

# Wicking Beds by Terra Perma

## A Duncraig Edible Garden (DEG) Workshop

The most precious gardening resources are **water, soil and sunlight**. How can we have a productive garden through summer but not squander Perth's rare precious resources of water and soil fertility.

For high productivity vegetable gardens especially heavy feeding annuals we either need to clay sandy soils or garden in containers. Other options result in most water and nutrient leaching away. In this workshop we concentrate on creating a liner to containers the water and nutrients, for more information on claying soils and other soil building see our soil notes.

Wicking beds are an appropriate technique as they capture the water which would otherwise quickly seep down through our sandy soils (away from our plant's roots) taking our hard fought, invaluable nutrients with it. Once captured in the base of the wicking bed, the capillary action of the soil holds and draws up that same nutrient laden water as necessary to meet the needs of the plants.

We found that a wicking bed can be produced on any scale and its design can be adjusted to cater to the size of the container or garden bed desired.

In constructing these beds, we focus on keeping costs low, reusing discarded materials and, in the case of the larger garden beds, the longevity of the bed (in combination with the impact the bed material has on the quality of the soil – I'll explain more on this later). So you will see we have evolved (after much trial and error) to food grade import olive barrels cut in half, old styrofoam fruit boxes and with the bigger inground beds, clay as the liner.

The wicking bed barrels and small boxes are not meant to be any more sophisticated than a self watering pot, but on a potentially larger, more cost effective scale.

### What's a wicking bed?

Glance at the diagram over page illustrating a Generic Wicking Bed while you read the following to get a picture of what is discussed. Further we have included specific examples of the types we have used which will also clarify things much better than a bunch of words.

A wicking bed consists of a **Reservoir Zone** at the base which is within a water tight container or bed liner (e.g. clay, black plastic, pond liner, old bath tub ...) and consists of a spacer material to 'hold up' the soil and leave a open water/air reservoir for ongoing supply of soil moisture. The water can be delivered to the reservoir by either just watering the top of the container (smaller containers and barrels) or by including a hose with perforations in it (we use slotted agricultural pipe, but anything tubing can be punched with enough holes to fill bed and not scale up over time) within the design to delivery water directly to the reservoir. The **Reservoir Zone** has a very important **drain hole** at the top to prevent flooding when too much water flows into the bed (e.g. heavy rains – which might otherwise float your plants right out of the bed!).

The base of the **Reservoir** needs to be flat to ensure that there is an even water delivery the length and breadth of the bed otherwise some plants might get too much water whilst others get too little.

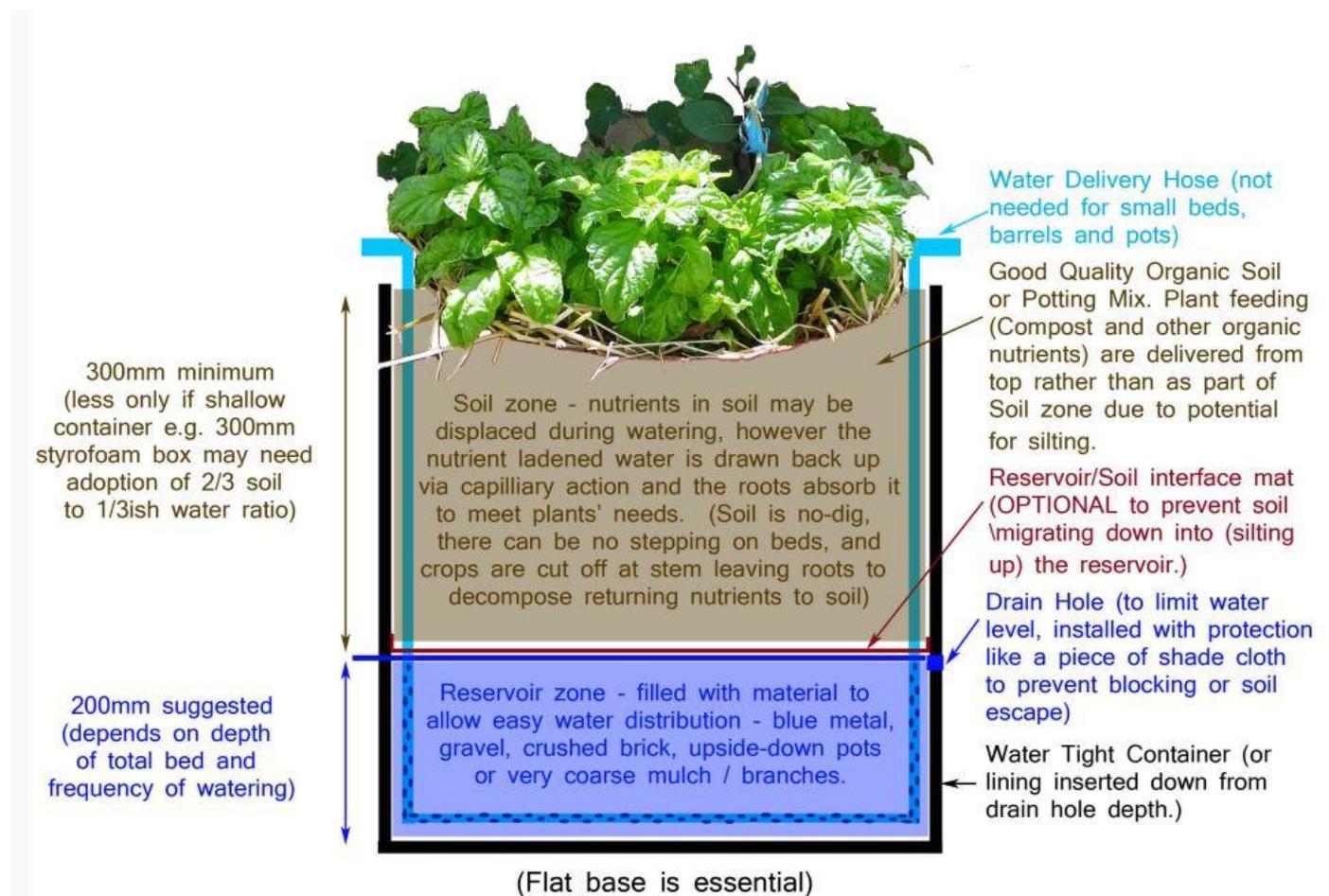
Depending on the size of the bed/container, you may or may not need a **Reservoir/Soil Interface mat** on top of the spacer material. This mat (normally used in the larger garden beds) acts to minimise the silting/sanding up of the reservoir zone, taking up the space otherwise designated as water holding capacity.

Above the Reservoir (and interface mat, if applicable) is the **Soil Zone**. For the container based wicking beds, it is recommended that a potting mix is used (use one containing zeolite, cocopeat/coir, vermiculite –

we use [Green Life Soil's Potting Mix](#) which is available on-line (note that they have not paid us for free advertising!)

The problem with normal vegetable mix is all of the small mobile bits of carbon silt down through the soil and clog up the reservoir zone, hence a non-compacting long lasting 'inert' potting mix is recommended. This inert nature works fine as we are liquid feeding from beneath all the time. You can make up for the lack of fertility in this mix by adding compost and manures as a **top dress** with each crop – the water will take the nutrients through the mix and the capillary action will deliver it to the plant roots.

For larger garden beds, then grab some of that beautiful soil we have been cultivating in other parts of the garden. The larger beds are longer term producers and the speed at which they start pumping out the crops will depend on the initial soil. Starting with poorer soil (i.e. bacteria poor) and composting/manure application will result in a fabulous bed in 3-6 months rather than adding beautiful (but expensive for the volume required, if you have not cultivated it yourself) rich soil (i.e. bacteria rich) immediately and getting a yield within a month.



## The Generic Wicking Bed

Depths defined in the schematic are all dependent on the size of the container and the duty of the wicking bed. The higher the water zone the more water it holds and the less frequently you will need to top it up (NOTE: Don't empty the reservoir and avoid overflowing out the drainage point as much as possible – this is removing the nutrients that have been rinsed out of the soil).

Capillary action is said to work around 30cm in soil, the deeper the soil, at soil point you are limited by capillary action (the top of the soil will stay dry as its more than 30cm from the water) and the more you will need to initially “top down” water seeds and seedlings to get their roots down to the capillary water zone started .

## Why use a wicking bed?

To grow food in Perth you must cycle your soil fertility and stop water/nutrients leaching through our sandy soils. Wicking beds stop the nutrient laden water from leaving the root zone and allow the roots/soil to take it back up as the plant's needs. They act like a natural water table passively keeping soil moist.

## Why a wicking bed might not suit you?

Stored nutrient rich water in the reservoir zone allows **anaerobic bacteria** to develop. This occurs if the reservoir is does not dry during the watering cycle – i.e. there is a permanent body of water. Anaerobic digestion processes lead to a “pond muck” smell. Having said that, we have not had an issue with this and, to be honest, with our in-ground beds, who knows if they get dry at any point? In the smaller pots and barrels which you might have closer to the house or in a more enclosed courtyard, this smell can be minimised by not overflowing your reservoir and hence allowing the smelly water to exit the pot – water exiting the pot is a removal of nutrients so avoid this, smelly or not! This is, of course, unless nature does it for you with a heavy downpour, in which case you are will have a very dilute overflow and are unlikely to have issue anyway.

Having said that, it is important to understand where any overflow is going to go from this drain hole for aesthetic reasons... i.e. if you have light bricks you may end up with staining from the nutrients. So think about your location and needs – perhaps having a bucket in place (so you can put the nutrients lost from the wicking bed elsewhere in your garden) or place the bed so that the drain hole is above a mulched or grassed area.

If you are worried at all about smell, start with a small system and see how you go. We have not needed to do anything special, but if you are worried then there are various options you can consider. One being the discussions within the Permaculture community occurring at the moment (mainly for those is warmer wetter climates than ours i.e. QLD) who are looking at using Bokashi to manage the effect of the anaerobic digestion. Feel free to research it yourselves but as far as I can tell Bokashi refers to a select group of microorganisms – fermenting cultures – which compete with the other anaerobic bacteria to process the organic matter available. The difference being that these cultures break down the organic matter in a way that is odourless.

Wicking beds are prone to being always wet environments, therefore if the plants prefer **freely draining soil and roots are prone to rot**, then this is not the bed for them.

**Recently we have started putting in two drain points one at top of reservoir for dry weather and one at 1 inch from the base of the reservoir for wet weather. While the loss of nutrients is a negative wicking pots (not so much clay lined beds) are to wet in winter. Water saturated soil will not grow plants, so if you can't reduce the water going into the bed (the preferred option) you can lower the drain point so the soil can drain like normal soil.**

Similarly **fruit trees and large long-term perennials** will struggle due to the shallow soil depth and tendency for the root ball area to collapse over time.

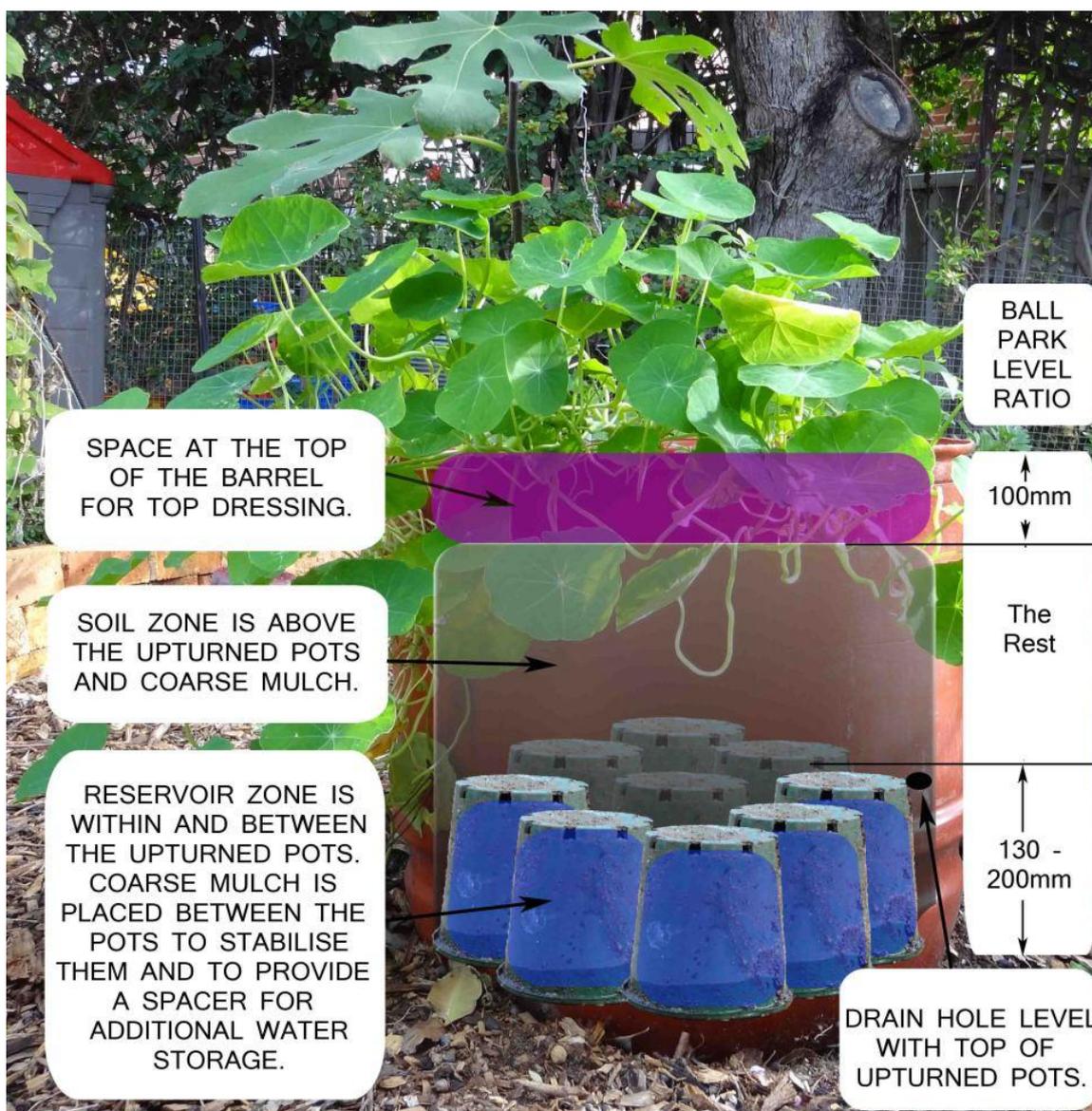
Avoid using wicking beds for fruit trees, instead put a single drain point 1" up from the base of the pot and not bothering with the water zone / wicking arrangement. This stops the root ball drying out and shrinking away from the sides of the pot with the water bypassing around the roots by going down the side of the pot and going out the holes in the bottom of the “normal pots”. I.e. giving the water a longer residence time to hydrate the roots but with a limited volume stored in the pot base.

## What can a wicking bed be made out of?

**Food Grade Olive Barrels** – cut in half (i.e. so you get two) or 3/4 barrel if you want more soil zone.

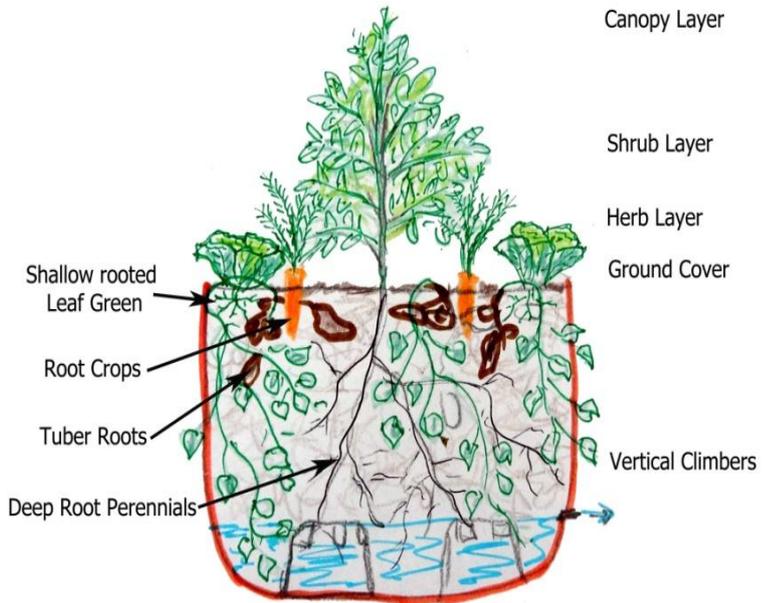
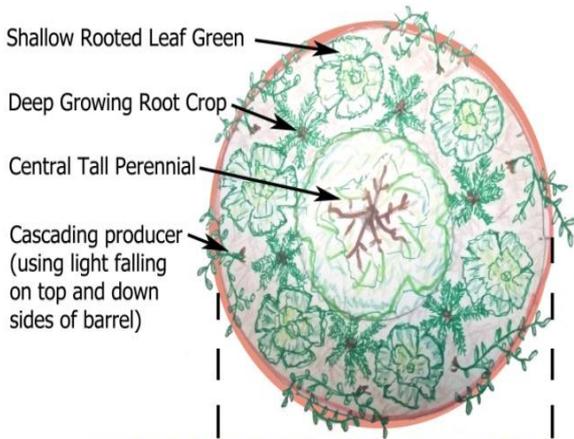


We found in half to be the best performer and you get two for the price of one.



General design applied to the barrel – note that this example is using a 3/4 barrel.

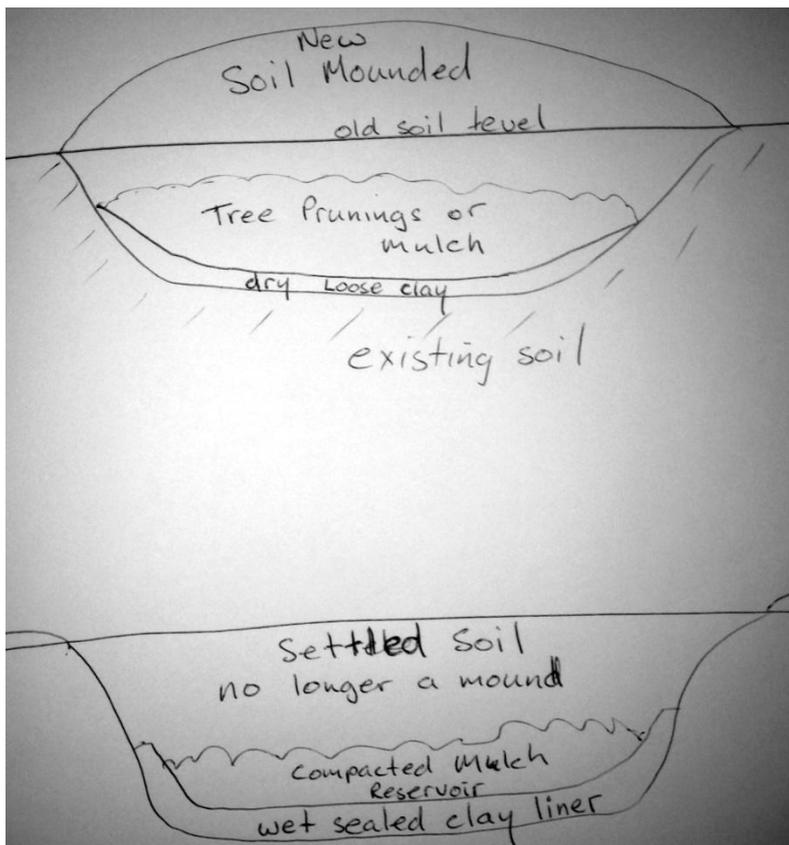
# GENERIC WICKING BED PLANT PLACEMENT



## STYROFOAM BOXES (closed)



## Inground Wicking GARDEN BEDS – (Open)



Line hole with dry clay, your bed sides will need a gentle slope/angle or you won't get a bowl shape out of the clay.

Filled it with “woody waste”. Covered it with coarse tree mulch (in between woody waste as spacer and to support soil better).

Cover mulch/pruning's in soil. The soil is initially mounded up as it will settle into the mulch and you will be left with a hole for a bed.

You can layer/mix bentonite clay, rock dust and kelp in poorer soils, sprinkled on top of the soil. Trial and error – act, observe, adjust....

You may wish to top dress with a purchased vege concentrate mix, or compost, bring in your prepared soil (full of bugs and fungi etc) from elsewhere in the garden, or spend the first few months growing the soil with

green manure prior to planting.

As this was to be a feature for the street and we wanted to encourage a little community interaction (not to say wanting to keep the council on side!), we went for the quick more expensive option of purchase vege concentrate. Out the back, where things could be bare for longer, we used the other two tactics with significant success.

## ***Components Options:***

**Clay liner** – The clay is put in and the water, used to fill the reservoir, causes the clay to expand into a water tight lining. Where there are leak points, the free clay is washed with the leaking water to the holes and is deposited at the gap, eventually filling it. This means that although the bed is more fragile and the clay liner may get damaged by walking on top of the bed, digging in the bed or having roots escape through the base of the bed, the clay has a chance of repairing the smaller holes.

We use clay as it is a long term soil amendment and we plan to move into food forests where everything needs to share all the soil so plastic liners (designed to keep things in and out) are not helpful.

Additionally clay is great for our sandy soils and hence we are adding to the future health of our system by putting the clay in. It does not need to be removed. Clay is costly \$60 a bed.

**Plastic** – Plastic of any form (pond liner plastic, actual pond liners, builders plastic) will provide an immediate seal, could be regarded as more resilient to damage due to walking on and may prove easier to achieve a flat base on your bed. However once damaged, your bed will not hold water; the use of plastic affects your choice of spacer as piercing the bed early in construction would be a disaster; the plastic adds nothing positive to the soil in the long-term and the plastic needs to be removed and disposed of at the end of bed life. 200 micron Builders Plastic is cheap, \$5 a bed.

Use plastic above ground liner if you want to keep tree root or runner grass out of your garden beds.

For inground beds that are adjacent to a Super Six fence, plastic lining is essential as the fence acts as a better wick than the soil and will become the preferred path of water migration, accelerating the drainage of your reservoir.

**Poor soil** – Sand poor soil can be put in and composted / manured to develop the soil in situ. This will result in the bed taking 6 months to reach full production then about 18 months of high yield depending on your ongoing support.

**Purchased Soil** - We purchased Greenlife soil concentrate and blended with our own sand (no point buying sand) in their Vegemix.

## **Our experience –**

We cut our teeth on the wicking systems with large-scale garden beds lined with builders plastic and since have evolved to clay unless there is a reason why plastic is essential. We have also adapted the method to much smaller gardens by testing out different containers and have come to the conclusion of small areas, (or large areas where cost is limited) and where rearrangement might be required, the food grade barrels win hands down.

Whilst rectangular beds are still very much the norm in community gardens, these half barrels allow you to start small and grow in a modular manner to limit the cost commitment of an evolving community activity. They also are a strong, cheap and simple reservoir system which is white ant proof and UV stable. Plus they are mobile to enable you to adapt to changes in season, purpose and sometimes just a whim. They also can be used (or/and reused) cheaply and effectively for various other activities e.g. pond liners, small rain collection points. Having said all that, they are not as glamorous (or expensive) as wine barrels and therefore tend not to be “borrowed” from public gardens.

Before you ask, no, we don't have shares in a company that sells these barrels (WA Barrels) and, whilst we like these olive barrels (which were once a waste product, but are now becoming more sort after for purposes such as this! In fact the price has gone up for us as a result of their popularity – curses!), you can use your imagination with what you use. We have found Gumtree very helpful for ideas.

## Bathtubs and Fridges



A internal riser allows you to create an adjustable reservoir in the base of the bath without cutting holes in the side. Place a woodchip or reservoir material in the base to stop the soil silting down and reducing its water holding capacity.

## Wicking Bed Design and Building Procedure

1. Create a flat base, and I mean flat! (use a level or add water). The longer the bed the more important. A slope will see one end too wet and the other too dry. Clear base of any sharp objects that will puncture the liner.
2. Bed is ideally 500mm total depth, 300mm soil (min) and 200mm for the water reservoir. The Duncraig Edible Garden beds have deliberately deep soil (500mm so more than capillary action will work over) as there will be frequent interaction/gardening and top down watering to start seeds and seedlings so we can maximise the growing soil capacity and increase summer proofing by establishing deeper rooted plants in spring.
3. Width and length of bed to suit available space, liner and practical purposes. 1.4m width max if accessible on both sides, 0.7m approx if one side. Can be a bit wider if a raised bed. You can't step into these beds.
4. Place in the water proof liner for reservoir: builders plastic, pond liner, clay, or a container (bath, barrel). you can use this to check it level if you add water now.
5. Locate and place in the fill pipe: access for filling, and running length of bed for good water distribution (speed of filling). Use slotted ag pipe or PVC pipe with holes. This is not needed for small beds and pots.
6. Fill reservoir zone with material that allows for easy water distribution such as blue metal, gravel, crushed brick, or even coarse mulch. Mulch or other organic materials will break down over time, adding more nutrients but requiring yearly refurbishing.
7. At the reservoir soil interface use geotextile, carpet, or similar prevent soil migrating down (silting up) into reservoir for long term (non mulch) reservoirs (i.e. blue metal/gravel/sand). Allow the geotextile to lap up the side of the 'bed' so the soil wont slip past the layer. We don't use a barrier in small pots and wicking barrels as it is not needed.
8. Create a drain hole and consider where to overflow of high nutrient often smelly liquor will go. Drainage occurs at the interface so cut/drill/pipe your drain at that point. Drain should be protected with a bit of shade cloth to prevent soil escaping/clogging, and mossi breeding. Ensure drain can be checked as it can be blocked by worms.
9. Fill with good quality organic soil that's a bit coarse as the water will encourage a bit of compaction. We use Greenlife Soils Potting Mix as our home soil is either sand or compost. This soil must then remain No Dig, No Stepping on Beds, use walk boards if required for access. Crops should be cut off at soil level leaving roots in soil to decompose, helping decompact and fertilise.
10. Some settling will occur, expect to need to top-dress beds with compost or soil to bring soil level back up to top after first crop is harvested.

### NOTES

- The bed can be built in-ground, above ground, or in a container. Use tin, wood, rocks, straw bales, etc for the sides. If in-ground then consider the drain, if it's also underground that will work in sandy soils but not in heavy/clay soils (no drainage)!
- Lined wicking beds are ideal for high yield leafy greens and moisture loving herbs.
- Not good for larger root veggies, fruit trees.
- Allow reservoir to completely dry out to 'pull in oxygen' as water is pulled up into the soil this will reduce anaerobic activity.
- Avoid overflowing your nutrient soup, but still keep drain clear to avoid watering logging in heavy rain and over watering. Ideally have a alternate low drain (creating a empty reservoir) for winter if the bed stays to wet. Try and move or shelter the pots/beds from excessive rain in winter to avoid losing fertility.