The Water Element - Permie Retic.

1. What is YOUR garden vision ?

I have put 2 tons of clay, and 50m3 of street tree mulch on my yard over the last 5 years as I aim to turn the entire block into a food forest. A solar passive house amidst a semi closed canopy of food plants and highly diverse native support ecology. This is a long term plan, perhaps 10 years in the making until the system will completely look after its self even in Perths tough summer climate. As I have fruit trees, herbs, veggies and companion plants all sharing the soil, it is a lower food yield than most veggie beds, however it is also lower input and long term regenerative.

So what is your vision? Most people are not aiming for this, their plan is quick, short term, high yield vegetables and herb garden (wicking pots and cheap DIY drippers). We need to know the vision before we design a garden, choose a water supply and then layout a reticulation plan.

Also have you done a water audit ? Accurately evaluate how much water you and your family need, including washing, drinking, gardens etc. This will be important when considering your water supply plans and what options or combinations of options are best for you.

2. Make a watering plan

Firstly are we reticulating an existing garden or create a new garden design based on a logical watering plan and soil types. **In eco-logical design we always start by looking at what nature would do.**
In this case nature grows a 'garden' based on the water available in the space, wet lands in wet areas and . Therefore it would be good if we can create a design of a garden (ecosystem based on all the important aspects (See Terra Perma Resources Page - Permaculture Design Heading) and plan our water zones .

2.1 Zoning and Planting Plans- Based these on grouping plants with the same Water Needs

Nature does this by default, that is if the wrong plants germinate in the wrong soil (dry plants in swampy soil) then the plant will struggle and die rapidly. With the convenience of putting water when and wherever we want with simple reticulation systems it is easy to forget this first step in reticulation planning.

Dry Mediterranean herbs such as oregano, thyme, rosemary, sage and perennial vegetables plants and trees will not need loads of water once established. Many natives and 'landscaping plants also have low water needs. We can place these on the same reticulation lines or zone. Moisture loving plants like leafy greens, tomatos, snow peas and broadbeans need frequent watering so locate them together.

This Guide by Josh Bryne has some great info - http://joshbyrne.com.au/wp-content/uploads/2013/12/PM-8731100-v1-WC_Water_Efficient_Landscape_and_Irrigation_Guide_WEB.pdf

In zoning your plantings for their water needs don't forget natures plan, if you have an area that naturally holds more water then use it for your thirsty plants. Effective zoning will also reduce the amount of reticulation stations (solenoids) control valves and adjustable problems you face later.

A garden plan that will help you figure out your reticulation should include things needing to be watered and fixed structures. All pots, garden and lawn areas, any paths or driveways, retaining walls and where your taps are located.

2.2 Soil Water

Rainwater is the best water to use on the garden, following the ecological principle of planting the water before you plant the plant make sure your soil or garden bed can hold lots of water. Make the most of catching all your winter rainfall and keeping it in the top soil of your garden. If it evaporates from the soil surface it is lost and if it sinks down into the deep sand soil (below your topsoil) it is normally lost. Another saying is the best place to store water is in the soil, so all money and effort that increases clay, organic matter and living plant roots/leaves is well spent and should be prioritised above rainwater tanks, and reticulation systems.

Calcium bentonite can hold 5 times its weight in water, and quality compost and humus can hold 6 times its weight in water. So if the best place to store water is in the ground you might want to spent a few thousand dollars on clay and organic matter enrichment of your soil prior to getting rain water tank and fancy reticulation system installed to water you garden in summer. This is passive water harvesting, every time it rains your soil can again hold 5-10 times the amount water than if you had not improved it, that is not including the improved water holding that grows from this much healthier soil food web (fungi and other moisture holding systems).

There are two options to change the depletive action sandy soils - clay or liners/containers.

Either you must increase the water and nutrient holding capacity of your sand with clay, organic matter and dense plant systems in the topsoil; or you need to put a liner under the topsoil (like a perched water table) that stops the nutrients and water leaching out of the root zone.

3. Water Supply and Flow

Cheap and adaptable above ground (hidden in the mulch) black poly pipe based water distribution seems to offer the best DIY option in my opinion.

Small container gardens and larger perennial gardens change over time, therefore we advise putting in reticulation that can also change over time. A plan is handy to get you started and order quantities of pipe and drippers but nature grows and evolves, and so must your reticulation.

There are many specialist drip options now available at places like Bunning's or Total Eden. As recommended and good as Dripper systems are, they too, only work if you have containerised your garden or heavily improved the soil, in deep sand the dripper water simply sink straight down in a narrow tubular space.

3.1 Water supply, Flow and How many Drippers/Sprinklers

Supply

After you have drawn a plan, and realise your water source you will need to determine that sources flow rate. Mains water pressure will vary greatly from house to house based on elevation, supply main size, and other factors. Bore flows will depend on the size of the bore pump providing the water. Rainwater tanks can either be gravity feeding water (low pressure) or utilise a pressure pump to supply water.

Flow

Given all these variables the simple way to test this is to check your flow rate from a tap that is connected to the water source and pressure you will be using to reticulate. A flow test is important as it dictates how many sprinklers you can run at once. To do this you will need a standard household bucket (9 litres capacity). Remove any tap fittings from the tap you want to use and turn the tap on fully, then place the bucket under the tap and time in seconds how long it takes to fill. If you are going to use more than one tap repeat this process for each tap.

Turn your tap full on and time how long it takes to fill a 9 litre bucket

e.g. it might take 20 seconds to fill 9 litre bucket.

Divide 20 by 9 = 2.22 seconds / litre. So for 1 minute, i.e. 60 seconds divide 60 by 2.22 =27 litres/minute. Then for 60 minutes, 27 x 60 = 1620 litres / hour. This is your possible flow per hour out of the tap. We can now use this flow to figure out how many dripper (l/hr each), sprinklers (l/hr each) or how many meters of dripline you can service.

Note while it's nice to know the full potential flow of the tap, most tap timers will restrict the flow from your tap so **measurements should be done when the timer has been attached.**

All drippers, sprinklers and dripline has different emitting rates, and some are variable like our recommended veri-flow drippers. Check your desired fittings.

So to show what your tap can service here are a few examples to help you with the sums.

If the purchased drippers emit 2L/hour each, and they are at 30cm spacing's, that is 6.66 litres/metre. Assuming about 75% of this is deliverable in summer due to drop in water pressure and losses of fittings etc, you would get 75% of 1620, i.e. 1215 litres/hour.

Since the dripline can deliver 6.66 litres/metre. 1215/6.66 = 182m is the length of dripper line you can run. These calculations are not normally a problem for dripline but will need to be done for sprinkler based reticulation.
This is evaluation of flow and calculation of zones/stations/solenoids is essential for micro sprayers and sprinklers as they need enough pressure to make them work and cover the watering area you have designed them to cover.

For example pressure micro-spays generally throw a 2m radius and need between 50-70L/hr for each sprinkler. This means that they need to be installed every 2m and your flow rate in litres per hour divided by 70 will give you the maximum number of sprinklers that can be installed on each zone. Going back to 1215l/hr /70l/hr = 17.35 sprinklers or 2mx 34m coverage (68m2). If you have 200m2 of backyard you want to water that is 3 times your limit. Thus you need to create 3 zones to make sure you supply the pressure/flow needs of the sprinklers.

Veriflow drippers can have their flow adjusted by you as desired /required from 1-50 l/hr each. So if they all run at full flow 50l/hr, which would not be unusual for veggie pots (wicking beds) we can add 1215/50 = 24.3. That is after 24 drippers the flow rate will start to decrease for each additional dripper. You can still put in 50 drippers but they wont be able to all produce 50l/hr dripper flow.

4. Supply options and Limitations

4.1 Mains Treated Water

Every urban house has a mains connection and while this is the normal and obviuos source of water for you and your garden there are other options so it is still part of an informed and calculated water plan. Scheme water prices are on the increase and in coming years (with the same drying trends) scheme water will largely come from Desalination plants (desalted ocean water). This has a high energy cost so mains water prices will rise a lot in the future in Perth. Currently there is a scale for usage the more you use the more the extra costs. Currently cost is $1.3/kL but that will likely rise to $2/kL due to desal costs. A rainwater tank might save you 80kL -$100 this year, $150 in a few years and $500/year in 10 yrs. Now it's not very cost effective, in 10 years time that $2000 tank pays its self off in 4 years.

If you are piping mains water around your yard over extended distances the run of thumb is to use 1" PVC or 32mm metric poly, I recommend poly. A cheap option is to use 19mm soft black poly pipe but this is easily punctured and is not designed for this job. I recommend you use 32mm Blue line if you intend to bury it and have it directly connected to mains supply (no tap isolating it), and save the cheap 19mm black low pressure poly for running on the surface (or in mulch) after a tap has isolated it (can turn that line off and on as you or a timer desires)

I will leave the post tap reticulation system discussion until later as it is much the same as the bore reticulation system and can be discussed together.

4.2 Rainwater

A urban house roof could feed a 30 kL tank but a 10kl tank would be more logical from a space in urban backyard perspective.
This rainwater could provide the house with high quality drinking water for most of the year and, while you could should 'plumb in' the rainwater in the house for toilets and showers, I would isolate it in late winter to ensure your tanks are full when the rains stop.

For me a tank offers premium clean drinking water, so at 10 litres a day for 5 people (50 litres a day) for a large family's drinking needs, the tank 10kl (that is discussed further) would last for 200 days if it was full when the rain stopped (unlikely)and you switched it to just supply drinking water. If it was half full you still have 100 days

of no rain period summer drinking water. Given there is a little summer storm rain Nov-April (6 months = 180 days) you should make it without needing to drink scheme water.

Tank calculating includes daily use, roof area, rainfall, roof type (run off coefficients) and other factors, you can use Tankulator to make it a bit easier. For a 200m2 roof catchment (you need all that to go in the tank), Innaloo rainfall and tin roof (and a guess at a families moderate water usage 400l/day) - See the recommendation over the page.

So the software is suggesting a 10kl tank. Note the tank is only full from June until December each year and that is without a larger draw for summer garden watering needs. Recall its only 400l/day usage. I might put 1000l out in a single watering session, into 2-3 raised beds.

Recall dripline can deliver 6.66 litres/metre/hr so if you had 100m (a decent sized garden), that is 666 litres per hour in watering. At two waterings per week thats 1.2kL so your tank is empty in 1-2 months. This is where the reality that, **rainwater tanks are no good for summer garden watering**, kicks in. Once it stops raining in summer you can empty your tank in 1 week trying to water the garden.

That said rainwater tanks are a good source of clean and healthy (untreated chlorine and fluoride) drinking water, and as a bonus (if you plumb it into your house bathroom usage) it will save you 80 kl of water you would have used from the mains in winter when rain tops up your tank each week.

Rainfill Tanks is a good supplier of metal tanks - In their current pricelist a **10,200 ltr (10 kL) tank** dimensions (2330x2400) is $2,053 in aquaplate or **$2,197 in colourbond**. Incl. Metro delivery delivery . All the costs need to be figured in, and the vision and aims of each part of your water element rationalised.

4.3 Ponds and Aquaculture

When looking at water in the urban backyard dont overlook the function of ponds, these are an essential water element in your ecosystem. You can just have a pond for aquatic plants and wild animals and insects or you can stack some extra functions on that pond. I dip the watering can into the pond to water seedlings for best quality water.

A well set up large pond that has a high fish stocking density (goldfish/koi or you might grow edible fish, brim, trout etc) will need to have its water cleaned of the over supply of nutrients from fish poo and excess feeding. While aquaponics is currently trendy is is very tricky to maintain. One option is to have a holding tank 1000L IBC or 200L olive barrel that you can gravity feed or pump 50% of you pond water to each week. This dechlorinated, nutrient rich water is an excellent water source for you vegetables and trees. You might use this source manually like worm wee in a watering can, or you can connect it directly as a gravity reticulation supply. For further reading and complexity look at fertigation systems where you can filter this nutrient soup and vacuum feed it into a larger full yard automated reticulation system, it could all be automated the reticulation goes into the pond, stirs up the sediment, the overflow goes to your large holding tank and fill each reticulation run.

Soil biology much prefers untreated water supply, note chlorine kills bugs, bugs run the soil, while this should not scare you

4.4 Grey Water

We will just touch on this lightly as its quite a technical topic also, you must change washing habits for this water supply to be used. If we look at the rainfall tank scenario, the family that uses 400l/day will likely create 200l/day of usable grey water. Grey water being sourced from showers, baths, laundries (not kitchen sinks or toilets). That equates to 1.4kL per week of water that could be used to water trees and other garden areas (we dont recommend using grey water on high yeild veggie beds even subsoil as it will salt/contaminate you soil food web). Grey water is best used on trees and open soil where winter rainfall will leach away any buildup of washing soaps and other bodily debris.

Grey water production is not dependant on rainfall, thus we produce and can catch the same amount of greywater in winter as in summer. In winter we dont really need grey water in the garden but in Perth free draining sandy soils and unpredictable climate a little too much water is better than to little. Grey water is a very helpful permie garden ecology (trees trees and more trees) watering option.

Dripline and subsoil drippers (coloured pruple) are designed for grey water systems, these must emit the water sub soil (or under mulch) legally. As most of our perennial systems are already under mulch this is fine.

So our grey water is providing 1.4kL per week of water during summer. Recall again that dripline can deliver 6.66 litres/metre/hr, so if you had 100m of purple grey water subsoil dripline (a decent sized garden), that is 666 litres per hour in watering. At two waterings per week thats 1.2kL. All this water can come from the 1.4kL of 'waste water' that would end up in sewage systems if you dont have grey water system. **Summarised from below you can have this supply for $4000 (lots of DIY) to $8000.**

Ross Mars Grey Water system is shown below. If you can DIY all but the licensed plumber connections grey water can be a lot cheaper than you think.

The GRS H Filter system is intended for use of the entire house, e.g. laundry and bathrooms, where as the GRS V Filter system is most often used for a single fixture e.g. laundry. We can do full installation including all design and specifications for council applications, typically full installation including any electrical plumbing and general labour to install
irrigation, present at council inspection and handover to client.
Full installation prices fall between $6,000 –8,000 plus GST subject to a consultation/ site assessment

Basic DIY kit starts at $2,500 inc GST Spare filter bag, 80 L poly pump pit fitted with Davey 10m head submersible pump, inlet and overflow connections and galvanised checker plate lid, Biomatt filter with spare cartridge, KRain & Irrigation Kit. **So perhaps $4,000 (incl plumber/council approvals)**

GRS Horizontal Filter Kit details WITHOUT PUMP or irrigation kit RRP $660 inc GST

Basic irrigation kit RRP $440 inc GST.
200m Tiran dripline, 50m x 25mm Purple poly header pipe, 2 x Vacuum breakers, 2 x 25mm purple manual Flush Valves, 20 x 25mm Clamps, 4 x 25mm End Plugs, 2 x Male Directors, 50 x 13mm Take Off's, 7mm Punch, 5 x small Spotter Boxes and 1 x large Valve Box.

4.5 Garden Residential Bores

A garden bore is a good option in most areas of Perth, check with the Water Corporation for your area, some zones have been contaminated and others near the ocean and river have become salty due to over extraction. The Perth Ground Water Atlas will tell you your house blocks subsoil water depth and quality (best guess). Local bore companies will also have a very good idea (as they will have put a bore down in your street already) if its feasible to sink a bore in your location.

The ethics of bores is a little mixed up currently, while the ground water is being over extracted in many areas it is not in most areas of suburbia. Also IF we all actively directed our rainfall that we don't collect into tanks into mulch pits and ground soaks (instead of into storm water drainage or sewage systems) there would be plenty of ground water for home food gardeners. My house has no gutters but I actively stop and sink all water coming off hard surfaces and sink it into my deep sandy soil. Trees and plants get a little benefit but once the surface top soil is soaked all the water then percolates down into 20-30 meter deep sand and limestone shallow aquifers that the garden bores draw off. You bore

may go deeper than these short term zones to get cleaner water but the water is slow filtering down to that point from either your water harvesting or the person down the street.

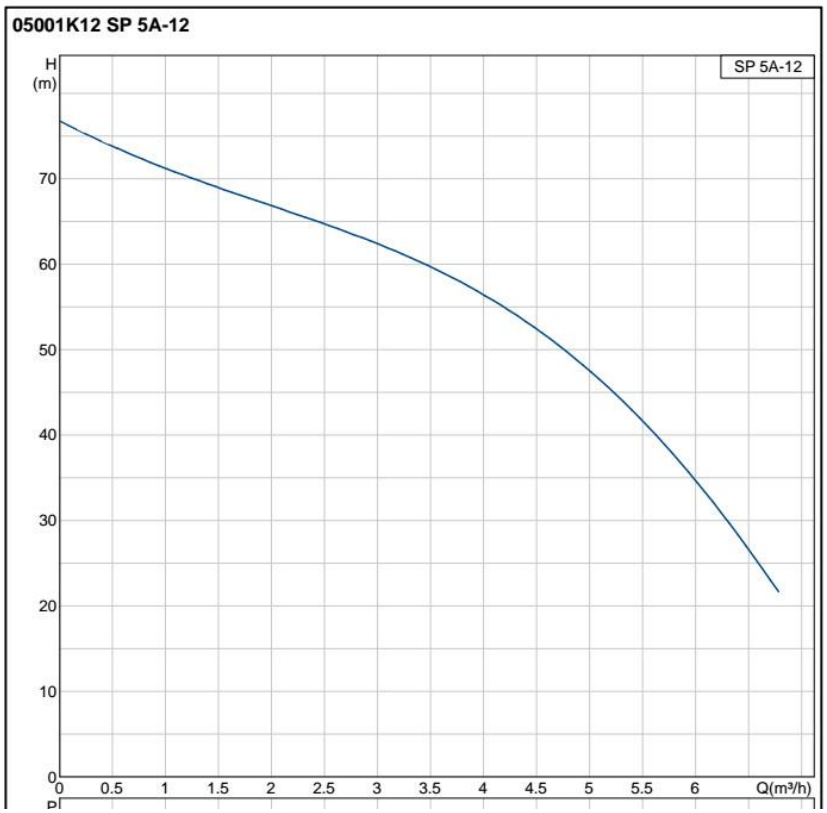
Essentially if we all actively redirected roof, shed, driveway and main roads runoff from rainfall into our deep sandy soil (this is very easy) then bore water would hands down be the best option for urban food growing water supply. Most water is still being wasted on green lawns which is illogical and unethical in our dry dessert like climate.

A bore costs about $100-$120 per meter to drill, line and install pump. That is including the cost of a submersible pump, pump screen section, bore shaft pipe, and wiring to the top of the bore. You will need to pay and electrician another $500 plus to wire your bore into a switch board (if needs 3 phase power rather than 1 (single phase)). If you choose a smaller single phase powered electric bore pump (as I did) you can just have it wired it into an existing GPO that has a current low draw need.

My bore went down 35 meters (quite a deep bore) the depth depends on you height above sea level (just check the Ground Water Atlas - http://www.water.wa.gov.au/idelve/gwa/).

I will discuss the reticulation system in detail later as you will need one for whatever water supply you use. A bore pump has a higher flow and lower head than most mains supplies.

Pumps have a pump curve that is a ratio of possible flow out given a back pressure (head/elevation) on the pump.



You can see from above pump curve at 35 m head (it needs to push water 35 m uphill) my small 1.5kW Grunfos single phase bore pump puts 6m3/hr (6000l/hr) or **100 l/minute out at 35 meters** elevation (backpressure head).

Flow can be limited by pump size, lift (how deep the bore is), and the refilling capacity of your bore hole (what the pump sucks the water out of). If my bore was 60m deep this pump would only supply half the flow, 3m3/hr.

So if the Bore supplies water at 100l/minute (1.67 l/sec) that is it fills a 9 litre bucket in 5.4 sec. This if you recall is much faster than the flow coming out of the mains water taps (20 sec to fill 9l bucket).

Given the flow rate of even a small bore is much greater than the that coming out of a mains water tap (the pressure might be less), the pipework that you used to connect the bore outlet to you reticulation needs to be larger than a mains copper/plastic pipe 20mm pipe. Essentially the smaller the pipe the larger the friction loss as the higher the velocity to water must travel in the pipe. Pipe diameter choice is a trade off between the cost of larger diameter pipes and the wasted energy of friction in pipes that are to small. It is worth discussing with the bore installer the size pump you need for the amount of water and depth of bore (they are the experts and you are already paying for their time).

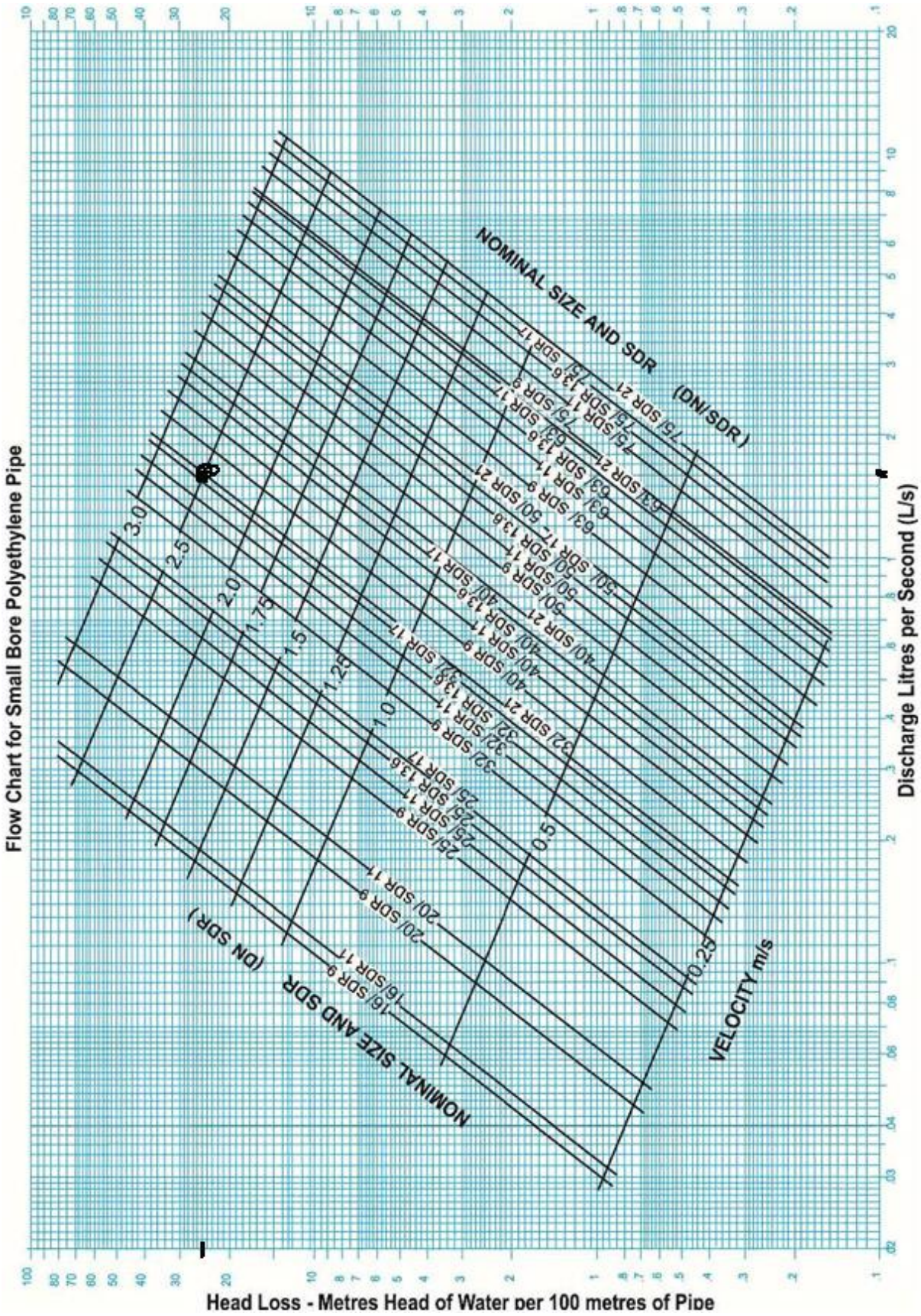
There is a lot of maths that you could go through but start with the standard cheap piping sizes at your local irrigation supplies (I use http://www.perthirrigation.com.au/). Also while there are multiple wall thicknesses (PN values) for higher pressure situations our low pressure needs mean the low end PN 12.5 is more than ample. Even PN 6.5 can withstand 50m of head pressure.

Therefore we choose between, 20, 25, 32 or 40mm OD (Outside Diameter) pipe. We know that high flow rates cause to much friction, and we are going for the minmum size to avoid to much losses without costing to much extra for larger pipe and more importantly larger fittings.

Note: The best tip you will get for sizing your bore reticulation ring/supply main is the outlet piping (the top part of your bore supply line) that the bore guys install. My pump outlet (its sepcifications) was 40mm but the bore guys stepped it down to 32mm with the connections they put on top. So 32mm seemed the obvious choice but we will go through the number shortly. 32mm was the obvious choice to continue on with unless I could get a small cheaper option that did not cause to much friction loss.

Note: While Metric BLUE LINE pipeworks is slightly higher than imperial RED or GREEN LINE (RURAL) the fittings are a lot cheaper, and as fittings will be 3/4 of the reticulation cost I suggest going with Blue line pipe and fittings. This may be different if you live in a rural area and most people use RED and GREEN line. Either pick the most economical one and stick to it in the future.

Note: The costly factor in reticulation as stated above is not the pipe it is in the fittings so the more you reduce joiners, elbows, etc the cheaper it is. Also larger diameter fittings are much more expensive. For example a joiner to connect two lengths of pipe (a compression poly metric slip joiner) : 25mm costs $5.76, 32mm- $8.00 and 40mm - $12.60.
If you expand this to the entire purchase of bits 25mm pipe bore supply will cost half that of a 40mm, so you don't want to choose 40mm OD if 25mm OD will do.



So my choice of 32mm is on the low size and will be creating a lot of friction loss due tothe high pipe velocity (fitting all that flow through that small pipe). 32mm is just ok, 25 mm would not work as that would not even fit on the acceptable/possible pipe sizing graph.

If you want to go through the maths involved with the friction loss of bends, choking points and piping distance this is beyond what we will cover here and likely only something you need to do if sizing a rural pump to supply a distant tank to meet your farms needs.

Go here for more information - http://www.vinidex.com.au/technical/pe-pressure-pipe/hydraulic-design-for-pe-pipes/ - http://www.cheapapumps.com.au/calculate_total_head.html - http://www.engineeringtoolbox.com/peh-pvc-pipes-pressure-drop-d_317.html

For your information this was my bore specifications:

Bore Drilling to Depth of 30m Including the Bore Pump - Grundfos 5A/12 1.5HP and single phase 1.1 kW motor. with a 40mm female BSP pump outlet. Total Cost - $3800

Skip for drill sludge (sand) = $200

Wiring single phase Pump to power board was $500 (it will be more if you need to put in 3 phase power)

2 x Poly Pipe Metric **(blue line) 32 mm** PN 12.5, 50 Metre Coil Sub-total: $144.10
16x 32mm x 3/4" BSP Metric **Tapping Saddle** (2 Bolt)Sub-total: $59.36
6 x**Poly Riser** 20mm x 500mm (3/4") Sub-total: $12.72 (used as tap risers out of the saddle points)
10 x **Poly Elbow** MF 20mm (3/4") Sub-total: $7.40 an elbow to fit to risers to attach a brass tap.
4 x Compression Poly Metric **Slip Joiner**- Poly x Poly - 32mm (the pipe joiner when connecting two 50m rolls.) Sub-total: $33.04
Plus 2 Hunter solenoid valves $50 each Plus Solenoid wiring 100m $50.

Various 13mm pipe, isolation valves, barb sprinklers and drippers to put water to plants approx $200.

Out of the 3/4' tapping saddle outlet I screwed in risers for taps and for most outlets I used 3/4' thread to 13mm barb poly tap (can vary the flow rate). 13mm poly was connected to this and then run into drippers and sprinklers as required (and changeable) over time. This is discussed more later as you use the same system for a cheap mains retic supply network.

BORE WATER SUPPLY TO PLANTS = $5 GRAND

So bores reticulation supplies are not cheap even DIY, but they are water that should be sustainable, and is not treated to make it worse for your garden.

CONSIDER 1 BORE CAN SERVICE 3-4 FAMILIES (houses) you might want to share this cost in an urban area if you have trusted manageable relationships with your neighbours. This is also perfectly legal, and the same bore can run for each street number as per normal bore arrangements.

5. Water Controllers and Timers

Stepping back a bit, it is helpful (I would say essential) to have an automated on/off controller so that when you go on holidays in summer your garden can still be watered reliably and safely every few days. In my situation I have a Bore Pump starting/controlling Reticulation system but a mains controller just opens taps.

We recommend a manual adjustable automatic reticulation water control system and from experience have a mains powered (not battery) powered one. After trying 3-4 AA powered tap timers they have all failed and left the garden to die. To make a water supply automatic the controller must open a solanoid or physical valve, as the water leave deposits on these valves they get harder to open/close, essentially a small AA battery timer stops working after 3-4 months or drains the batteries to quickly to be viable.

Note at this point your 'mains supplied' retic might need a 25psi **pressure reducer** after your timer/controller to ensure you don't 'pop' your system as the head is too much.

You might also go for a filter which is normally recommended, and essential if you are using dripline which one blocked is not cleanable. If your tap timer has a built in filter no extra filter will be needed. If using a twist timer, installing an in line **filter** is recommended for your drip system. It is common to buy all in one threaded tap outlet, 25psi reducer and then filter, this has the same thread as the tap so you just need to make sure you have the 30cm of extra clearance that the all in one unit takes up. Prices range from $10-$20.

Controller and timer wise I have used with success (although the Brand is a 'cheap' one) **Holman Water Whizz 4 tap outlet** (with extra in ground solenoids controllers if required). **$180 or so.** http://www.bunnings.com.au/tap-timer-holman-4outlet-rsr-waterwhiz-co1942_p3120504 or the Motor bike battery type shown below (I don't recommend the more expensive battery option unless you can't avoid it, but this can be run/recharged with a $50 solar panel if your power point are more than 20m away)

The main benefit this has over other reticulation systems is that it fits onto a standard garden tap and gives you 4 zones by directing the single tap into 4 automated individual manifolded tap outlets, therefore you can run 3 dripper lines and 1 garden hose, 2 drippers, a hose and a sprinkler, etc. Each having a individual run days times etc.

So you get 4 idiot proof already wired solenoid valves with your controller. It's not ideal for normal subsoil wide spread lawn retic, but very suitable for our simple DIY flexible food garden permie needs. I have had one working in full weather for more than 5 years so at least the old ones where reliable.

Another interesting timer that I have not tried, but does not have a easy tap supply and requires inground wired solenoid valves is Hydrawise - https://hydrawise.com/pricing/. This is for the techy gardening types or might give your other half something in common that they find interesting about your garden. Despite the fancy wireless mobile phone and computer controls it is not much more than standard retic controllers.

As stated I have not found any of the battery operated timers to be reliable (the small batteries cant turn the valve once it gets a little fouled so last 2-3 months). This system has a power plug based supply (DIY 10m cable run to controller and 10m to tap run) and the battery is just a backup to hold your reticulation settings if the power goes off the mains.

Although designed to be anti-syphon, it is advisable to install a **Vacuum Breaker** at the highest point of the system, especially when you are running subsoil (buried drippers or dripline) this stops the vacuum drawing soil into the drippers and blocking them. This will allow air to be enter the system once turned off rather than suction being placed on the drippers.

If your tap timer has a built in filter no extra filter will be needed. If using a twist timer, installing an in line **filter** is recommended for your drip system.

5.1 Watering days and timer run times.

As a general rule early morning watering is best, but this is important for sprayer and sprinklers more than sub mulch drippers. Wind and evaporation effect sprinklers more and evening spraying can cause mildew with plants staying wet on the leaves all night.

The will be allocated watering days in most areas, so work within these limitations.

Zone run times, or how long to leave the watering on for. This decision is a tricky one and effected by many things, it is situation specific so we will run through the decision making process and factors rather than offering one answer.

The answer depends on how well your soil retains moisture, what part of the growth cycle is your crop in, average temperatures, and how long that piece of string is

Drippers vs sprayers in the same zone.

Regardless of the intial plan and design you come up with in a ever evolving permaculture garden you will need the flexibility to change nad adapt the water supply over time.

Young crops will in general need more water during their growth phase. Longer, less frequent watering cycles encourage deeper root systems that are then more protected on very hot conditions (IF you have improved the soil with clay and organics else this extra deep water will be wasted). All plants can wilt on hot days- this is normal. You just want to be sure they look ok the next morning.

As a vague, very general guide for low flow rate drippers or dripline (2-4l/hr) in good, organic rich soils irrigate for 1 hour every second day for young crops, easing to 1 hour every 3rd to 4th day as they mature. You will need to fine tune depending on crop, soil, and temperatures.

6. Flexible water point Individual Dripper Systems OR Dripper Lines

Pricing First

50 meters of Netafim 13mm Techline PC Irrigation Drip Tube (holes every 300mm) is $74 dollars. So that's effectively 150 fixed point (inflexible) drippers in 50m - $74

50 meters of 13mm polypipe is $15 and a 50 pack of Pope Veriflow Drippers is $29 (150 would cost $87). So the flexibility to place drippers at your desired spacing and adjust to your desired flow costs you $102 or $30 more.

If you are growing veggies in a row in conventional garden beds then the dripline is a logical choice, if you are growing a permaculture garden with plants spacing based on needs or chance or variable pot placements the veriflow drippers make more sense.

The individual drippers can also be run to a pot using 4mm 'Micro' poly fittings. We use these to take the drippers up into the wicking pots to create the best option for these situations. The cost increases a little more but the look and functionality is excellent.

Pros and Cons

Emitters can be attached directly to the poly tubing - usually 13mm or 19mm - or they can be attached to the end of either 'spaghetti tubing' or 'risers'. Spaghetti tubing is 4mm diameter flexible black tubing that is screwed to the main line (13 or 19mm) at one end and the emitter at the other. This tubing is useful for transporting water away from the main line to a shrub or pot plant. Risers are 4mm rigid tubing at set heights (e.g. 30cm) that are also screwed into the main line at one end and the emitter at the other. This allows water to emit above ground level.

Drippers: As the name suggests, they drip. Water is emitted at a very slow rate which means there's very little wastage. They come in several forms, each with different flow rates according to its purpose, and some of them are adjustable. Drippers with very high flow rates are sometimes called bubblers.

Individually positioned drippers are ideal if you've got a lot of containers or hanging baskets. They're also great for small shrubs and trees. Another option is a dripper hose, which is simply a hose with evenly spaced holes along it. Behind each hole is a white plastic grid which determines how much water flows out. Dripper hoses are ideal for vegetable beds or annual beds. They give good, even distribution of water along the whole bed. They're fine to lay under mulch which saves even more water.

The downside to drippers is that they're prone to clogging. There's nothing worse than installing your system and finding it doesn't work just because of a few bits of grit or a couple of ants, so a filter at the start of the line is a very good idea. If you're on bore or tank water it's a must, and remember to clean them out regularly and change them yearly.

Sprayers: These throw water droplets into the air anywhere from a few centimetres to many metres, so they're ideal for covering any sized area. The droplet sizes range from very fine (misters) to quite large (sprinklers). Water is usually sprayed in the pattern of a circle - either quarter, half or full circle.

Misters are a special type of sprayer. They create a humid environment that many plants love. They'll also keep a seed bed moist without disturbing the soil or your delicate seedlings.

Pros and cons of each:

- Sprayers can deliver a lot of water very quickly but because the droplet is atomised into the air, there's a lot of loss to drift and evaporation.
- Sprayers also wet foliage which can cause fungal diseases like black spot and powdery mildew.
- You won't get this problem with drippers, but remember to water for longer with drippers to promote good, deep root development in your plants.
- Sprayers may seem a cheaper and easier option at first because they cover such a large area but plants grow and can block out the spray pattern.

Layout of pipes post water supply and timer.

How you layout your system should be defined by you plan for the garden plants, water needs zoning and other factors already discussed but the following a suggestions for how you layout the reticulation piping and fittings.

- running the supply lines along fences and the edges of pathways reduces the chance of them being damaged.
- pipes that are laid in an open area that could be dug sometime in the future, will need to be buried a little deeper and also be encased in a protective sleeve.
- for group plantings, run parallel lengths of driplines along the beds and connect one end into the polypipe supply line, using a punching tool and dripline connectors.
- pin the dripline in place using pins made from fencing wire or old coat hangers.
- it is preferable to cap each length of dripline individually with a piece of 13mm polypipe so that it can easily be moved out of the way when building up and working on the soil. It can then be placed back on the surface afterwards.
- when placing driplines around shrubs and trees, create a spiral around the base, and make sure that the lines are evenly spaced to ensure uniform watering.

Once the system is operating, the two key maintenance tasks are:

- cleaning the filter at least once a month (more often if using dam or bore water)
- flushing the lines at the beginning and the end of the irrigation season. This removes any material that has made it past the filter and settles in the lines.

7. Retro Fitting an Existing Lawn Retic Sprinkler System

Reclaiming the Lawn

Many people will already have a automatically reticulated lawn and backyard plants. Generally this is a buried pvc subsoil system with pipes that are glued together 30cm-0.5m underground.

If you already have this expensive and longterm reticulation system you just need to modify it to meet your needs.

A mains sprinkler based reticulation system will have 4-5 large lawn spriklers to a zone. It is common to have a front lawn zone, a shrub edge planting zone (driveways and side of the house) and one or more backyard zones (more lawn and garden).

A bore might have many more sprinklers on just one zone, as we discussed a big old bore will have much higher flower rate than a mains tap.

Retrofitting these systems to get a supply to run you new dripline or drippers is pretty straight forward but it may effect the opperation (spray range, popups stay down) or more correctly the pressure of the existing system so that it no longer works. If you are removing all the lawn that is fine, if you want to maintain the lawn you need to make sure there is enough pressure extra to run your retic.

To asses excess pressure, different for each zone can be tricky my approach is take a suppply off the zone that is nearest or supplying the least amount of sprinklers (high flow needs). Create your 19mm and 13mm dripper systems (pop in an extra inline filter) and connect it to a sprinkler riser (discussed shortly) or an accessible (or excavated) bit of pipe and assume to it will be ok. Normally you are not wanting several sprinklers in that zone and you can use their flow for your new add-on.

Popup and fixed sprinklers normally have female threaded ends that screw down onto a male spigot coming out of the ground (pipe network), this can be white PVC glued or black poly pipe with slip fittings in newer (cheaper) designs. See a mockup below.

You can buy female endcaps with a barbed outlet to go onto 19mm or 13mm black poly pipe. I also would add a barded valve so you can control the flow (reduce pressure nad thus sprinkler ranges) or isolate the reticulation line. Essentially this valve offer huge versatility for $1.50.

8. Recommended System - Post Water supply timer.

- 25mm manifold or ring main stepping down to 13mm for drippers reticulation to water wicking pot garden beds, sprinklers, trees and sprayers in nurseries.
- Use VERIFLOW drippers (pope brand) so you can adjust 0-50L /hr dripper flow for each wicking pots needs (lots of lush green plant 50L/hr vs small dry herbs 5L/hr. Adjustable flow so you can match the current needs of the pot, plant, application.
- When you need soil surface wetting (seed germination, green manure, etc) use 13mm barb end raindrop sprinklers (brass base and choice of spinning raindrop or fixed raindrop) can be put on 13mm poly.
- Rain drop sprinklers (better than finer misting heads) can be valve isolated (barbed 13mm inline tap) This allows you to run the sprinklers if needed with the drippers off (i.e. all individually adjusted closed) and negate the hand watering, or sprinklers off whilst only the drippers are needed.
- Zones (individual solenoid valves control this) within reticulation for the garden should have similar watering frequency needs. While we can adjust the flow at a dripper we cant change its frequency. Nursery areas and veggie gardens (non wicking) need at least 2-3 day watering in summer.
- The higher yield garden will require more watering than other areas and will be going all through summer.
- 13mm poly can run along the top of the wicking pots or, at more cost, micro dripper pipe can come up to allow a less "ugly" look. Another option is to run micro dripper pipe into the drain holes but this means you won't see the inflow or overflow.
- In-ground wicking beds are better off with drippers every 3o cm but you could get away with one inlet if the bed had a fill pipe.
- Adjustments will need to be made to the flow nozzles as plants evolve.
- Avoid watering following a decent rainfall (20mm or 2-3 days of 5 mm in the week) to minimise the chance of overflowing the reservoir.
- Hand water any brand new seedlings daily then return the barrel to the reticulated system once established.
- Include a hand watering hose (not off the reticulation stations) for small specific watering as required. Locate as is logical (on side of house on a hose reel) in a spot where a tap exists or is easily run through the wall.

9. Mulch

- **Improve the soil (clay and compost), water it and then deep mulch it.**
- **Rule No 1 - Cover the Soil**
- **Key point: Mulch for water saving and mulch for soil feeding are two quite separate things.**

9.1 Mulch is great for:

- Retaining moisture at the soil/mulch interface for a longer period of time, preventing 'crusting' of the soil surface and providing a rich environment for worm and microbe activity which, in turn, aids the fertility of the soil and supplies nutrients to the soil for plants to use.
- Regulating soil temperature and protecting the root system from the extremes of summer and winter.
- Increasing the water penetrability of the soil.
- Controlling soil erosion by reducing water run-off.
- Controlling competing and unwanted self-seeding species.

9.2 Water wise or Hard Mulch

This is for summer soil protection and water conservation, needs to be made up of large irregular shapes that do not hold water. This is to prevent the mulch both forming a waterproof layer (think grass clippings rotting into a lump) nor the capillary action/wicking of the soil moisture back through the mulch to the sun and wind. It often is called street tree mulch - Leaf, bark and wood chippings, again is for **Water saving and slow release soil building and fungi food**.

This needs to be deep mulch, otherwise it will dry out, wash away and be otherwise ineffective. 5 cm deep would be the minimum, but a free or cheap source should be 10-15cm thick. As the tree clippings are a mix of leaves, bark and woodchips, you can see that the leaves and bark decompose rapidly and sink through the harder cellulous woodchips, leaving a hardy water retentive irregularly mulch. The action of nitrogen draw down is not as much of an issue - the food supply is aimed at fungus rather than bacteria and the slowly released low amounts of nitrogen in the leaves and bark is enough to feed the fungus as it very slowly breaks down the hard woodchips at the soil/mulch interface. The beauty of this is it slowly builds to soil and soil biology while you concentrate your efforts on other higher input/output growing zones or other life priorities and, when you come back to it a few years later, you can have beautiful soil to evolve into more yielding systems.

You can also mulch Veggies and annual plants for summer evaporation reduction with tree pruning's but it doesn't feed the bacteria or other soil biology much. I recommend using a feeding mulch underneath at the same time.