of some sheets of 200 grit sandpaper. Tack a sheet down abrasive side up to a piece of plywood, pyneboard etc larger than the sheet of sandpaper using drawing pins or similar.

3. Turn both halves of the olla (pots) so the rim is down and rub them on the sandpaper in a circular manner so that the normally rounded rim is worn down to a flat profile, this will allow the silicone joining each half to form a better seal. ***Warning*** – the dust generated by this operation will contain crystalline silica and should not be inhaled. Do the sanding outside with good ventilation but if you are still concerned wear a P1 dust mask.

4. Wipe off any dust left over from the sanding operation from each rim. Using the cartridge gun loaded with a silicone cartridge, run a bead of silicone around the rim of the bottom pot (the one with the drainage hole plugged) the width of the pot rim. Then invert the top pot and place it rim down on the siliconed rim of the bottom pot. To ensure a good seal, run your finger around the join to smooth the surface off and make sure all parts of the join are sealed with silicone.

5. Allow the silicone to cure for at least 24 hours, then test fill each olla to ensure they will allow water to seep through their surface. (I know you checked out the original one before starting but this is a final quality assurance test). If you want you can install a cork or rubber plug in the filling hole in the top of the olla to reduce evaporation and keep dirt and insects, lizards etc from getting into the olla and taking up space.

Once they pass the final test, they will be ready for installation.

2.3 Making Small Ollas

There are occasions, such as when planting into pots or other planting spaces with restricted areas where the usual size ollas (around 380mm tall x 180mm max. diameter) just won't work. In this case I wanted to plant into 'self-watering' hanging pots but the alleged reservoirs built into the pots were tiny. So, I decided to add some small ollas with a base measuring 75mm, a top of 120mm and holding about 1350mls when full, to improve the water holding capacity of the pots. Also, near the mint in the herb spiral I used an even smaller olla composed of two pots that were 50mm across the base, 80mm across the top with the completed olla holding 500mls when full.

The process of making ollas of any size is simple enough. It is just a case of getting two terracotta pots the same size, using silicone sealant to block the drainage hole of the pot that will be on the bottom, sanding the top edges of both pots to ensure they are flat. Finally apply silicone sealant to the top of the bottom pot and placing the top pot so that the top of both pots are sitting together, sealed by the silicone. Leave them until the sealant is set (24 hrs minimum) then test by filling the new olla with water and ensuring there are no leaks. Easy!

Completed olla prior to placing in the herb spiral

Olla in place

My concern has been that the hole on the top (formally the bottom of one of the pots) was only about 8mm for the herb spiral olla or 11mm for the hanging pot ollas and getting the water in through a hole that size can be slow. I do have a small funnel which exactly fits the filler holes but allowing air to get out as the water gets in is what takes the time. I decided that one possible fix was to drill a small hole beside the main filler hole that would allow the air to escape as the water flowed in. I was unsure how to do

it without completely wrecking the olla, but figured a small tungsten carbide tipped concrete drill might be worth a go.

After searching around I found a 3mm one which looked like it might work, I gave it a go on a piece of terracotta pot, and it worked perfectly. I lined it up on the top of the herb spiral olla and, again, it worked perfectly. The hanging pot ollas were already installed so I had to take down each pot and then drill each of the holes individually.

With all the ollas installed/reinstalled I tried filling them using my funnel and the water went straight in, only taking a couple of seconds to fill each olla until it came rushing out the breather hole. The experiment was a success!

It works!!!!

2.4 Ollas: Overview and Review

About 15 years ago I was fooling around on the ‘net and came across the idea that if you dug unglazed terracotta pots into your veggie patch and then filled them with water, they would release that water slowly underground, thus keeping your veggies watered! In other words, ollas!

First experiments

The pictures I saw were of round pots with a spout at the top, which would project above ground and allow you to put the water in. I didn’t have anything that looked like that so I got hold of some el Cheapo, unglazed terra cotta plant pots, and some pot saucers to go on top. I used silicon to plug up the drain hole then inserted them into one of our veggie patches. I dug them in a staggered pattern, with six pots in a 1.2 x 3 metre veggie bed, and this has been the pattern I used ever since.

As a proof of concept it worked well, and when I removed them at the end of the season, the soil around the pot was just a mass of roots from the vegetables I was growing, showing that they also approved of the idea.

Craft of the potter

What I really wanted to do, though, was to learn how to make them myself. I signed up for a local, council run, potting class and fooled around making things, leaning various hand making techniques, but without using a potter's wheel. Once I had enough practice, I started making ollas by coiling, this is a fairly easy skill to master, unlike throwing pots on a wheel.

Number 1, Dry but not fired

I had calculated that I would need somewhere in the area of seventy ollas to fit out all of our veggie beds and so I set to work. Each pottery session was 2 hours, but it took me about 2.5 hours to make a single olla plus lid. So in other words, about two weeks per olla roughly. Each olla holds about 6 litres of water.

As I made and fired sufficient ollas for a bed (4 or 6 depending the size of the bed), I would dig them in and see how things would go with them in practice. I found that they worked very well, but with a couple of caveats when using them in association with the chook tractor, mainly involving the lids. The point is also worth noting that, because these were made one-at-a-time over a couple of years, there is some variation in sizes of things like lids and the filler neck.

Over time, I wound up making two types of lids. The first type had an overhanging lip all the way around the lid of the olla. This worked well for filling the ollas with water, because I have a trigger gun with a long aluminium tube attached which fits on a hose from one of the tanks which has a pump. I just lean over, push the tube up under the lip and then the tube can go straight into the olla, filling it up without me having to scramble around on my knees to remove the lids. When the olla is full, I just pull the tube out and the lid slips back into place over the opening and I move on to the next one.

That is the good bit. The downside is that when the chook tractor is in place, the chooks can also easily flip the lid off and then chuck all sorts of debris down into the olla while they are scratching around. Where the filler neck is wide enough, I can reach down inside the olla and remove the debris, but where the neck is too small, this means the olla has to be dug up, turned upside down and shaken to remove the rubbish.

To get around this I designed lids that had no overhang, some with sides that sloped inwards so that the chooks would get no purchase and flip the lid off and others with flat sides, these modifications worked well. It did, of course, introduce complications when refilling the ollas with water but even that was not much of a problem. All our ollas have one or the other type of lid.

If I were doing it again I would make them to a standard size. With the filler necks being different sizes, the lids were also different sizes. To make things easier (I thought) I put a number on the side of the olla and the same number on the lid so they could be matched up. What I forgot was the majority of the olla is buried, so it would have been better to put the olla number on the side or top of the filler neck.

Commercial pots and Ollas

By the time I got about half way through making the from-scratch ollas, I started to get frustrated with the time it was taking. I did experiment with several other types of irrigation for the veggie beds, but still came back to ollas as my go-to. I needed a better plan!

My better plan was to go back towards my original idea, but this time use commercial pots one on top of the other, the drain hole of the bottom one blocked with silicon, and the two joined at the middle, leaving the top drain hole open for filling the olla with water. The process of manufacture was basically –

1. Cut a thin piece of plastic film to go under the drain hole in the bottom pot, put it in place and fill the drain hole with silicon.
2. Sand the rim of both pots to ensure good sealing.
3. Apply silicon to the top the pot with the filled drain hole, invert the second pot and place it, rim to rim, on the first
4. Allow the silicon to cure for 24 hours.
5. Once cured, do a test fill to ensure there are no leaks. If no leaks, you are ready to go!

Testing prior to installing, just to make sure the water comes through

The ollas I made myself were generally thicker (10mm – 12mm) than the commercial pot ollas where are around 5mm – 6mm thick. This means that the water tends to drain out

more quickly from the thinner walled ollas. This can be good in hot weather, but means you need to top them off more often.

I found some plugs that would fit in the top of the olla, but for the most part, due to the smaller filler hole the chooks didn't kick much debris down into them so I don't bother with the plugs or digging them up and shaking the debris out. Also, leaving them without the plug means that they can be easily filled with the tube and hose setup and I still don't have to go grubbing around on my knees.

By using different size pots to make the ollas, I have been able to use them in a number of different situations including large pots and hanging baskets as well as in the annual veggie beds.

Conclusion/Suggestions

In general terms I am very happy and satisfied with the ollas and their performance in the veggie beds, and pots. I will make the following suggestions –

- If you are making them from scratch, make the filler neck big enough so you can get your hand down and pull out any accumulated rubbish.

- If you are numbering them, place the olla number at the top of the filler neck as well as the lid.
- Consider what type of lid you want to make, depending on how you will use them.
- Ollas from commercial pots are easy and quick to make, the larger the pots you use the less often they will need to be filled but the more space they will take up in the bed.

3.0 Buried Pipe

The original concept of buried pipe irrigation was getting hold of, or making, a whole stack of unglazed terracotta pipes (sound familiar?) which you would then bury beneath your veggie patch, leaving one end open at ground level so you could pump water into it. In the same way ollas work, the water in the pipe would diffuse out into the ground, thereby irrigating any vegetables etc planted above it very efficiently. The pipe would have been put in either directly under or to the side of veggies planted in rows.

Terracotta pipes seem to be fairly difficult to come by these days and are expensive when you do find them, but there is a modern alternative – ag pipe! Agricultural pipe (or Ag pipe for short) is a flexible corrugated pipe, usually with slots in it, the larger sizes (100mm+) are covered with a non-woven sleeve or sock. The idea is you bury it in an area that is poorly drained and set it up so that the excess ground water drains to storm water or local watercourses etc, thus removing unwanted excess water. But…….

It can also be used to do the opposite, supply irrigation water underground to the roots of your precious plants. I find the best of the sizes to use is the 50mm diameter stuff, but it does not come with a sleeve or sock covering it. The idea of the sock in this instance is it keeps roots and debris out of the pipe so it doesn't get blocked up, but it also acts as a wick, allowing the water run into the pipe to be wicked up so that it is available to the plants from the full diameter of the pipe.

Making the Sock

To make a sock for your 50mm pipe, get hold of a pack of 60cm x 6m drain matting, this is a non-woven fabric used as a filter in drainage trenches etc to keep them clear. I have used drain matting from RELN and from Everhard, and found the Everhard product to be a bit thicker, so I would use theirs again.

Remove it from the package and unfold it so it is sitting on the floor in a single layer, then start from one end and roll it up tightly to form a cylinder 600mm wide by about 150mm in diameter. Make sure you have a good solid leather glove on your non-dominant hand (which holds the straight edge used to guide the knife). Then place a metal straight edge across the role 200mm from the edge, (ie 1/3 the way in) and then cut through the drain matting with a sharp Stanley knife or similar, it will take a number of strokes. Measure in the middle of the remaining 400mm width roll and do the same again. This will result in you now having 3 x 200mm wide by 6 metre long strips of drain matting.

The next trick is to find someone whose super-power is sewing (mine isn't but thankfully Linda's is, among other things!). Fold the matting over so that it is 100mm wide and then sew down the open edge so that you then have a 6 metre long tube in effect. Slide the sock over the ag pipe slowly and carefully until it is fully covering the designed length of ag pipe. Your buried pipe irrigator is now almost ready to be installed.

The Filling Point

With most of the buried pipe……well, buried, there still needs to be an aboveground section where we can put the water in, it ain't gonna irrigate itself. With the pipe needing to be in a circuit I had to find some way to join the two free ends anyway, so it was very easy to use a Tee fitting, bought where I got the original ag pipe from. I made sure the sock covered up to the solid plastic part of the tee piece, then I fitted a short length of ag pipe into the upturned section of the tee to form the filling point. All I had to do then was add an end cap to keep out dirt and prevent critters like snails from using it as a base of operations for raiding parties.

Installation

I have run this type of irrigation in several beds, 2.1 metres wide x 2 metres long and 2.1 metres wide by 3 metres long. The general process was to dig out a 50mm – 100mm wide ditch down into the bed using a trowel and hand-hoe following a not quite square, not quite oval path, with a few wiggles along its length to increase surface area. Once I got below the level of cultivation I hit good old hard Sydney clay subsoil so I didn't get as far down as I wanted but 50mm to 100mm seems to work OK.

I placed the sock covered ag pipe onto the bed, formed it so it ran where I wanted it to go and then traced around it in the dirt. I then dug out the channel using the trowel and hand hoe, getting the bottom as level as I could. If the pipe runs uphill away from the filler point it could cause problems getting the water distributed evenly along the pipe so use a spirit level to make sure it is roughly level. To get that much soil out of the bed meant it kept falling back into the ditch rather than sitting on the top of the bed, so I had my wheelbarrow nearby and was able to put some of the soil in there. Once the pipe was installed and covered I distributed the soil in the wheel barrow over the top of the bed.

I ran some water into it to make sure it worked and then mulched and planted out the bed. Finished! (almost!)

Testing the System (or - A trap for young players!)

When I installed the buried pipe in the 2 metre long bed, I left the furthest end from the filling point uncovered so I could check that sticking a hose in the filling point and turning it on watered the entire length of the pipe. This was a good test but I forgot to do that with the 3 metre bed so I decided to get technical, and inserted a cheapie moisture meter (you know, shows dry-moist-wet soil) at the furthest end from the filling point.

I turned the hose on and waited, and waited and waited. The needle did not move off the "dry" setting at all. Bugger! I figured I would need to install another tee fitting so I could fill from both ends. Just for the hell of it, I inserted the moisture meter half way along the buried pipe. Still no reading, this was not looking good. I had obviously screwed up something monumental. So I removed the meter and the inserted it right beside where the water was going in – still no movement. Hang on a minute!

Yes, the (newly bought) moisture meter was faulty, I could dip it in water with no response at all. I rummaged around and found an old one and it worked, and confirmed that my design was OK!

4.0 Buried Capsule

Buried capsule irrigation uses the same sort of process as ollas, that is to say they are based on a water holding container made from unglazed terracotta, which allows the water to diffuse slowly through the side of the container into the soil. The surrounding plants can then send their roots towards the water source which is located (ideally) in the plants' root zone. The difference with buried capsules is the terracotta container is completely buried and there is a reservoir on the ground surface directly above the capsule which can be observed regularly so it is obvious when the buried capsule needs to be refilled.

While this method is probably the most technical and time consuming of the low tech, low cost irrigation methods to construct, it is still easy to put together with an afternoon's work.

Components

Terracotta Bits

It starts out with an unglazed standard terracotta plant pot and I use a standard 23cm (9.06") pot which is 20cm deep and has a drain hole 22mm across (this is an important measurement). Also required is a pot saucer of similar diameter to the top of the terracotta pot. Sometimes it can be difficult to find the exact size, in my case there were no 23cm pot saucers, only 21cm or 25cm. In most cases either will do as any gaps will be taken up with silicone sealant. I chose 21cm terracotta pot saucers, they were labelled as water impervious, but that is OK too because we want the water to be diffusing through the side of the pot rather than sinking into the soil through the bottom.

The pot and pot saucer together are used to construct the capsule.

Fittings

We now have the basis for the buried capsule itself, but now we need a way of connecting it to the above ground reservoir so I used some irrigation fittings. I got hold of fitting that had a 19mm thread on one end and a 15mm BSP barb fitting on the other, you need two per capsule. To help secure the fitting into the capsule I butchered a Garden Rain 15mm Female to Female Rural Poly Irrigation Coupling and to join the reservoir to the capsule a length of 19mm clear vinyl tubing (in this case 1 metre).

The Reservoir

Just about any thin walled container that you can drill through will do, but if it is clear it will make it much easier to assess the water level at a glance and know when it needs to be topped up. I use a series of nominal 1.5 litre cylindrical plastic containers with a screw on plastic see through lid (although they hold about 1.8 litres when absolutely full) which are 19cm high by 11cm across the base, and easily available and cheap.

Putting Things Together – The capsule

To start, turn the pot you are going to turn into a buried capsule upside down so that the drain hole is uppermost. Cut some 3mm – 5mm thick rings from your 15mm Female to Female Rural Poly Irrigation Coupling, 4 will be enough for each buried capsule. I use a small electric band saw although you could achieve the same thing with a hacksaw (but with somewhat more effort!). Two of the rings will be used to secure the 19mm threaded fitting into the drain hole of the pot. First, screw one ring onto the 19mm fitting down as tight as you can, holding some cloth in your hand helps to grip the thin ring I find. Then place the fitting into the drain hole of the pot with the barbed end facing out, and on the inside screw the other ring down tight, to secure the fitting into the drain hole. A bead of silicon sealant (yet again, silicone is my friend!) will ensure a watertight seal.

With the fitting in place the pot saucer can be attached to the pot to form the capsule. If the saucer is the same size as the pot or smaller it will need to be put together right side up, if the saucer is larger it will need to be done upside down. All that needs to be done is to fit

the saucer on the open end of the pot and apply a bead of silicon sealant between the two surfaces, while applying a bit of pressure to the nozzle to ensure that the bead is squeezed into the gap. If the bead is being applied right side up it will need to be set up so that the fitting sticking out of the drain hole is put into a slot between two lumps of timber to ensure that the pot has a firm base. It is easier if the saucer is larger, it can be done upside down and by putting the pot on a lazy Susan it makes it easier to rotate it as the silicone is applied.

When the silicone has been applied, use a finger to wipe over it and make sure that it has gotten into all crevices of the join. Leave the whole assembly for a day or two so the silicon sealant can set. Once the silicone is set, fill the capsule with water just to make sure there are no leaks, before moving onto the next phase of construction.

The Reservoir

As mentioned above, the reservoir I use is a plastic container often used to put dry foods in, which is 1.8 litres in capacity and has a screw on lid. A 19mm threaded fitting needs to be inserted into the bottom of the plastic container so that water run into it can be directed down into the capsule. The easiest way to use a 19mm spade bit to drill a hole in the bottom of the reservoir then use the same technique as fitting the 19mm threaded fitting into the capsule, and then seal with silicone sealant.

Unfortunately this won't work for me, because I need to lift the chook tractor over the veggie patch and the chooks are gonna dig the living daylights out of it so I needed to be able to remove the reservoir while leaving the capsule in place. I also needed to block the

hole leading to the capsule so the chooks didn't fill it with dirt. Rather than use silicone sealant I used a soft washer between the bottom of the reservoir and the 19mm threaded fitting. I also have a cap for the fitting so that I can remove the reservoir then screw on the cap to seal the open end of the capsule.

We now have the reservoir and the buried capsule and all we need to do is join them together. I use some 19mm PVC tube, but how much you need will depend on how deep you want your capsule to be buried, ideally around the root zone of whatever it is you will be growing. By cutting the tube so that it just joins the two barbed ends, no tube showing in the middle and with the reservoir sitting on the ground the capsule is about 80mm below the soil surface and this is about the minimum depth. Any deeper and all you need to do is put in a longer piece of tube between the two ends.

To make sure there was no vacuum, I also drilled a 19mm hole in the centre of the top of the reservoir, but it seems that this is also a great way to refill it without removing the top. A long tube fitted to a hose can be used to refill the reservoir by inserting the end of the tube through the breathing hole and then filling it up from there. It also makes refilling easy if you are growing a tall or rampant crop which can make getting to the top of the reservoir difficult.

Installation

To install the buried capsules I first fitted the two barbed fittings and the pipe, so I knew roughly where the soil surface should be and then screwed the end caps over the top fitting to prevent dirt getting in. Using a soil auger which is about the same diameter as the capsule I dug down to the required depth, put the capsule in the hole and the covered it up with the spoil from the hole, to the point where only the cap was exposed. This is so the bottom of the reservoir is sitting on the ground and is firm, that way it can't move around and break the seal.

Once the first capsule was in place I installed the others, using a long piece of timber and a spirit level to ensure that they were at the same level in the soil. With all of the capsules dug

in, I connected the reservoirs and then filled them with water. The bed was now ready to plant out.

5.0 Deep Pipe

At the time of writing the original article (winter 2016) we had just come off a period of over 4 months with almost no rain – just a couple of showers over that time, barely enough to wet the ground. Overall, Australia is a drought country and climate change seems to be making that worse if anything so even when the rain comes we know that more dry conditions are just around the corner. It is with these gloomy thoughts that I started to research low cost, low tech irrigation techniques that were also water efficient.

Deep Pipe Irrigation

The basic point of deep pipe irrigation is that it gets water where it needs to be; direct to the roots of trees and shrubs. This has a number of benefits –

1. Less water is used – because you are getting the water to where it needs to go rather than standing around watering the ground surface and hoping it percolates down to the roots (while half of it actually runs off), less water is needed to achieve the same result.

2. Less time is used – in a likewise manner, because you are not standing around with a hose waiting for water to percolate down. It is just a case of fill each pipe and move on. It can even be set up to be drip fed, reducing time required even further.

3. Deeper roots are stimulated to grow – when trees and shrubs are watered from the surface, surface roots develop to make the most of this water. Unfortunately the top of the soil is the first bit to dry out leaving your plants susceptible to drought. By using the deep pipe method water is applied down into the soil, stimulating the plants roots to grow down and out to follow the water as it moves through the soil.

So, what is deep pipe irrigation?

Deep pipe irrigation uses of a length of PVC pipe 50mm in diameter (less if drip irrigation is to be used) and between 400 mm and 600mm long, sunk vertically into the ground within the plant's root zone into which water is fed, directly irrigating the root zone.

I use 500mm long pipe because it is in the middle of the range and gives me an even number of pipes if you by your PVC pipe in 3 metre lengths, as I do. To make the irrigator, cut the pipe to length, then drill a series of 3mm holes 50 to 75mm apart down one side of the pipe, mark at the top which side the holes are on. When installing the pipe it is crucial to have the line of holes facing the plant to be watered.

There needs to be a cover for the open end (top) of the pipe to prevent dirt and leaves etc filling the pipe over time and to keep out wildlife. My original plan was to have a solid plastic end cap on the open end (because I liked the look), but that left me with another problem. One of the reasons to put in this irrigation method is to reduce the time required for watering, but if I had to get down on my knees and take each cap off, then replace it after watering, it seemed a bit self-defeating. To get around this I used

some spare shade cloth and made a clip by cutting off a 25mm length of the 50mm PVC tube and then making a vertical cut on one side so it could be opened out and fit around the irrigation pipe. This holds an 80mm square of shade cloth on, allowing the pipe to be filled with water but keeping out the wildlife.

Retrofitting Deep Pipe Irrigation

This style of irrigation is excellent for establishing new trees and shrubs and so can be put in at the time when the new plants and put in place. Deep pipes will also allow you to water existing plants but is a bit more hassle to put in, here is how I installed them to my existing plantings.

I had a 1500mm length of old imperial 48mm outside diameter galvanised pipe with a 50mm socket on one end (although an end cap would also do). To turn it into the tool I needed I used my angle grinder to cut the end without the socket on and angle from each side so that it came to two sharp points, one each side of the galvanised tube. It also helps if you make a mark on the side of the tube at the depth to which the deep tube is to be installed (in my case about 450mm-500mm).

To use the galvanised pipe to make a hole for the deep tube waterer to go in I needed a post driver, a large stillson wrench, a 25mm square stake about 1800mm long, a pair of ear muffs and a rubber hammer. The process is as follows –

1. Decide where the pipe is to be situated and clear away any mulch and debris from the ground surface, place the galvanised pipe pointy end down onto the soil and place the post diver over the top of it.

2. Make sure you are wearing the ear muffs because it gets very noisy when you are right next to it. Lift the post driver up and ram it down onto the top of the galvanised pipe, which will sink into the ground. Do this about half a dozen times or as many times as it takes for the pipe to be driven down to about a third of the desired depth. Remove the post driver.

3. Remove the galvanised pipe from the ground by using the stillson wrench to grip and turn the pipe to loosen it up for removal. While turning the pipe around, apply upward pressure to the stillson wrench so the pipe is slowly screwed out of the ground. This will be comparatively easy for the first part but will become increasing more difficult (but still doable) the further down you go.

4. With the pipe removed from the ground, place the stake in the top of the tube, invert the tube and strike it against a hard surface like a concrete path so that the stake is forced up into the tube and the plug of soil removed by the pipe is forced back out the end. You may need to clean some remaining soil out of the end if it is sticky and clayey.

5. Repeat steps 2, 3 and 4 until you get to the desired depth, cleaning out the pipe each time.

6. The galvanised pipe (48mm OD) is a bit smaller than the PVC pipe (50mm ID) so you need to put a bit of force on the PVC pipe to install it. Place the PVC pipe in the hole, ensuring that the line of holes is facing the plant to be watered and then, using a large rubber hammer, apply enough persuasion for the pipe to be installed to the bottom of the hole (ie, hit it!).

7. With the pipe installed, place the cover on by putting the square of shade cloth (or other mesh you have handy) and clip it in place.

You can now deeply irrigate as many trees and shrubs as you have deep pipes for.

5.1 Deep Pipe Reservoir

I have been spending some of my time working out ways to maximise our water use and one way I have come up with allows us to use greywater from the house to deep water out perennials, working with our previously installed deep pipe waterers.

Our problem, as I see it, is that if we gather water from the bathroom, laundry or kitchen, say if we wash and peel veg into a bucket, or use a bucket to catch the water coming from the tap before it flows hot, or whatever, to apply the water to the garden, we toss it onto the well mulched soil surface. As with any watering of the soil surface, it may or may not make it through the mulch, some will be lost to evaporation and what does make it into the soil will encourage surface root development rather than deeper roots, which makes the plants more susceptible to droughts.

What I wanted to do was to come up with a way to easily (gotta be easy or it won't happen!) pour the water deep into the soil without meaning we have to stand around for 15 minutes pouring while the water soaks slowly into the soil. If it uses (for us) existing infrastructure, is quick simple and cheap to make, from parts which are readily available, so much the better!

The answer, it turns out, is the deep pipe reservoir or 'DPR'. (if you can think of a sexier, more catchy name, please let me know).

The DPR consists of three parts mainly –

1. a 100mm x 50mm PVC taper level invert

2. a 1 metre length of 100mm diameter PVC pipe, and

3. a 100mm PVC straight coupling to keep them both together.

Total cost for the setup is a bit over $25.

Add in a bit of blue glue to hold it together and a bit of shade cloth or equivalent mesh and a 105 – 127mm hose clamp (at $3.45). Admittedly, if you do not intend to put any water into the DPR which has solids which may clog the holes in the Deep Pipe waterer, such as veggie peelings or food residue from plates rinsed, the shade cloth and clamp and not required.

The manufacturing is easy as possible, apply some PVC pipe glue to the outside of the taper level invert and the inside of the straight coupling, then insert the taper level invert into the straight coupling and hold it in place for a few seconds, then repeat the process with the 100mm PVC pipe, inserting it into the other side of the coupling. Cut a piece of 120mm square gauze or shade cloth (if used), place it over the top open end of the 100mm PVC pipe and secure with the hose clamp.

To use just remove the mesh and C-clip securing it from the top of the deep pipe waterer and slide the open end of the DPR over the now open end of the deep pipe waterer. Now that it is installed, water can be poured from a bucket or whatever container is in use, through the top mesh, filling the inside of the DPR. Then it is just a case of allowing the water to drain into the deep pipe waterer, thereby providing irrigation for the chosen plant. The DPR may be left in place for subsequent watering of the same plant, or transferred to another plant which requires irrigation.

The DPR is light, strong, cheap to make and easy to use. If you have deep pipe waterers in place, make one today, if you don’t, start making and installing them today, don’t you know we are in drought?

6.0 Leaky Tube or Hose

The leaky tube or hose is not a new innovation, they have been around for a long time. In fact I remember my father pressing them into service in the garden when I was a kid. They are made from recycled rubber and usually come in two diameters – 6mm for use in containers and 12mm for use in the greater garden. The 12mm variety can be used with standard 12mm garden hose and 13mm irrigation hoses and fittings such as tee pieces, end plugs and joiners.

The idea is to bury the leaky hose near or even under the plants you wish to irrigate, and then turn on the pressure and let the water seep out over a 20 – 30 minute period to provide water to soak the area.

There are several things which need to be taken into account when designing a system using leaky hose –

- The water source needs to be under pressure (usually mains or through a pump) to make sure water leaks out at the desired rate, gravity flow from tanks is not enough.
- Short runs of leaky hose off an impervious supply pipe (eg 13mm irrigation pipe) will work better than long runs of leaky hose. This is due to the fact that over a long run, most water will be delivered closest to the supply point and the pressure will drop the further away you get from the supply point. This reduces the amount of water leaking out and hence the amount of water delivered at a distance. A good rule of thumb is that runs over 4 metres in length should be avoided.
- Again, due to the pressure regulating how much water leaks out, if the hose in not level you will get more pressure and that is to say more leakage from downhill runs. On an uneven site, following the contour will help.
- Leaky pipes, by virtue of their construction have a tendency to be a bit fragile and can be split by turning on the tap too quickly. When pressurising the leaky hose it needs to be done slowly to avoid shocking the system. Even better, introduce a 100kPa pressure reducer between the water supply and the leaky hose, usually screwed onto the tap before attaching the supply hose.
- Standard garden hose and non-leaky standard 13mm irrigation pipe can be used to supply water to the leaky hose and to connect between the runs of leaky hose.
- If the water supply is contaminated or hard with minerals, the runs of leaky hose should be cleaned out every year or two. This is done by removing the end caps and running water through the system to remove any materials blocking the holes in the leaky hose.

I used leaky hose to add irrigation to our herb spiral (AKA the herb wedding cake) and will be used to irrigate the surface plants in the fruit tree circle (deep pipe irrigation has already been installed for the trees).

To install the leaky pipe I made up a circle of it about the same diameter as the bottom tier of the (3 tier) herb wedding cake and used a 13mm tee piece to join the two open ends. I installed it in a wavy fashion, sneaking it in and around the existing plants and for the most part burying it 25 – 50mm into the dirt. One problem was burying one side of the tube could put pressure on a bit I had already buried causing it to pop up above the ground again. I'm sure the neighbours would have given me the Academy award for colourful language that day. I was able to solve the problem by getting hold of some u-shaped wire staple things and using then to hold the pipe down by pushing the firmly into the ground, then covering the tube with soil.

I then made and installed the second, smaller pipe circle in the second tier from the ground, so that the free end of the tee piece pointed down towards the free end of the tee piece in the bottom tier, which was pointing up. I then used a short length of 13mm irrigation tubing (ie not leaky) to join the two circles. All well and good, I hear you say……but how do you get water into the leaky pipe? Funny you should mention that!

On the other side of the top circle of leaky pipe, ie 180° from where the two circles are joined, I cut the top pipe in half and inserted another tee piece. I place some 13mm irrigation pipe on the free end of the tee and then put a standard hose coupling on the end of the irrigation pipe. It is set up so that it points at the tank in the front yard and I can

connect a hose up to it from the tank, through a pump and a pressure reducer to the coupling. That way I can use the pump to irrigate the herb wedding cake with tank water.

7.0 Bucket and tube

The summer of 2012/2013 was predicted to be a long and hot one so I had to get my act together and make sure we can deliver the water to the newly installed lavender hedge to help it get established. The system I put together was simple, cheap and effective, but not necessarily the best one for all situations, it consists of a reservoir, delivery tube and a connecter joining the two.

The Reservoir – I used a recycled 20 litre container with lid but I could just as easily have used a 20litre recycled plastic cube or even a 200 litre drum or old wheelie bin. Whatever you use it should have a cover on it to stop small animals being drowned and keep out windblown rubbish that may block up the holes in the delivery pipe.

The Connector – this is one of the most wonderful little plastic doohickies known to man – a ¾ inch BSP to 13mm barb poly fitting. It can be screwed directly into the bung on the bottom of a plastic cube but will need to be correctly fitted into any solid walled container that you want to use. They do come in different sizes so you can use larger delivery hose if you have access to it, but the 13mm sizing works well with this set up. (The connectors are available from specialist irrigation suppliers or the irrigation section of large hardware stores.)

The Delivery Hose – I used 13mm black plastic irrigation pipe because that is what I had! There has been a roll of it kicking around the shed for years so it seemed like a good choice, but I could have used recycled standard 12mm garden hose as well. Even if the hose was too weathered to hold pressure it would be OK for this project because the water was delivered by gravity and so pressure is minimal.

There are a number of advantages to this type of irrigation –

- Low cost/no cost to set up

- Can be filled with water from any source eg water saved from the shower while waiting for the water to run hot or from a rainwater tank
- Efficiency, there are little or no losses to evaporation or runoff, especially if the water is applied under a layer of mulch
- Water application is also very efficient in that each plant can be separately targeted.

The down sides are that this is still a fairly manual process, needing to be topped up by hand and the delivery pipes will need to be moved when cultivating or replanting the bed.

Putting the System Together

1. Before I started on the irrigation system I needed to work out which end of the bed the reservoir should go, the bed appeared to run downhill from the Bay tree but I used a spirit level to confirm this was the case. Seeing as water runs down hill, under the bay tree is where I put the reservoir.
2. I used a recycled 20 litre bucket as my reservoir so I drilled a hole in the side, towards the bottom using a 25mm spade bit in my electric drill. If I was using a 20 litre cube, there is already a hole in the bottom for the fitting to screw into so this step would be unnecessary. To give it a bit more height and to make sure it had a steady base I put a bit of scrap timber across the end of the bed surround and then sat the reservoir on it.

3. I screwed the fitting into the hole and then screwed a ¾ inch BSP socket on the fitting, inside the bucket. I Screwed it down tight and got a reasonable seal but the system is outside and not under pressure so the odd drop of leakage should not be a problem, but if it is run a bead of silicon around the fitting on the outside of the bucket will fix it. (always remember – silicon is my friend)
4. I ran the delivery hose, in this case 13mm irrigation pipe, along the bed and cut it to length and put a plug in the end. If I didn't have an end plug hanging around I would have bent the free end back on itself and secured it with a clip or bit of wire or something.
5. I then secured the free end to the ground with a wire loop to hold it in place until I put the mulch on. The mulch would hold it in place, stop it from getting too hot and lengthen the life pipe by keeping it away from UV radiation from the sun.
6. Using my battery drill I then drilled a 1/8 inch hole just uphill of each plant that would need to be watered and that seemed to work pretty well, with each plant getting a reasonable flow rate when I checked it out.
7. Once I was happy that the plants would be getting enough water I put the wood chip mulch on, to me it looked pretty good but my lovely partner in the sustainable life was not happy with the look of the white plastic bucket, so there was one more job.
8. We discussed several ways to disguise the bucket but settled on a screen made of bamboo which certainly camouflages it well.

This system is a very simple one but there is a huge variety of fittings available that also make it very flexible. Due to the irrigation system being powered by gravity it would make sense not to put too many bends and kinks in it though that will slow the water down before it gets to the end of your delivery pipe. If you do start having problems you could raise the reservoir up on a wooden framework to provide more "head" or pressure to get the water where it needs to go. You could also consider a bigger diameter main delivery hose with smaller ones off to the sides to deliver water directly to the plants.

8.0 Bottle and Wick

Self-watering pots are a wonderful idea! They reduce the amount of work you have to do to keep your precious plants watered and they are very water efficient, providing a reservoir so the plant stays hydrated but with a minimum of evaporation. Unfortunately my experience with the commercial models is that the reservoir is way too small for the size of the pot and resultantly the size of the plants being grown. I prefer the homemade variety, you can make them to your own specifications.

The downside is of course that no matter whether your self-watering containers are store bought or home builds, it would be somewhat expensive to convert all potted plants over to this style of watering. This is especially true for those container-growing enthusiasts amongst us. So what is the answer?

I'm glad you asked!

The answer is to convert all of your existing growing containers over to the "bottle and wick" watering system. It is cheap, very water efficient and reasonably easy to do, especially at repotting time.

The idea is that a synthetic rope wick of the right type connects an external reservoir to the root zone of the plant in the pot, the water travelling down the wick by capillary action. This allows a large reservoir to be connected to a standard pot so that it will have all the advantages of a self-watering b pot, but without the expense.

How to

The first thing is to get hold of some material to use as the wick. Nylon or polyester braided rope is ideal (polyethylene is hydrophobic and so not a good choice). Unfortunately in many cases the material the rope is made from is not put on the label, in which case you could ring or email the company to find out or just use one which is labelled if you can find one. I was able to find some labelled as being polyester where other types from the same manufacturer were not labelled.

Cut the rope to size allowing enough length so that the rope will go to the bottom of the reservoir and coil around, run between the reservoir and the pot and still have enough rope left over to coil around the inside of the pot.

To keep down evaporation from the wick between the reservoir and the plant pot some plastic tubing, just a bit bigger than the rope, will also be needed. I got 6mm rope and 8mm tubing, although larger diameter rope would allow more water to be transported. Cut the tubing to size so that the rope will be covered from where it leaves the reservoir to where it enters the soil surface at the pot.

To make it easier to thread the rope into the tubing, apply a small flame gently to the free end of the rope so that it melts down a bit, this keeps the core and outer layers of the rope together and makes passage through the tubing easier. I used a needle to thread some cotton through the free end of the rope, then holding the pre-cut tube vertically, allowed the needle to act as a weight and pull the cotton through the tubing from end to end. I could then grab the cotton and use it to pull the rope through the tube so there was rope hanging out each end of the pre-cut tubing.

To make the reservoir, I recycled a two litre plastic milk bottle. I cut a cross up near the top of the bottle and inserted through it enough of the rope so that it went down to the bottom of the bottle and coiled around a bit. I then inserted the plastic tubing around the rope so that it fitted through the hole leaving no rope exposed.

I place some potting mix into the pot so that it was about a third full, then took the free end of the rope and ran it down onto the soil surface. I placed the plant in place and then filled the pot with potting mix, ensuring the rope wick is fully covered with soil. I then filled the bottle with water. Make sure the bottle lid is not on so tightly as to cause a vacuum as the water is drawn from the bottle, otherwise the water will stop flowing.

The water should move along the rope wick by capillary action and you can see the progress of the water through the clear tubing. It took a few hours to move along the 40cm or so of the wick I made and you could see the progress of the water through the clear tubing..

9.0 Self Watering Containers

9.1 Self watering PET bottle pot

One of the great ideas that has been developed in recent years to help us out with the long hot summers is the concept of self-watering pots. That is to say, pots for growing plants which have a built in reservoir of water, which keeps the plants hydrated. As usual, the idea has been latched onto by pot manufacturers but they seem to have missed the point. The commercially available self-watering pots have a very small reservoir and tend to be gimmicky, rather than a serious alternative to standard plant pots.

Making the Pots

1. To start out you will need a bottle that has enough volume for the roots of the plant to grow, so use at least a 1.25 litre bottle, although a 2 litre or 3 litre bottle would be even better! And don't throw away the lid, you will need it.

2. Using a sharp knife (and wearing a solid leather glove on your non-dominant hand, I'm just sayin') cut around the bottle about two thirds the way down towards the base. The top will be the growing space and the bottom will be the reservoir, and now you just need to connect them. This will be done with some wicking material, I use synthetic rope. Natural fibres can also be used but will rot down in time.

3. Nylon or polyester braided rope is ideal (polyethylene is hydrophobic and so not a good choice). Unfortunately quite often the material which the rope is made from is not put on the label, in which case you could ring or email the company to find out or just use one which is labelled if you can find one. I was able to find some labelled as being polyester where other types from the same manufacturer were not labelled.

4. Cut sufficient length for your wicking material to go from the bottom of your reservoir up to a least half the way up your growing area. If you are using a synthetic wick, apply a bit of heat to one or both ends to melt them, it will stop the wick fraying and make it easier to get though the bottle lid. Since the material is a wick and not a tube, this will not affect its ability to conduct water.

5. Drill a hole through the centre of the lid approximately the same size as the wick you are using, I used 6mm wick so I drilled a 6mm hole. Push the wick up into the growing area, ensuring you leave enough length for it to get to the bottom of the reservoir and coil around a bit.

6. Fill the top section with growing medium and the bottom section with water, assemble you pot and install your plant!

There will be no more coming home after a weekend away at the beach (well, it's hot, right?) to find all your beloved pot plants have dehydrated and died.

9.2 Making a Self-Watering Container

Growing veggies in containers is a good way of growing your own food if you are pushed for space, don't own where you are living and may need to move or have difficulties with the planting, cultivating and harvesting at ground level. Container growing has a lot to recommend it, but it also has a downside in that the containers will dry out much more quickly than veggies in the ground, one hot afternoon and they are wilt city!

So what is the answer? The self-watering container, originally marketed in the US as an Earth Box and now available in Aus, but you can also make them yourself. In principle, they are a container with a layer of growing medium on top and a water reservoir in the bottom and a structure that allows the growing medium to contact the water and wick it up to the plants in the growing medium by capillary action.

A good container to start with are those rectangular storage containers on wheels, you can buy them almost anywhere these days, I used ones 542mm long x 310mm high x 385 mm wide , 280mm high from bottom of growing chamber to top of rim and a volume of 55 litres.

It is best to get the opaque ones made of black or dark blue plastic rather than the clear ones which suffer horribly from degradation due to the sun's ultraviolet light. The clear ones will turn very brittle in about 12 months whereas the black ones I used have been in use in the back yard for over 5 years and show no signs of falling apart.

To make a self watering container I followed the process below and got to the point where it only took me an hour to whip one up –

1.Cut out the inner part of the lid to form the base of the growing chamber – use a jig saw by drilling a 6 mm hole and inserting the blade or starting the saw on an angle and slowly bringing the saw blade down into contact with the plastic. As you cut the rim off, stay as close to the outer rim as you can and when you are finished retain both parts.

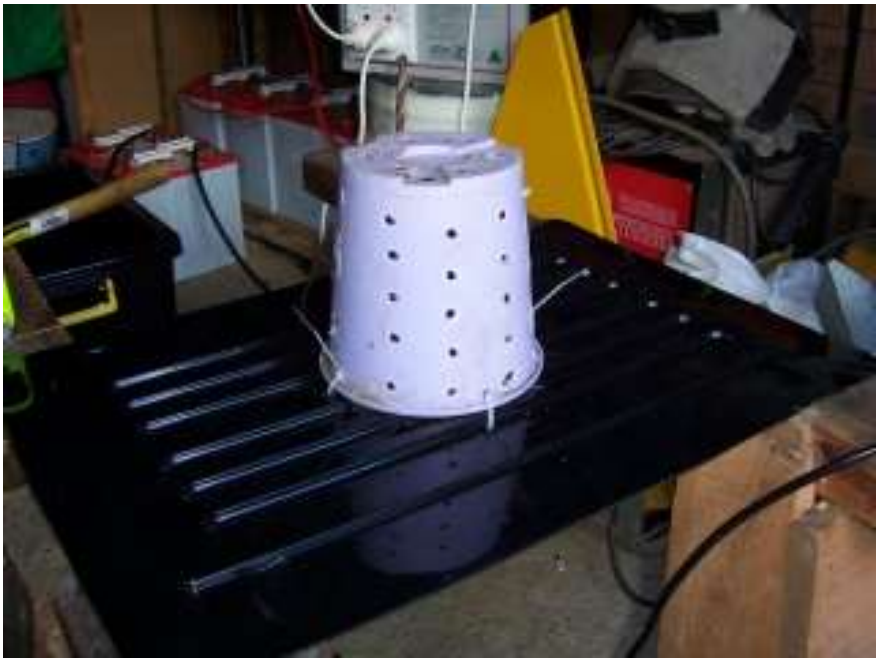
Note: This process is noisy as buggery so wear hearing protection at all times when using the jig saw and where there is any chance of flying materials always wear eye protection.

2.Use a Stanley knife or equivalent to trim off any plastic waste from the base.

3.Select the flower pot that you are going to use as your capillary well, one about 125 +/- 5mm is a good size. To allow water access to the material in the pot it needs to be perforated. This may be done by a drill, but it is probably quicker to use a pad punch and a hammer with the pot placed over a piece of scrap timber secured in a vice. The holes should be around 6mm in diameter and placed in rows up and down the pot.

4.Measure the diameter of the pot and mark a circle slightly smaller than the pot (say about 2cm smaller than the pot diameter) using a pair of dividers on the top of the base that you just cut out.

5.Drill a 6mm or so hole just inside the scribed line, insert the jigsaw blade and cut out the scribed circle. It is important to be aware of what you are cutting onto…….if the saw gets hard to push you may be disfiguring your table or saw horses. (I'm speaking from experience here!)



6.Drill or punch four holes equidistant from each other around the top of the pot. Place the pot top down on the base and over the hole you just cut out. It should be resting on the surface that will become the underside of the base. Drill four 6 mm holes in the base so that they line up with the holes in the top of the pot. Attach the pot to the base using four cable ties (I used 100mm x 2.5 mm cable ties, you will need 20 for each earth box you plan to build.) and then using side cutters, cut off the end of the cable ties.

7.It's now time to attach the supports so that the base that will support the growing medium won't wind up filling the water reservoir. I used 80mm diameter PVC pipe, because that is what I had but other things, even more pots if they are the same height, could be used.

8.Measure the height of the pot and then cut off 4 lengths the PVC pipe, I found a little band saw works very well for this but there is no reason why a hand saw would not do as good a job.

9.Drill the 4 equidistant 6mm holes again, around 6mm from one end of the cut pipe and then place the pipe on the base and drill a corresponding hole in the base and attach each piece of pipe with the cable ties. The base should now sit in the box and be stable. You should now drill a series of holes, say 6mm (1/4") through the base to allow transfer of oxygen and rainwater to drain into the reservoir below, I drilled them around the perimeter of the base and between each of the stiffening ribs.

10.In one corner of the base drill a 25mm hole using a speed bit or auger to fit the 25mm outside diameter plastic filler tube. Cut a length of tube so that when the tube is resting on the bottom of the box, it protrudes 25mm or so above the top of the box. Then chamfer the lower end of the filler tube so that one side is cut away, allowing water to be run into the bottom part of the box as needed.

11.Place the base into the box and drill two drain holes (around 6mm diameter is fine), one in the middle of each of the long sides of the box just below the level of the base, the idea being that when the water reservoir in the bottom is full, it will announce this fact by spurting water out of the drain holes.

12.The box is now ready to assemble by placing the base into the box and filling the top section of the box with potting mix, planting the veggies and then putting mulch on top.

Normal hay, straw or other organic mulch can be used or black plastic may also be used by putting it on top of the box then re-fitting the rim of the cut-out lid and making cross cuts in the plastic where each of the plants is to go. The black plastic will maximise solar heat in winter and keep weeds down but will not break down and add fertility to the box.

Almost any veggie can be planted in the completed box – a half a dozen brassicas, or eight lettuces, or a dozen shallots or you could fill it with herbs, the possibilities are endless. This year we grew ginger in one and had the best ginger crop ever!

You can also put liquid manure into the water that you fill the reservoirs with to water and feed your veggies at the same time. To fill the reservoir, I just run a stream of water from the hose into the filler nozzle until water gushes out the holes in the side, or top them up with a watering can and with a full reservoir you don't have to worry about going away for the weekend or a week.

2017 update

The self-watering containers are still working well in our backyard, some seven or so years since I put them together, and I thought I would mention what I have learned in the interim –

- Leave the plastic mulch off! It only cuts down on oxygen transfer between the atmosphere and the soil. Regular organic mulch works much better in the long run.
- Unless you have intentions on pulling things to bits regularly, cable tying everything together is not necessary. It can help to keep the central pot in place, but if you get a pot with a lip and then cut the hole so it is a bit smaller than the lip, it will support itself.
- Just to re-iterate – you really do need the black containers, preferably labelled as shock resistant or some-such. I was reading a garden book the other day where they talked about making these self-watering containers, but the pictures were of the translucent ones. Seems to me they had written the book from a theoretical rather than a practical experience perspective. (just sayin')

9.3 Making a Self-Watering Container from a 20 litre Bucket

The rectangular self watering containers described in another above work very well for growing a number of veggies in the one container, but if you want to grow one larger plant like say a tomato, capsicum or eggplant then the 20 litre bucket (or buckets) may be the one for you. They are also quicker, cheaper and easier to construct and so are a good way to start out, plus you can make up as many as you want to plant the number of crops you want to grow. Needless to say recycled buckets are the way to go, cheaper and more environmentally friendly; we get ours from a local hardware that gets them from the delicatessen next door. They have been used to ship and store cheese curd so they are food grade and can also be used to store dry goods such as flour, grain, sugar or pasta etc if you want. Herbicide or pesticide buckets should not be used for this purpose (obviously).

For each container you will need –

- Two recycled plastic 20 litre buckets (complete with lids if possible, although you will only use one lid per container).
- One small plastic pot approximately 90mm (or a bit less) high by 100mm wide.
- One 500mm length of 20mm wide plastic pipe as a filler.
- Two cable ties.
- 20 litres or so of good quality potting mix, homemade if possible.

Plus the following tools –

- Hand or electric drill plus –
    - One 6mm or ¼ inch twist bit (roughly, a bit bigger or smaller is OK)
    - One 20mm spade bit (or at least a spade bit slightly larger than your filler tube)
    - One hole saw, large as you can manage but 50mm is good.
- A jig saw with a blade designed to cut plastic
- 6mm (or so) hole punch and hammer
- Side cutters or scissors
- A black permanent marker

To make your container –

1. Take the container you intend to be the inner one and mark out where the pot is going to sit by placing it directly in the centre of the outside bottom of the container and drawing around it with your permanent marker. As luck would have it I could leave out this step because there was a raised plastic circle on the bottom of my containers that was more or less the same size as the opening of the pot I was using.

2. Then drill a whole stack of 6mm holes in the bottom to allow exchange of air and water where required and drill one hole on the inside of your marked line so that it is just touching the inside of the line or raised circle as it was in my case. Be sure to drill two holes on opposite sides of the centre circle to allow fitting of the pot. Also allow a 50mm or so area of the bottom of the container to be free of holes so you can drill the filler tube hole there.

3. Take the jig saw and poke the blade through the hole you drilled next to the centre circle and cut along the inside of the inner circle so that it is entirely removed and discard the bit you cut out, or throw it at your kids, either is good.

4. Using the hole punch, punch a few holes around the sides of the pot and two at the top, on opposite sides of the top. Using a hole punch in this case is generally easier than a drill of the pot has very thin walls like mine did.

5. Fit the pot on the bottom of the inner container by placing it over the large hole and fixing it in place by running a cable tie through each of the holes at the top of the pot and then through the holes you drilled each side of the 100mm hole in the bottom of the container. Pull them up tight and cut the excess off with scissors or side cutters etc.

6. With the spade bit, drill a hole in the bottom of the container about 25mm in from the side in the area you left for it when you were drilling the 6mm holes. At this point you can also drill a 20mm hole in the lid for the filler tube to pass through.

7. Take the filler tube and saw one side away at the bottom on an angle of about 30 degrees to the side so that water being run into the filler tube can get out into the reservoir quickly.

8. Insert the inner container (now full of holes and complete with fitted pot) into the outer container. Drill a 6mm overflow hole in the side of the outer container at the level where the bottom of the inner container sits. You can measure down or just take the whole assembly out in the sun and look for the shadow that the bottom of the inner container makes on the side of the outer one.

9. Fit the filler tube into the inner container. It should be long enough to travel down to the very bottom of the outside container and still stick up a centimetre or two above the lid when it is in place. In my case 500mm was perfect and allowed me to get two filler tubes from one 1 metre long section of tube.

10. Drill your 50mm or so hole in the very centre of the container lid using the drill and hole saw, if you are lucky there will be a mould mark at the exact centre of the lid on either the inside or outside. If you are unlucky, draw two lines at right angles across the diameter of the lid and drill where they intersect.

11. Fill the inner 20 litre bucket with your potting mix and plant your tomato, capsicum or whatever in the centre of the container so that it will come out of the central hole drilled into the lid. And then fit the lid so that the filler tube is also protruding from the top of the lid.

12. Fill the water reservoir in the bottom of the pot by pouring water down the filler tube until water can be seen coming out of the overflow hole – and you're done!
This style of self-watering container does not have as big a reservoir as the rectangular type so you will need to top it up a bit more often, particularly initially as the water wicks up into the potting mix, unless the potting mix was very damp to start with.
Despite the number of steps, these containers are much quicker to build than the rectangular ones and I set up a small production line and made five of the things in less than half a day. They are well worth a go, and will make veggie growing simpler and easier for you, as well as making it easy to move your crops around to catch the best sun, even with a full reservoir they are easily portable by trolley.

Update December 2010

You can't say I only talk about successes on this site, because here is one of the failures. The bulk potting mix that I used to fill up the 20 litre buckets seems to be somewhat deficient in nutrients and so the resulting tomato crop has been more than a little disappointing (insert swear words appropriate to your area here). The next trick will be to get hold of some good quality bagged potting mix and replant with new seedlings. In the words of a well known philosopher - "bugger!".

10. Conclusion

With the inexorable heating and drying of western Sydney, I have spent the last 10 years researching and then experimenting with different techniques to try and cope with these environmental changes and yet still grow our own food. The Journey has been an interesting one.

The journey was made even more interesting when, in early 2020, due to our water supply dropping below 40% Sydney moved on to Stage 2 water restrictions. While Stage 1 water restrictions had been in for months, they were fairly mild, but stage 2 water restrictions prohibited the use of reticulated water hoses for irrigation of gardens. This caused me to re-think my irrigation strategies, because all of a sudden I was totally dependent on our stored rainwater tanks, and those were not full!

Things had gotten real!

Fortunately I only needed to do some comparatively minor modifications and reshuffling to come up with a workable system, the bone were already in place, I had good techniques at my finger tips and I was familiar with using them. This, I suppose is one of the Great Lessons of my experience: don't wait for things to hit the fan, start setting up now!

As I write this in Mid-Winter 2021, our previous summer saw an increase in rainfall and a moderation in temperatures such that our water storage for Sydney is currently at 95% and water restrictions seem a long way away.

The thing is, however, that Australia is a drought country and climate change is still operating so I know that the hot and dry will come back. I also know that we will be ready for them, and so can you! Start experimenting with the techniques in this book and find out which ones make the most sense for you and your situation. Take the time to work through them and be comfortable with them, because even in wetter times, these techniques will allow you to grow food with a reduced water consumption, and that it a win for us all!

11.0 Resources

Books

Gardening with Less Water – David A. Bainbridge – Storey Publishing (US) 2015 ISBN 978 1 61212 582 4 – This is not a big book but it is chock full of techniques we all should be using. Part 1 of the book covers the techniques: buried clay pots, porous capsules, deep pipes, wicks, porous hose, buried clay pipe and tree shelters. Part 2 is about taking it to the next level and covers water-wise gardening tips, rainwater harvesting, landscaping for water catchment and developing a plan. If you are concerned about the water used in your garden, you need this book in your library. The book has lots of colour sketches and colour photos.

Create an Oasis with Greywater (6th Edition) – Art Ludwig – Oasis Design (US) 2015 ISBN 978 0 9643433 3 7 – This book describes how to choose, build and use 20 types of residential greywater re-use system in just about any context. It explains how you can put together a simple greywater system in an afternoon. It also talks about how you can integrate it with water efficiency, rainwater use and food production. It does reflect the US experience so some approaches may not work in Aus and some products may not be available. Obviously, any discussion about laws etc. should be taken with a grain of salt! Lots of black and white photos and line drawings.

Water Storage – Art Ludwig – Oasis Design (US) 2011 ISBN 978 0 9643433 6 8 – This book describes how to store water for the home, farm and small community. The book talks about general system design principles, avoiding common mistakes, different kinds of storage and working out how much water you need. Also covered is how to work out the best material for your storage container, plumbing details and real life examples of storage designs. As for the previous book this is US based. Lots of black and white photos and line drawings.

Rainwater Harvesting for Drylands and Beyond: Volume 1 – Guiding Principles – Brad Lancaster – Rainsource Press (US) 2013 ISBN 978 0 9772464 3 4 – While the drylands referred to in the title are mainly the ones in the US there are lots of ideas here which will work well in Aus. The intro talks about the author's journey around water, the first chapter

talks about rainwater principles and ethics. The second chapter talks about assessing your sites water resources and chapter 3 is an overview of harvesting water with earthworks. Chapter 4 covers integrated design, bringing in the effect of the sun on design, but chapter 5 – An integrated urban home and neighbourhood retrofit, I found to be most useful. Lots of B&W photos and line drawings.

Rainwater Harvesting for Drylands and Beyond: Volume 2 – Water Harvesting Earthworks – Brad Lancaster – Rainsource Press (US) 2013 ISBN 978 0 9772464 1 0 – The introduction covers how earthworks are defined, their advantages and a success stories. Chapter 2 covers the process you can use to assess your site and the next 10 chapters cover various water harvesting techniques including berms, French drains, terraces, infiltration basins, reducing hardscaping, swales, check dams and vegetation. The last chapter covers greywater and there is a motivational epilogue. While the title may not lead you to think there is much here for the suburban landscape it is a good book for the rural and suburban experience. Lots of B&W photos and line drawings.

Good Gardens with Less Water – Kevin Handreck – CSIRO (AUS) 2008 ISBN 978 0 643094 70 3 – The book covers how to improve soil structure to maximise water retention, selecting drought tolerant natives and exotics, working out how much water to apply to different plants, rainwater harvesting and use and how to avoid problems with greywater in the garden. Good info but not much on the productive garden and not particularly organic. Lots of colour photos.

The Water-wise Garden – Jeffrey Hodges – Viking (AUS) 2008 ISBN 978 0 670 07109 8 – This one IS nicely organic in approach! The book gives some theory around how plant use water and what effect this should have on watering practices, creating “water use” zones and improving the water-holding content of the soil. There are also sections on fertilising and dealing with pests and diseases using organic methods and the capture and use of rainwater and greywater. The book has a small number of colour photos and a few line drawings.

Watering Systems for Lawn & Garden – R. Dodge Woodson – Storey Publishing (US) 1996 ISBN 978 0 88266906 9 – The introduction talks about options for plant watering and the next chapter asks asks the question, “is irrigation practical?”. Freshwater sources (including spear point well) are discussed followed by recycled water for irrigation. Following chapters

cover moving water by pump and by gravity, surface, overhead and buried irrigation options and irrigation fitting and getting your system operational. As usual, the experience is US and so laws mentioned will not apply and not all products will be available. Lots of line drawings.

The Water Efficient Garden – Wendy Van Dok – Water Efficient Gardenscapes (AUS) 2002 ISBN 0957765525 – This is another small book with lots of great ideas. It starts off (after an intro which asserts we have enough water, but it is where the water is, geographically) with how to reduce you demand in the house and garden including working out a water budget. The next section talks about techniques for storing water in the soil, followed by one on how to supplement or replace tap water, with rainwater tanks etc. The final sections cover how to irrigate efficiently and how to minimise water loss. A great little book! Mostly B&W photos and line drawings with a few colour photos thrown in to confuse you.

The Wastewater Gardener – Mark Nelson – Synergetic Press (US) 2014 ISBN 978 090779152 2 – Again, this is not so much a "how to" as a "what I did" type of book! This guy does seem to know all there is to know about constructed wetlands and has worked putting them in and running them all over the world, including northern Australia. He was involved in the Biosphere 2 experiment and for 2 years managed their sewage treatment wetlands. He calls them wastewater gardens and has developed them in Algeria, Belize, the Bahamas, Indonesia, the Philippines, Spain – all over the world and this book is a distillation of his experiences. Lots of B&W photos and some colour photos.

Every Last Drop – Craig Madden and Amy Carmichael – Random House (AUS) 2007 ISBN 978 1 74166 888 9 – A detailed book on the theory and practice of saving water with a main focus on the home but some discussion around the bigger picture such as agriculture, desalination and water politics as well as a section on resources.

Waterwise Gardening – Kevin Walsh – Reed New Holland (AUS) 2004 ISBN 187706901 9 – Lots of good info, he covers waterwise design, mulch, the pros and cons of different watering systems as well there is an extensive section on drought tolerant plants although most of them tend to be ornamental rather than productive. There is also a good section on soils. The book strikes a good balance between theory and practice.

Water – Not Down the Drain – Stuart McQuire – Alternative Technology Association (AUS) 2008 ISBN 978 0 9578895 6 9 – This one is probably THE water book to have. Not all the

material in it is aimed at the urban/suburban householder but has stacks of good information. It covers why and the how of saving water, how to work out how much water you have available from various sources and then goes into detail about rainwater, greywater and the toilet and waste water treatment. Well worth having in your library!

The Water Efficient Garden – John Archer, Jeffrey Hodges and Bob LeHunt – Random House (AUS) 1993 ISBN 0 09 182569 5 – Don't let the maple leaf on the cover fool you, this is an Aussie book! It is a great book, particularly if you want to design an urban watering system, although the book does start off with the basics about soil, plants and what makes a water efficient garden. There is also good data on setting up a system for productive plants rather than just straight ornamentals.

Waterwise House and Garden – Alan Windust – Landlinks Press (AUS) 2003 ISBN 0 643 06800 7 – There is a good emphasis on planning with this book, and detail on waterwise options and strategies that can be adopted to improve water efficiency, both inside the house as well as outside in the garden. There is also a good section on what to do during a drought. The section on selection of drought tolerant plants does focus on ornamental species.

The Earth Garden Water Book – Alan T. Gray (Ed.) – Earth Garden Books (AUS) 2004 ISBN 0 9586397 2 8 – This is a series of articles about water harvesting, usage and conservation from the pages of Earth Garden Magazine. Some of the subjects discussed in these articles are of more use to those with a bit of land or in a rural area but there is still much of value in this book for the urban/suburban dweller. The articles in the book are arranged around collecting, purifying, conserving and re-using/recycling water and there is an excellent section on water saving tips as well as a chapter on water saving suburbs showing how others in the city have done it.

Drip Irrigation – For Every Landscape and All Climates – Robert Kourik – Metamorphic Press (US) 1992 ISBN 0 9615848 2 3 – There is not a lot of books around on drip irrigation and this is a good one. While this is primarily suited to the suburban dweller, irrigating trees, shrubs and veggie patches there is also a chapter on irrigating containers which would be of value to the urban grower. It is quite a technical book covering the how and why of drip irrigation in some considerable detail.

YouTube

https://www.youtube.com/watch?v=4AGbqrTek44&t=3s – Making and Installing Clay Pot Irrigation - Under the Choko Tree

https://www.youtube.com/watch?v=wsoT0z596GY&t=4s Making a Deep Pipe Irrigator - Under the Choko Tree

https://www.youtube.com/watch?v=mYVWrAfYwf8&t=1s – Installing a Deep Pipe Irrigator - Under the Choko Tree

https://www.youtube.com/watch?v=NYt7P2t7YLs&t=7s – Making a Deep Pipe Reservoir - Under the Choko Tree

https://www.youtube.com/watch?v=-TQY4_NgSDo&t=6s – Making a Self-Watering Pot from a Plastic Bottle - Under the Choko Tree

https://www.youtube.com/watch?v=eQ2qAID4XSU – Making a Buried Capsule Irrigator - Under the Choko Tree

https://www.youtube.com/watch?v=E0uUIR7Hy_E – Making and Installing Buried Pipe Irrigation – Under the Choko Tree