The Urban Aquaponics Manual

Growing FISH and VEGETABLES …..in Your Own Backyard.

Gary Donaldson

The greatest fine art of the future will be the making of a comfortable living from a small piece of land."

Abraham Lincoln

This image collection is a part of "The Urban Aquaponics Manual (2nd Edition)

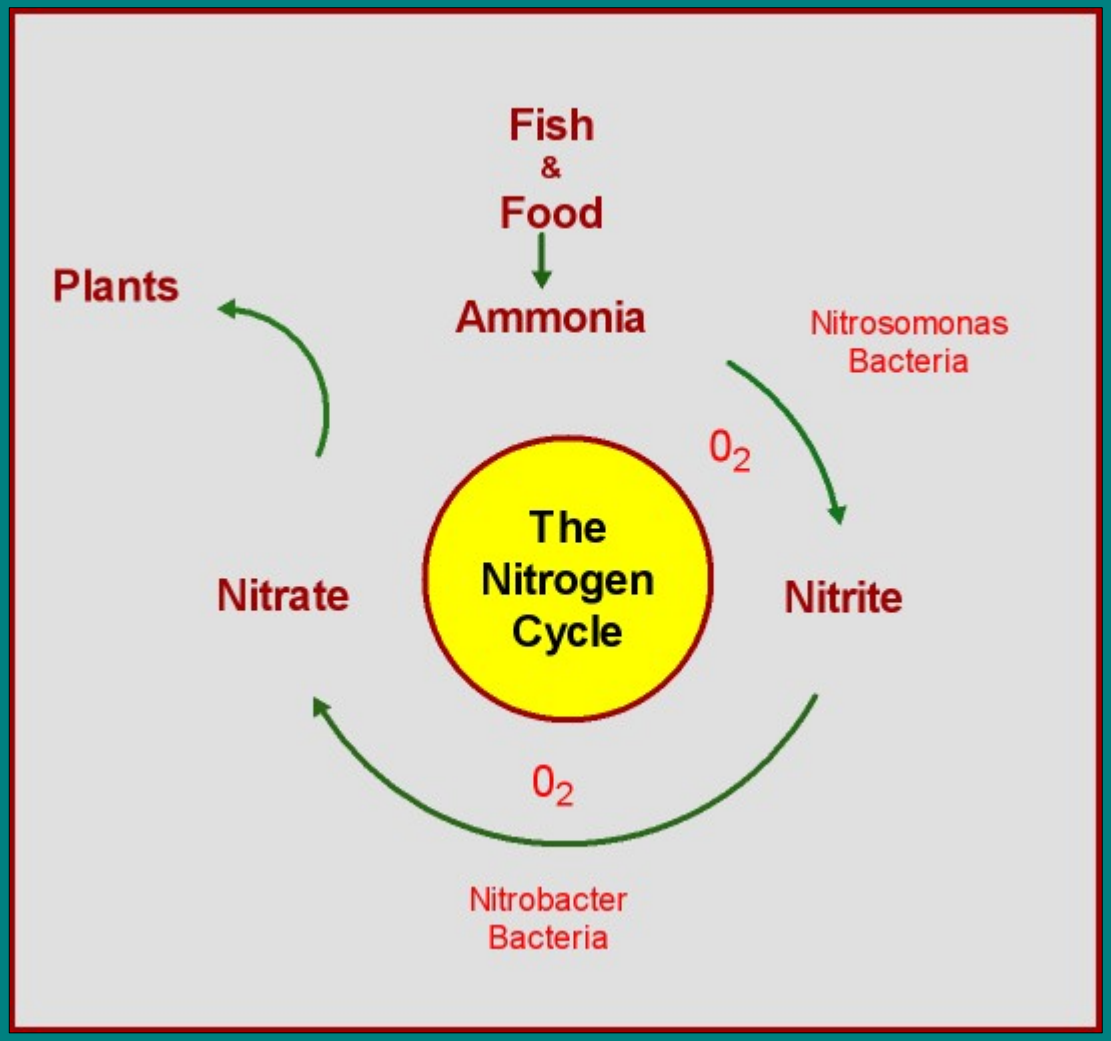
Bio-Security Warning

No organism from an Aquaponics system should be allowed to make its way into any natural watercourse.

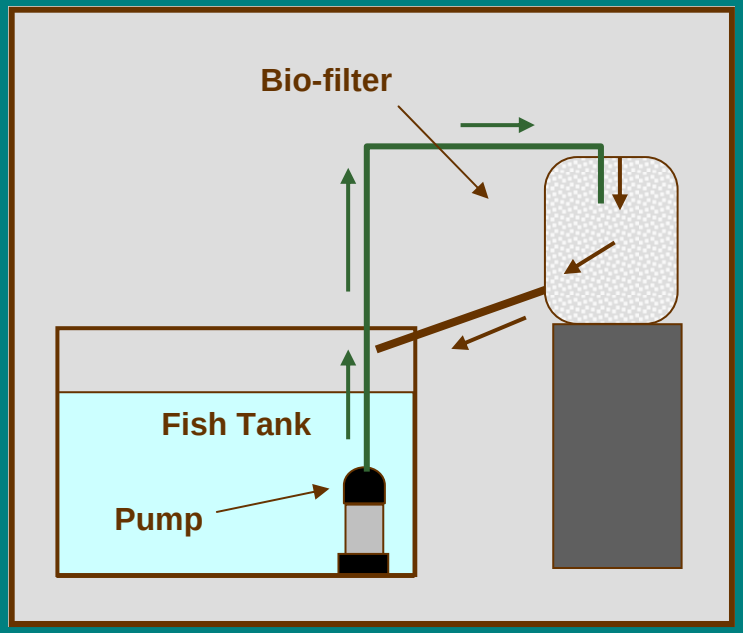
Plants or animals from an Aquaponics system that are introduced into the wild may be carrying disease organisms that can be transmitted to wild plants, animals or fish.

Urban Aquaponics

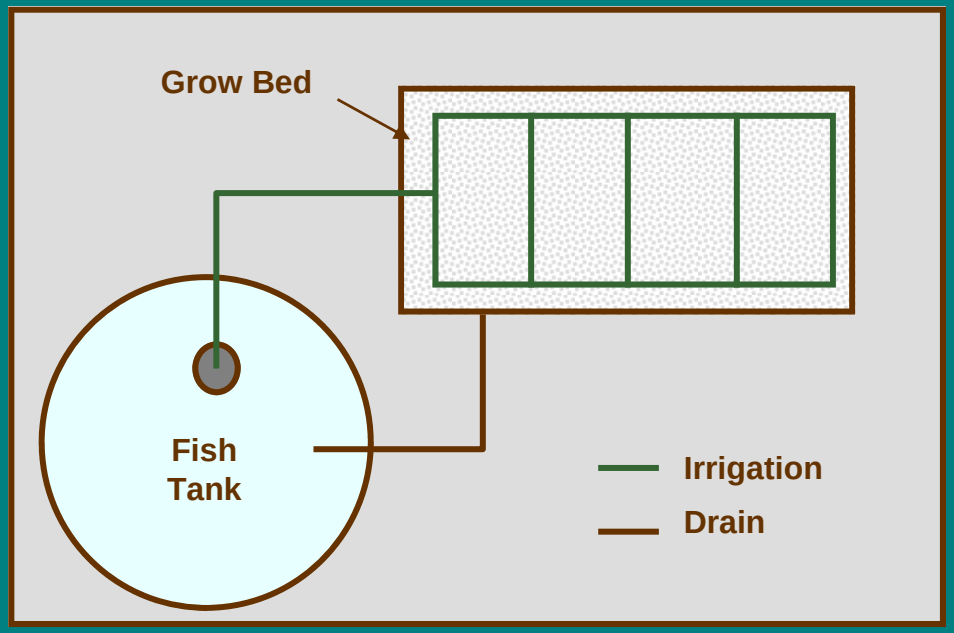
In this section, we look at what Aquaponics is…..how it works and why we do it.



In the aquatic Nitrogen Cycle, fish produce ammonia which beneficial bacteria convert to nitrites. Other bacteria then convert the nitrites to nitrates – plant food. Put simply, the fish feed the plants and the plants clean the water for the fish…..and we eat the fish and the plants.



A basic Recirculating Aquaculture System (RAS).



Add a Grow Bed and a basic RAS becomes an Aquaponics system. A gravel grow bed of the right proportions can be used as the bio-filter.

aquaculture + hydroponics = aquaponics

WHY?

Clean

Fresh

Food

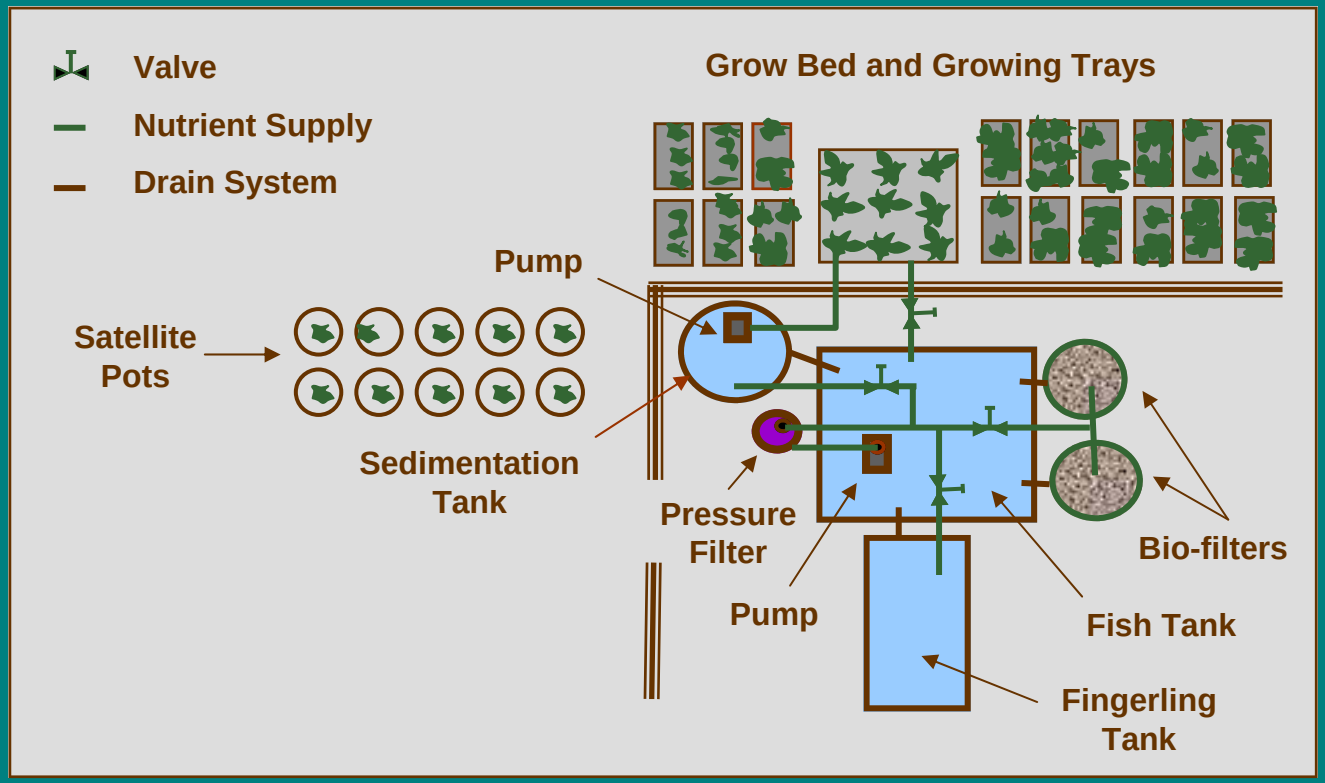
Aquaponics Benefits

- **Water-wise**….aquaponics is far more efficient in its use of water than any other form of food production.
- **Sustainable**….an Aquaponics unit mimics nature and there is no environmental degradation or pollution.
- **Less work**….no digging or weeding and properly designed systems will even eliminate bending.
- **Comfortable working height**….aquaponics growing systems can be designed to meet the special needs of people with disabilities.
- **Productivity**…..aquaponics systems are more efficient than conventional gardens, aquaculture or hydroponics.
- **Excellent learning resource**….for the entire family.

Our Aquaponics Systems

In this section, we take a look at the Urban Aquaponics systems in use at Creek Street Micro Farm

This was our very first system. The round black tub was the fish tank and the red drum was our first trickling bio-filter (still operating today). The white trays under the fluoro fitting were part of our first aquaponic seedling system.

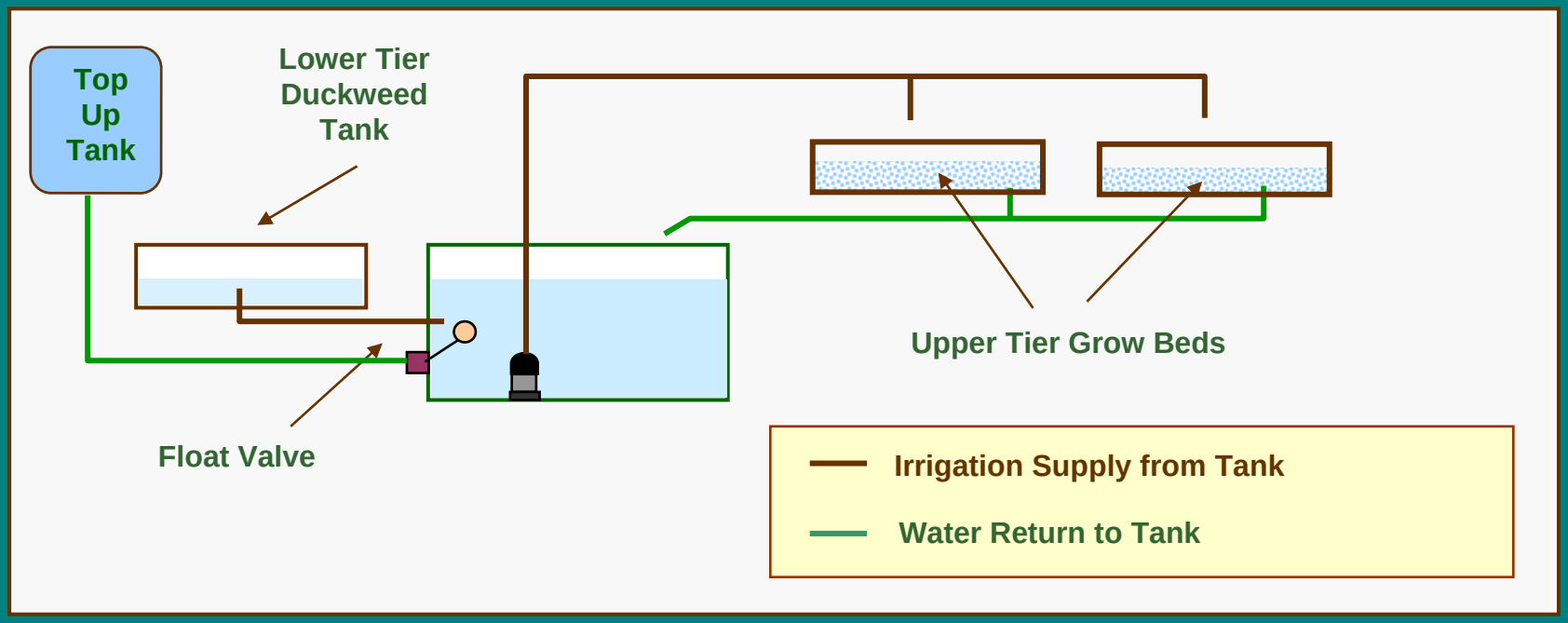


This system grew 44 Jade perch to plate size in 32 weeks. The system also housed 66 Jade perch fingerlings in a total water capacity of about 1,000 litres. Comprising a fish tank, a gravel grow bed, 10 satellite pots and 18 trays, this system relies on a 45 watt pond to move water around the unit at the rate of 4.500 litres per hour. Water quality is maintained by two small bio-filters, a sedimentation tank and a pressure filter.

This is the aquaculture aspect of the same system. Keeping your fish tanks inside makes for easier temperature control and avoids the algae blooms that will otherwise occur….

….and on the other side of the shed wall we had a variety of growing systems including trays, satellite pots and a small gravel grow bed.

The Urban Aquaponics Tidal System is capable of producing 50kg - 60kg of freshwater fish per year. It will also produce many kilograms of clean, fresh vegetables and herbs. The duckweed tank will assist in the management of water quality and provides high quality plant protein for the fish. The duckweed tank can also be used a floating raft grow tank or a water garden for plants like taro, kangkong or water chestnuts.



This Urban Aquaponics Tidal Unit is designed to grow fish, plants and duckweed. It features an innovative tidal arrangement where nutrient rich water is pumped up to the two 500 litre flood and drain gravel grow beds. As the beds fill, the water level in the 1200 litre fish tank and the 500 litre duckweed pond drop simultaneously. Once the grow beds fill to a predetermined level, the float switch shuts off the pump and the water drains back into the fish tank. As the level in the fish tank rises, so does the level of the duckweed tank. This action imitates the ebb and flow of a tidal estuary.

This aquaponics system comprises a fish tank, two small bio-filters and a duckweed tank. The use of small components enables us to move filters and tanks about to suit our preferences and prevailing conditions.

Two small recirculating aquaculture systems. These are also representative of the small, portable systems that we prefer for backyard fish farming.

This fingerling system comprises a 230 litre fish tank (complete with cover to prevent fish from jumping out of the tank and to reduce heat loss) and two 65 litre bio-filters. The 200 litre plastic drum (not part of this system) is used as a sedimentation tank.

This is our 950 litre microFish Farm…..features a range of innovations including an overhead bio-filter/grow bed. This unit will grow fish inside or out. Other features include minimal plumbing, low wattage motor and access barrier (to keep kids and pets out of the fish tank). The pumping cycle is controlled by an autosyphon.

Building an Urban Aquaponics System

In this section, we:

- **revisit the UAP design criteria**
- **consider various system layouts**
- **assemble two ^{micro}Fish Farms**
- **build a low-cost fingerling system**

Design Criteria

- Capable of quantifiable productivity.
- Production parameters easily controlled.
- Scaled to suit a backyard or similar small area.
- Sustainable and environmentally-friendly.
- Main components should be durable.
- System should be easy to set up.
- Versatility – the ability to mix & match system components.
- Small footprint - vertical stacking for greater space efficiency.
- Inexpensive to operate.
- Affordability
- Expandability – able to grow one component at a time.
- Portability – able to be moved
- Safety – eliminating drowning and electrocution hazards.
- Neat and tidy – remember the neighbours
- Nuisance-free
- Water-wise

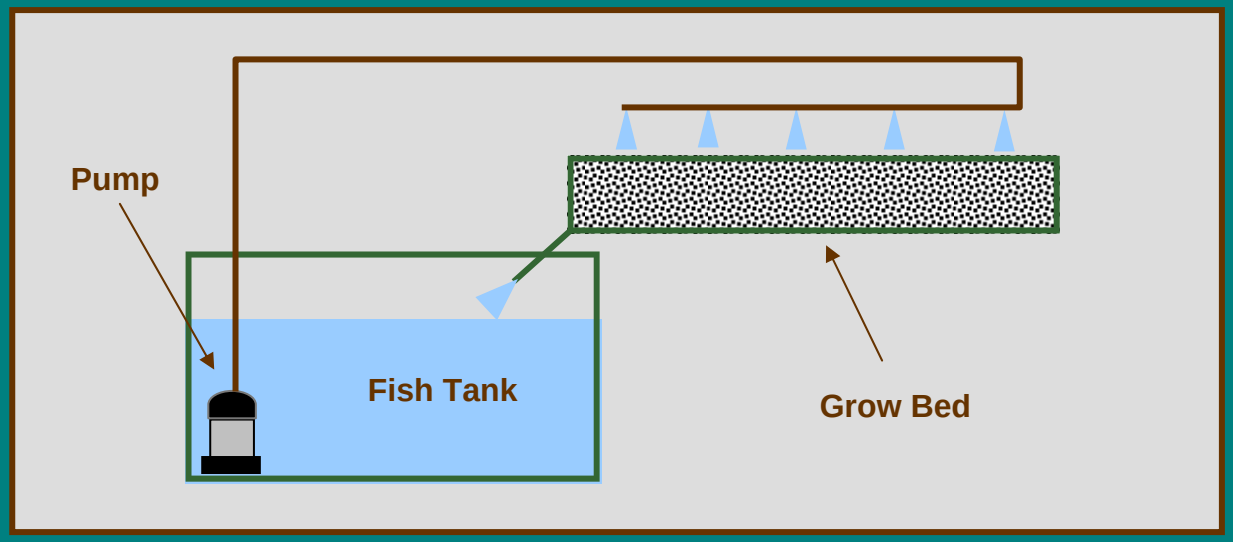
System Layout

The layout of an Aquaponics system will be impacted by many things including:

- The topography of the site.
- The choice of growing systems.
- The preferences of the operator.

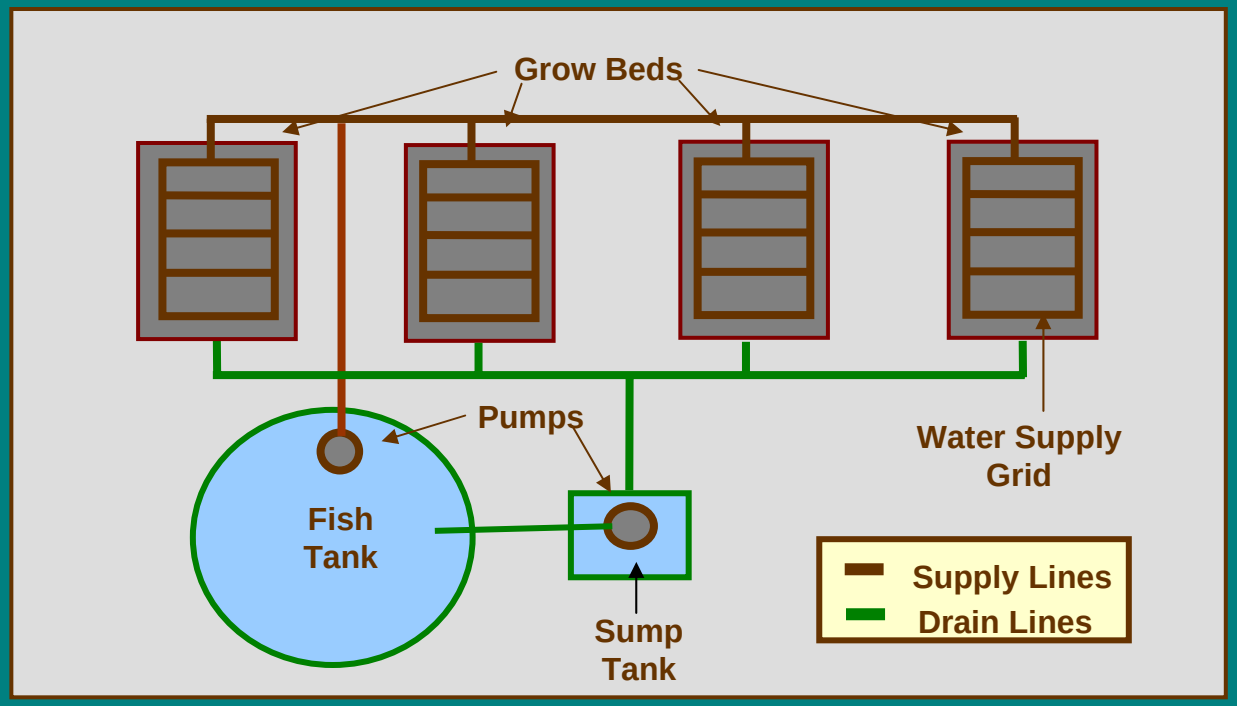
The following slides present some of the possibilities.

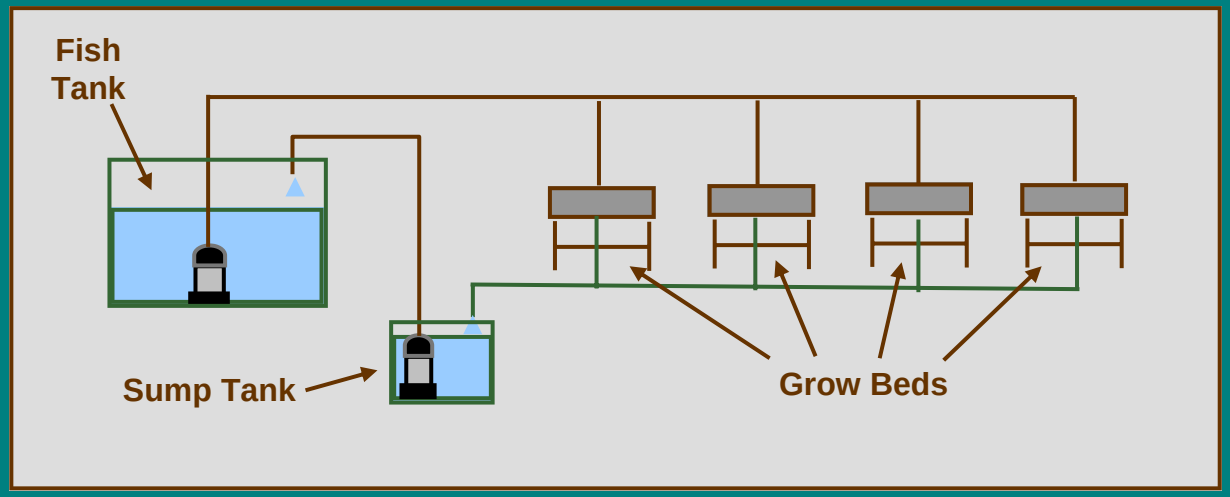
Flood and Drain System



The basic flood and drain Aquaponics unit can be set up for continuous flow watering or ebb and flow irrigation. This simple system uses gravel or light expanded clay aggregate (LECA) media. LECA floats, so put a layer of gravel over it if the bed is set up for ebb and flow use.

Ebb and Flow systems are controlled by electric timers and/or float switches……or the pump can be set to run continuously with the ebb and flow cycles being orchestrated by an auto-syphon. This system is simple, reliable and uses the grow bed for bio-filtration.





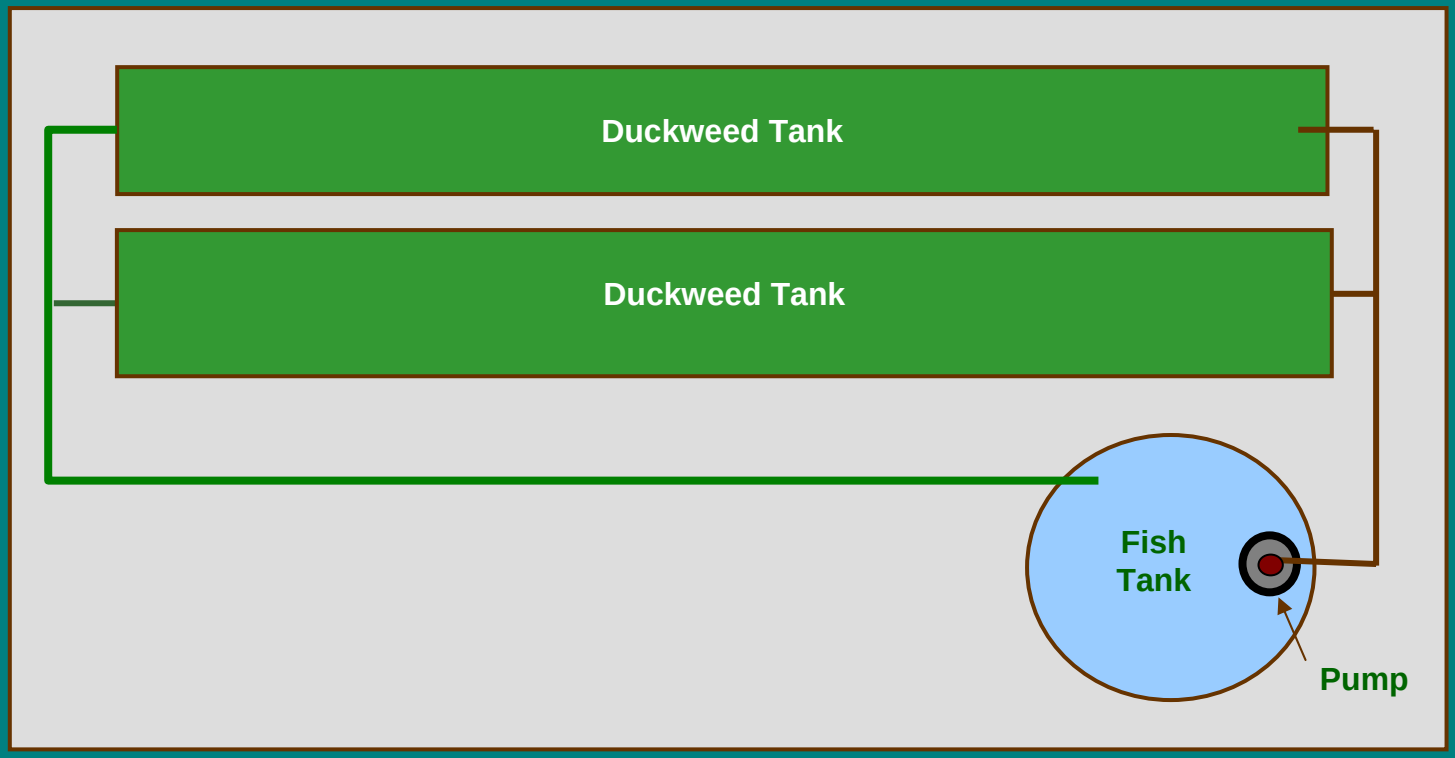
Sump Tank System

The plan and side elevations shown above and below show a typical sump tank arrangement.

This is used, for example, when grow beds are set lower than the fish tank or to facilitate flood and drain pumping cycles for several grow beds.

The pump in the fish tank is controlled by a float switch or electric timer and another float switch will operate the sump tank pump.

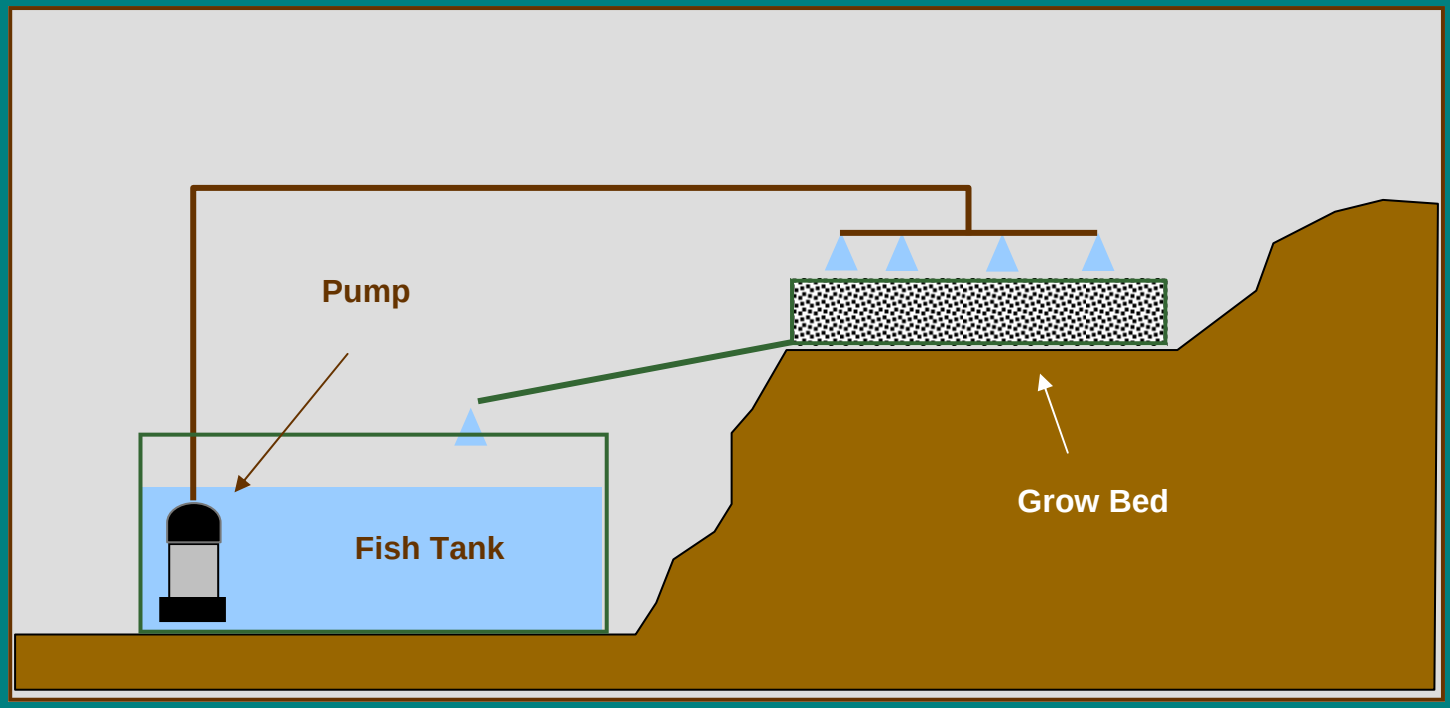
Duckweed System



This system is conspicuous for the absence of a bio-filter. The fish excrete ammonia into the water which is pumped out to the duckweed tanks. Duckweed is able to metabolise ammonia directly and, as it is harvested for fish food, the ammonia is removed from the system. The fish benefit both ways…..clean water and fresh plant protein. The trick with this system layout is being able to balance the ammonia production with the capacity of the duckweed to take it up. For most purposes, a trickling bio-filter would be recommended.

….and that’s exactly what we’ve done here.

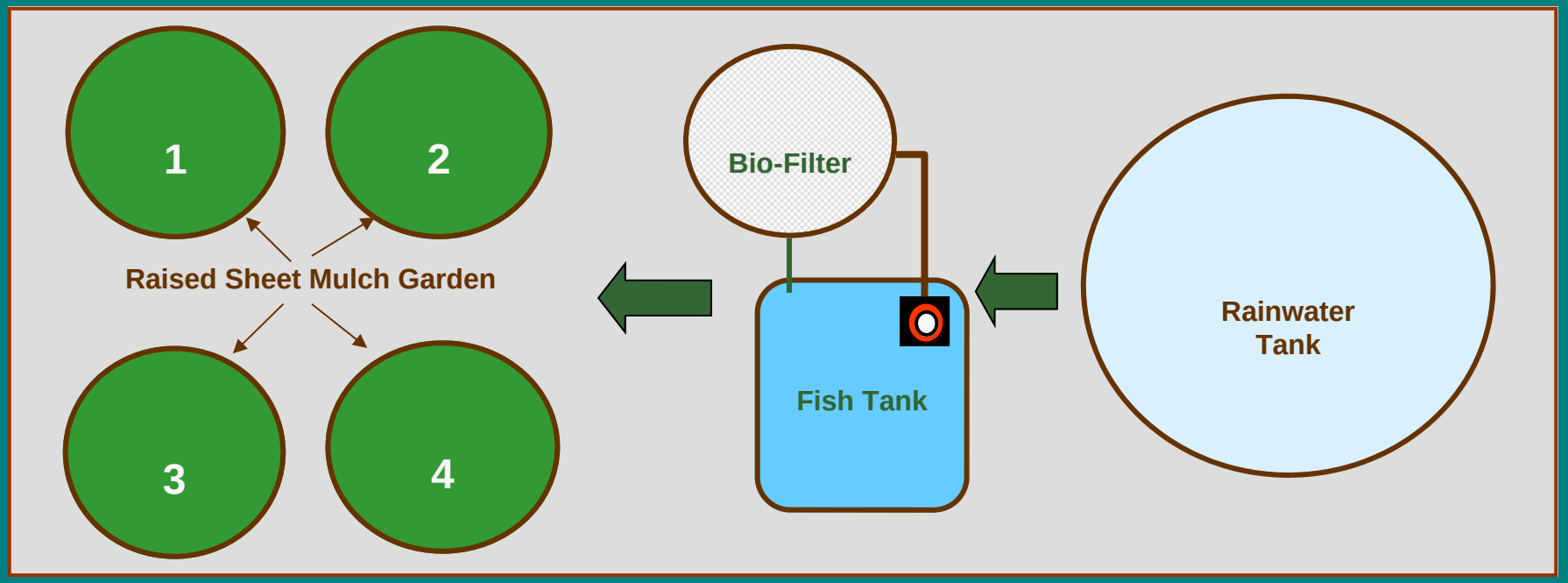
Sloping Sites



Sloping sites present challenges but also opportunities. They allow you to move water by gravity and they save you the expense of grow bed supports.

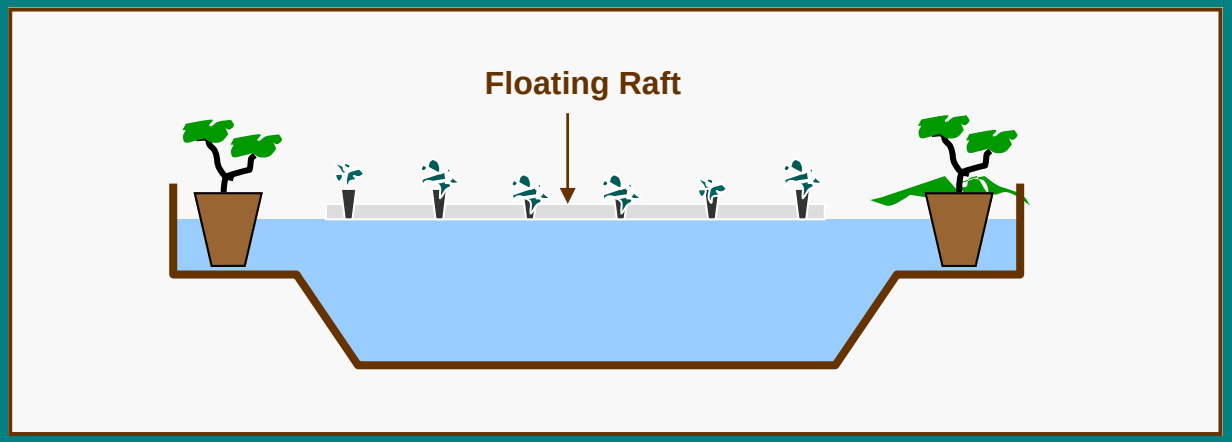
This is an example of where a steeply sloping site enabled us to avoid the need for a support stand for the duckweed grow tank.

Integrated Aquaculture System



While not an Aquaponics system as such, this layout is integrated aquaculture - using a fish tank to provide nutrient-rich water for plants in a soil-based gardening system. In effect, we get a crop of fish for the same amount of water that we'd typically use to grow the plants alone……and we get some free plant nutrients, too. The addition of a rainwater tank leverages the water-wise nature of the system even further. My reason for mentioning this system is to suggest that the relationship between fish and plants is not confined to Aquaponics.

Water-filled Grow Tank



A water-filled grow tank can function as a water garden, a floating raft system or a duckweed tank…..or any combination of these.

950 Litre
micro Fish Farm
Assembly

We began by levelling the site for the fish tank. In normal circumstances, some coarse sand would suffice. Our site, however, slopes steeply so we used gravel and some pine sleepers.

The tank is positioned on the platform.

Having inserted the autosyphon and water supply fittings, the bio-filter/grow bed is positioned on the tank.

The water pump and supply pipe work is connected to the bio-filter/grow bed.

The fish tank is then filled prior to loading the expanded clay media into the bio-filter.

The autosyphon drain allows the 230 litre bio-filter/grow bed to drain in about 90 seconds

The media guard prevents the expanded clay media from jamming up the autosyphon.

Almost finished now……the tank's full of water that we've drawn off from our other fish tanks and the bio-filter has been loaded up with expanded clay media.

Expanded clay media is the perfect choice for the microFish Farm. It is much lighter than gravel and is much easier on the hands.

A downside of expanded clay media is that it floats initially .....hence the rock to weigh down the autosyphon media guard.

The finished ^{micro}Fish Farm - complete with access barrier. This not only prevents children and pets (and wind-borne debris) from entering the tank but, in conjunction with the bio-filter, serves to facilitate algae and temperature control by covering the tank.

1200 Litre micro Fish Farm Assembly

We opted to use a concrete pad (that we'd originally laid for a rainwater tank) as the base for our grow beds - largely because it was the only place in our backyard which was level. We buried the 1200 litre fish tank by about 300mm.

We used cement blocks to support the grow beds – two tiers high.

Treated pine sleepers were positioned on the cement blocks to provide plenty of support for the grow beds. These support stands had to be robust because each grow bed weighs about 750kg.

The first 500 litre fibreglass grow bed in place.

We then used gravel to set the media guards in place……

….before creating a level support for the duckweed tank.

The duckweed tank in place.

We completed the main part of the installation just as the sun set.

Several days later, the system is complete and resplendent in its various temperature control attachments.

Too complicated perhaps?

You'll need…..

A tank…..about 200 – 250 litres will be fine.

A couple of small trickling bio-filters….a couple of tub outlets and some oyster shells

A submersible pond pump ….about 1500 litres per hour

…..and you have a basic recirculating aquaculture system in place.

Add a growing system…..

A few trays…..

…..or a small gravel grow bed…

…..or some satellite pots…..

…..and you have an aquaponics system.

This little system can be used to rear fish (depending on the species) from 3 – 6 months of age. Should you decide to build a larger Aquaponics system, it will enable you to extend the growing season by rearing fingerlings in conjunction with larger fish.

The main point to be made about this section is that Aquaponics is about a tank, a pump and a growing system (and maybe a bio-filter). You just add water and fish…and that's it.

Selecting Aquaculture System Components

In this section, we take a look at the components that used in the fabrication of Urban Aquaponics systems.

TANKS

Fish tanks can be recycled containers like industrial bulk containers (IBC) or other plastic containers like the small round tub. With a capacity of just 250 litres, this tub served as our first fingerling tank. While IBC's are not my personal preference for use as a fish tank……

…..Milne from Victoria has made very effective use of them in his backyard food production unit. An accomplished recycler, he never pays for much of anything. His capacity to add value to 'junk' is an inspiration to us all. This system consists of two IBC's, some NFT trough and a host of other bits and pieces that have been acquired from the recycling centre.

Mega Bins are widely used in the horticulture industry for the transport of fruit and vegetables.

We use four of these as fish tanks in our various backyard aquaculture systems.

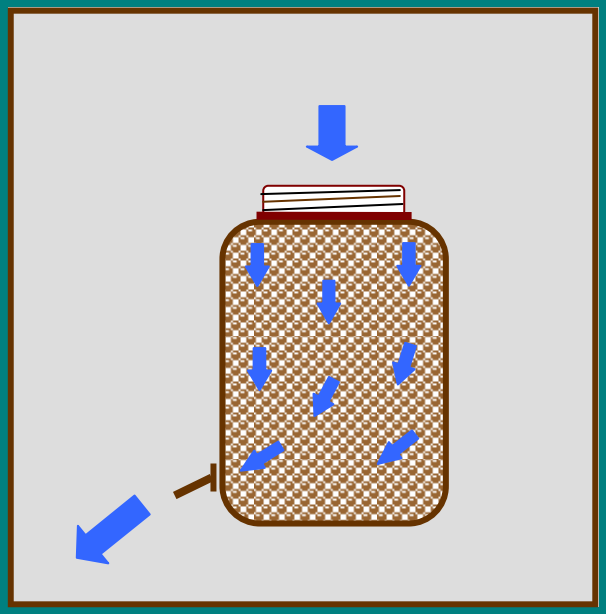
They hold about 650 litres of water, are made from durable polyethylene and are very easy to set up for use as fish tanks.

Martin A1 from Berowra in New South Wales uses rainwater tank sections for both fish tanks and gravel grow beds. He's also made effective use of lined timber-framed ponds in his system. Note the use of access barriers on all tanks and ponds – very responsible.

This 950 litre fibreglass tank (and a similar 1200 litre option) is the cornerstone of our microFish Farm concept. These robust units are space-efficient, versatile and durable.

Bio-Filters

Biological filters facilitate the colonisation of beneficial bacteria in an aquaponics system.



A simple bio-filter – a plastic drum filled with suitable media. We use oyster shells but other options include styrene beads, course gravel, expanded clay and manufactured plastic media.

Oyster shells – cheap, effective bio-filter media.

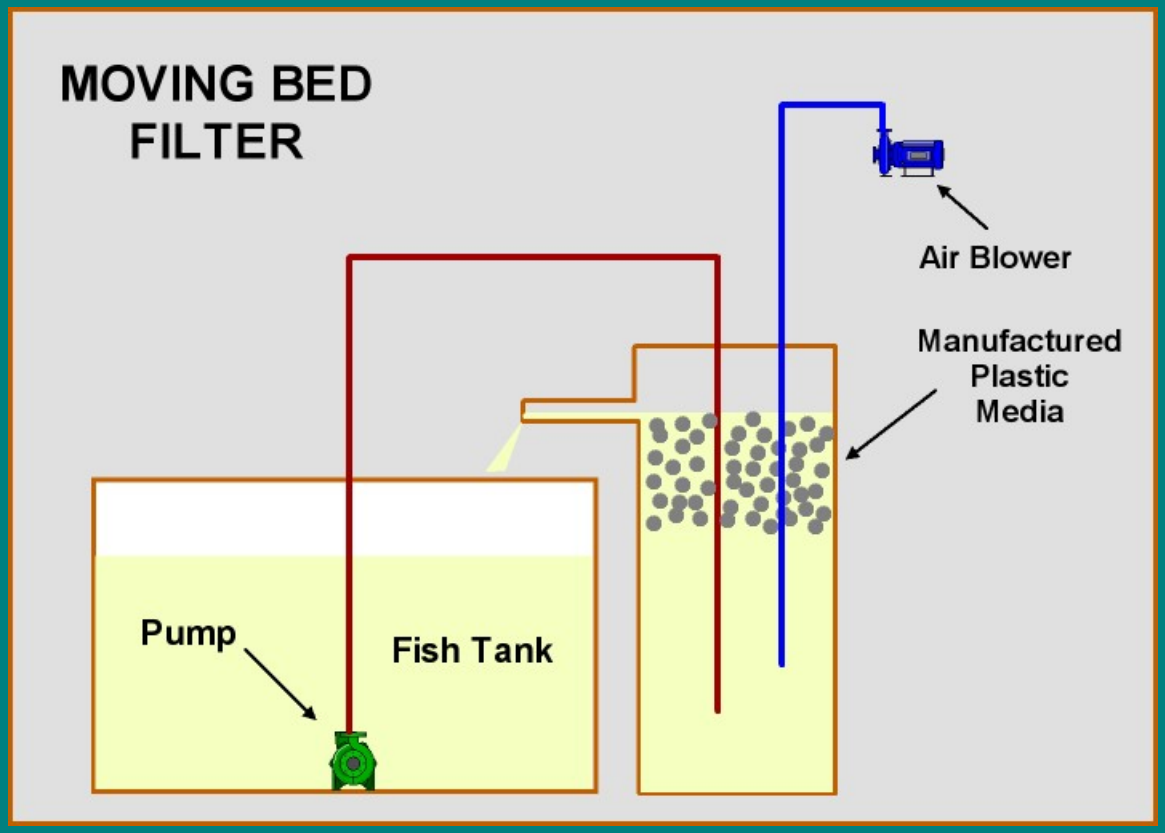
Trickling bio-filters are among the most simple, yet most effective means of facilitating colonisation of nitrifying bacteria. These compact units are recycled 65 litre pickle barrels filled with oyster shells. The water enters the bio-filter from the top and drains through the bulkhead fittings at the bottom.

This is another variation on the trickling bio-filter theme. Stacking plastic crates are filled with oyster shells and arranged so that the water trickles in from the top and drains through a bulkhead fitting back into the fish tank.

Grow Beds

Flood and Drain Grow Beds are a variation on the trickling bio-filter theme…… with the added feature that they are also an effective plant growing system.

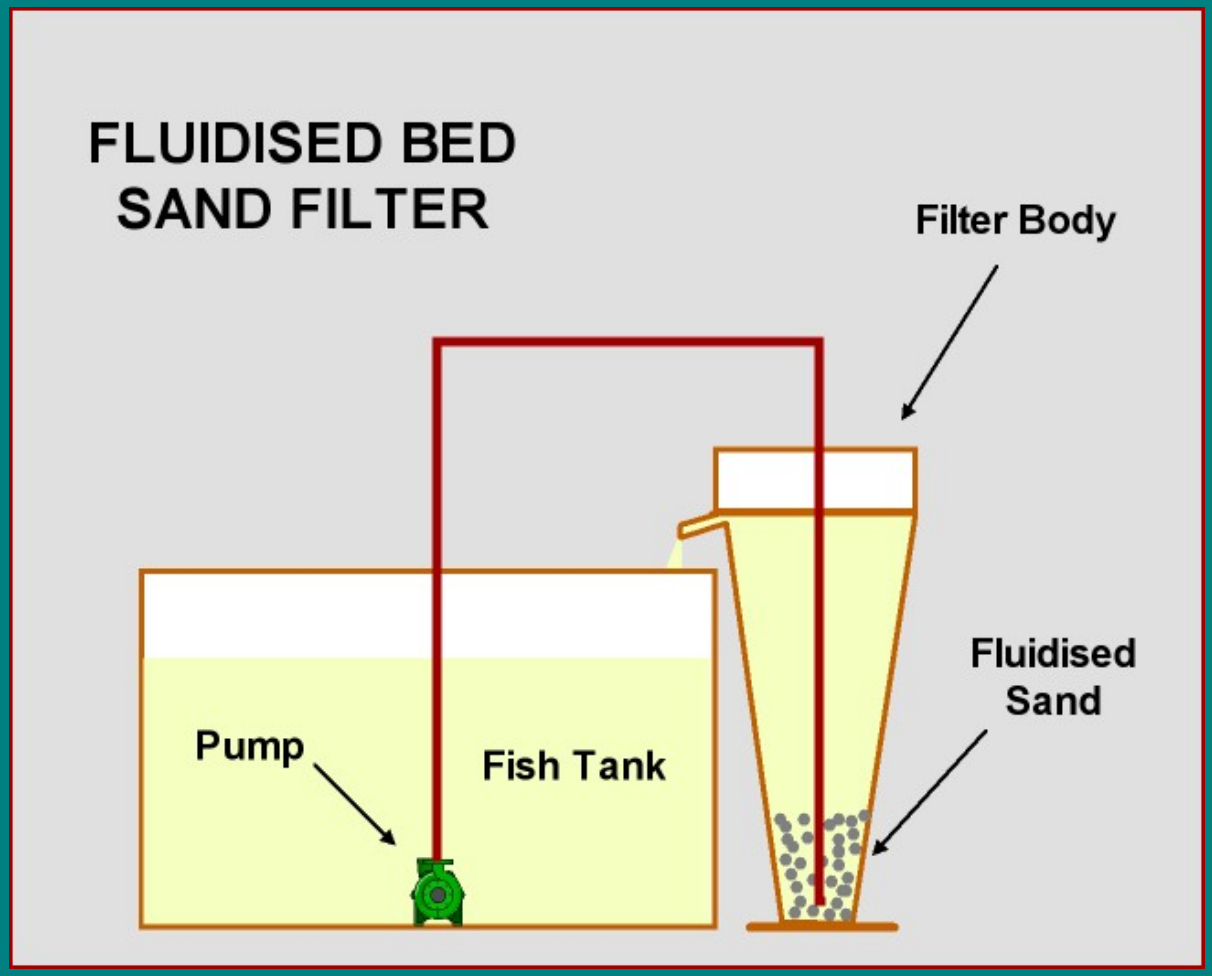
Gravel is inexpensive (its principal benefit) and very heavy (its major shortcoming).



The Moving Bed filter technology was developed by Anox Kaldnes. It is based on the use of Kaldnes K1 or K3 plastic media which float on the water in the filter. Bio-film attaches to the media and acts as a substrate for nitrifying bacteria. High volume air is pumped into the filter causing the media to churn. This churning continuously dislodges the bacteria in an innovative self-cleaning action which constantly renews the substrate and stimulates the growth of fresh nitrifying bacteria.

Moving Bed Filter

Kaldnes K1 manufactured plastic media – pricey in small quantities, self-cleaning and very effective at facilitating nitrification. Used in a Moving Bed Bio-filter.



The water is pumped from the fish tank down into the base of the sand filter at a pressure sufficient to fluidise the sand (keep it in suspension). Because of the huge surface area presented by the sand (to which the beneficial bacteria attaches) this type of filter is very effective at nitrification.

Mechanical Filtration

Mechanical filtration is used to strain out some of the fish wastes from the fish water before it goes into the grow bed or bio-filter.

The image at left shows filter foam while the photo above is of some Dacron that has been used as a mechanical filter.

While the filter foam is more durable than the Dacron, it also costs more.

A sock tied over the outlet from the fish tank is also an effective means of removing some of the fish wastes.

Bio-filters (including flood and drain grow beds) function better (from a nitrification perspective) if they do not get heavily loaded up with fish solids.

This 200 litre plastic drum has been used as a sedimentation tank and is currently in use as a Moving Bed bio-filter.

Fish solids are allowed to settle out and are removed from the system with a simple siphon….leading to improved water quality.

An even more convenient way to settle out and remove solids is the….

Swirl Tank

Used to settle out solid wastes from the water in a fish tank.

The water is introduced into the swirl tank so that it sets up a circular motion (from which the tank gets its name).

The solids settle into the cone-shaped base of the tank where they can be easily decanted.

Canister Filter

Features three filtration processes:

- **Mechanical**
- **Biological**
- **UV – kills off algae**

It is useful for clearing up an algal bloom in a tank.

Water Pumps

For smaller Aquaponics systems, low wattage submersible pumps are ideal. They can pump quite large amounts of water and cost cents per day to run.

Sump Pumps

For larger aquaponics systems, submersible sump pumps will move larger quantities of water to a higher head.

They usually start at around 6,000 litres per hour and a float switch is often an option.

Pump Tips

- Always buy more pumping capacity than you need to allow for the inevitable expansion and to maximise the life of your pump.
- Factor the pumping head height when choosing a pond pump.
- Ensure that your submersible pump is rated for continuous operation.
- Bypass surplus flow rather than restricting the pump.
- Recirculate the surplus water for added aeration.
- Keeping a spare pump (in the event of equipment failure) is cheap insurance.

Air Pumps

The #1 cause of fish deaths in Aquaponics systems is low Dissolved Oxygen levels.

Buy an Air Pump

Pump Control

- Electric timers
- Float Switches
- Auto Syphons

Float Switch

Timers

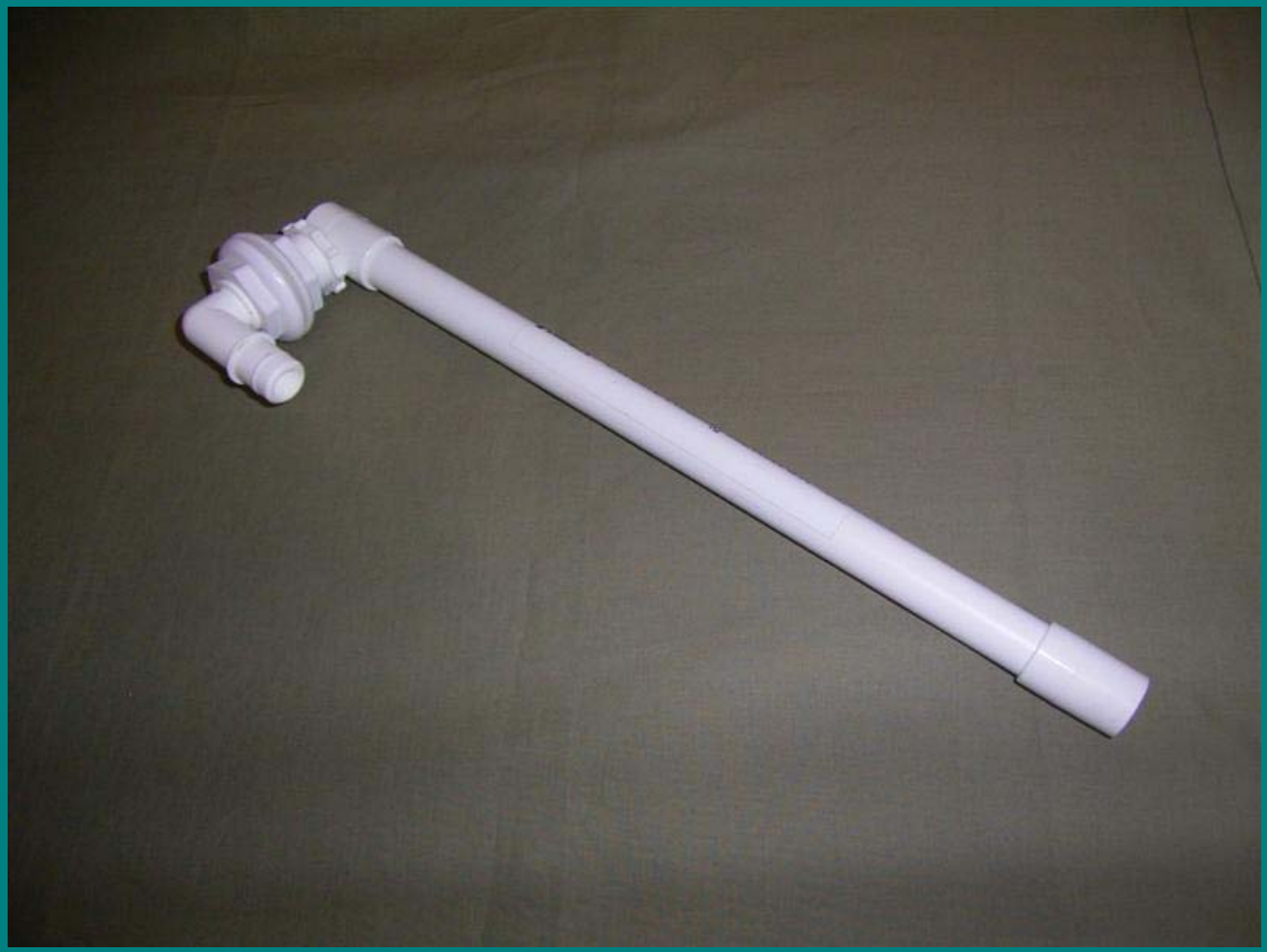
Auto-syphon installation (from left) grow bed drain, standpipe, auto-syphon unit & media barrier.

Fittings, Hoses and Pipes

We make extensive use of micro-irrigation fittings. They are easy to work with and relatively cheap to buy.

For larger installations, we use PVC pipe and fittings.

Bulkhead fittings are used to create watertight connections for tanks or grow beds.



This a venturi device intended for use on the bait tank of a recreational fishing boat. It can also be used to introduce large volumes of air into a fish tank.

Risk Management

In this section, we look at keeping you, your family and your fish ….alive and well.

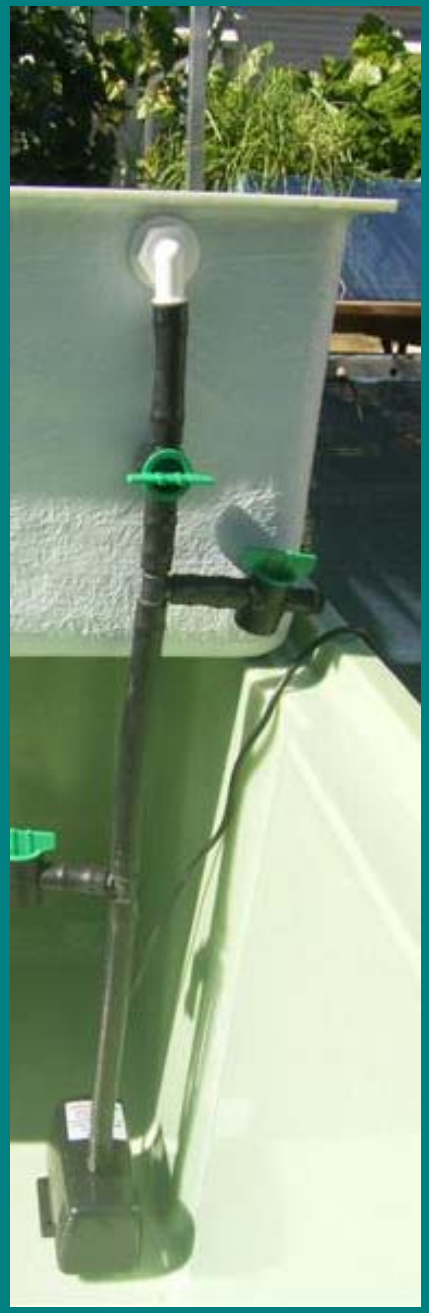
Access Barriers

Fish tanks are no less dangerous than unattended baths, spas and swimming pools and must be kept covered at all times to prevent access by toddlers and pets.

Blockages and Leaks

In aquaponic circles, the build up of suspended solids on pipe walls and in fittings is referred to as Bio-film. This substrate (which supports the nitrifying bacteria that are central to recirculating aquaculture) can block up small pipes and openings…..particularly when it has been allowed to dry. Periodic pressure flushing of pipes and hoses will eliminate most bio-film problems.

While bulkhead fittings are very useful devices for backyard fish farmers, they are also prospective failure points on an aquaponics system. I have pumped a fish tank almost dry because I overlooked the replacement of the strainers in the bulkhead fitting and a fingerling became lodged in the fitting.



Here's what happens when you develop a blockage in your system plumbing. Our current systems have all of the pipe work contained within the tank perimeter so that if a leak should develop, the water will run back into the tank.

This is a 240 volt power failure back up switch. It is designed so that, in the event of a power failure, a battery-powered pump kicks in. As soon as 240 volts is restored, the battery back up is automatically disconnected.

This small petrol-powered generator is another strategy for dealing with power failure.

FISH

In this section, we look at the comprehensive range of freshwater fish and crayfish species that are available to Australian Aquaponicists.

Jade Perch

An excellent species for beginners – not suited to cooler climates – high in Omega-3 oils – very good table fish – tolerant of variable water quality.

The Barcoo River in Queensland – home of the Jade perch

Leathery Grunter

The name says it all – the black markings might cause this fish to be confused with a Jade Perch but you'll know the difference if you get one on your plate.

Silver Perch

The most widely kept species for backyard aquaponicists in Australia. They will cope with a wide range of temperatures making them suitable for the southern states.

Murray Cod

King of Australia's river systems

Barramundi

An excellent table fish with an International reputation.

Eel-tailed Catfish

Can be kept in most parts of Australia – unusual in appearance and excellent on the plate.

Golden Perch

Known by various names including Callop, Murray perch and Yellowbelly.

Ausyfish proprietor Bruce Sambell with one of his Golden perch brood stock.

Freshwater Crayfish

- Yabbies
- Redclaw
- Marron

Sleepy Cod

- Fast growing.
- Strictly carnivorous.
- Highly regarded eating fish

Female Sleepy cod and babies…..lots of them.

Other Species of Interest

Australian Bass Fingerlings

Honey perch are showing some aquaculture potential. Australian bass, already an established sport fish, has yet to prove itself in an aquaponic context.

The Jungle perch and Neosilurus catfish are other species of interest to local aquaculture researchers.

Honey Perch

A nice catch – six metres from our back door.

Steamed Jade perch – it may not look pretty but it sure tasted good.

Grilled Jade perch and salad – high in Omega 3 oils.

Managing Water Quality & Temperature

In this section, we look at some of the water quality parameters and the means by which we monitor those parameters. We also consider some rainwater capture and heat retention strategies.

Water Hardness	
State	mg/L
Melbourne	10 - 25
Sydney	40 - 60
Perth	30
Brisbane	100
Adelaide	135 - 150
Hobart	6 - 35
Darwin	32

Optimum Temperatures - ^{0}C	
Barramundi	28 - 32
Jade Perch	20 - 30
Murray Cod	20 - 35
Silver Perch	23 - 28
Marron	23 - 25
Redclaw	23 - 31
Yabbies	23 - 31

CO_2 Levels	
<15mg/L	OK
15 to 30 mg/L	Respiratory Distress
>30mg/L	Lethal with prolonged exposure

Simple and inexpensive water tests will enable you to ensure that your aquaponics system is operating within the appropriate water quality parameters.

One of the principal benefits of Aquaponics is its ability to produce fish and plants with relatively little water. Capturing rainwater further leverages its water efficiency.

This 10,000 litre tank is the centrepiece of our rainwater harvesting efforts.

This 1000 litre IBC captures rainwater from the back of our house for use in two small aquaponics systems.

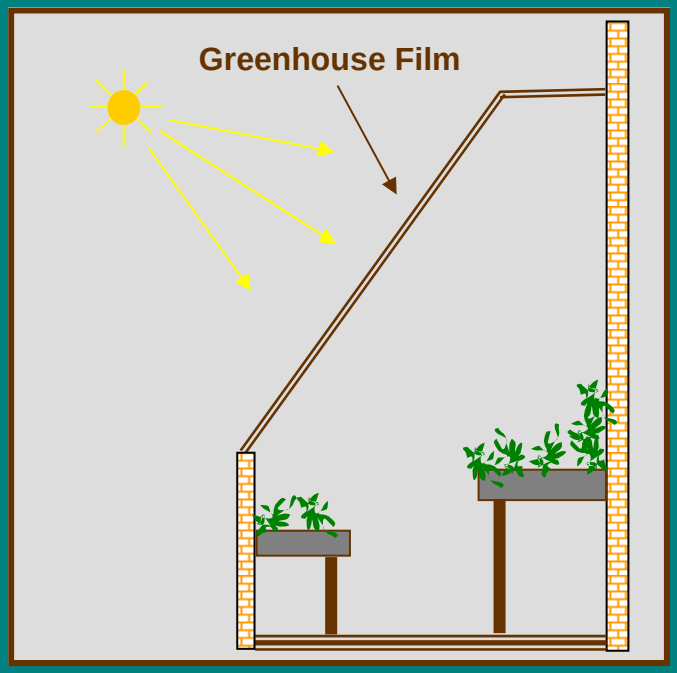
A 500 litre water butt from the local hardware store enabled us to collect rainwater off the shed roof - we subsequently discovered that this container is not rated for potable water.

Temperature Control

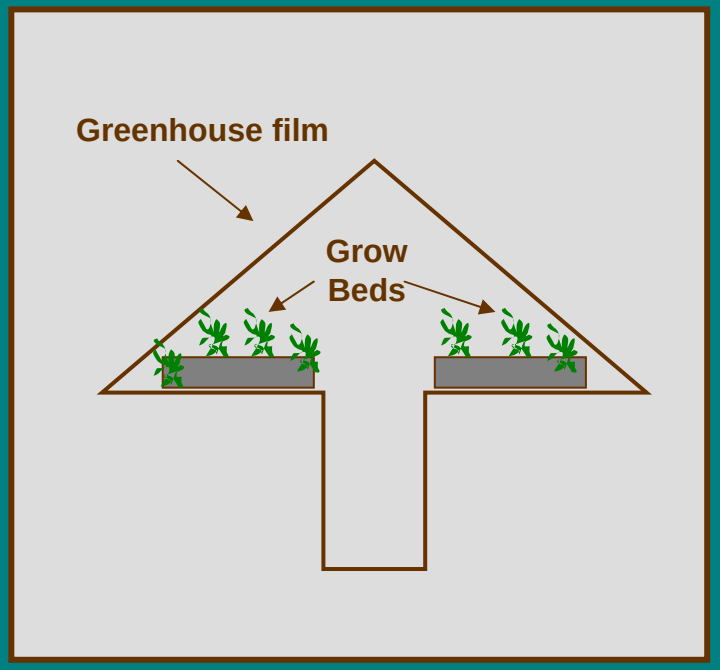
Covering an aquaponics system components is arguably the most effective means with which to control temperature. Small sun-facing cold frames and a lightweight mini-greenhouse are some of the passive solar strategies that we employ to moderate the temperature within this innovative Urban Aquaponics system.

This lightweight mini-greenhouse ensures mild temperatures on the coldest days in our area.

Other Types of Greenhouse



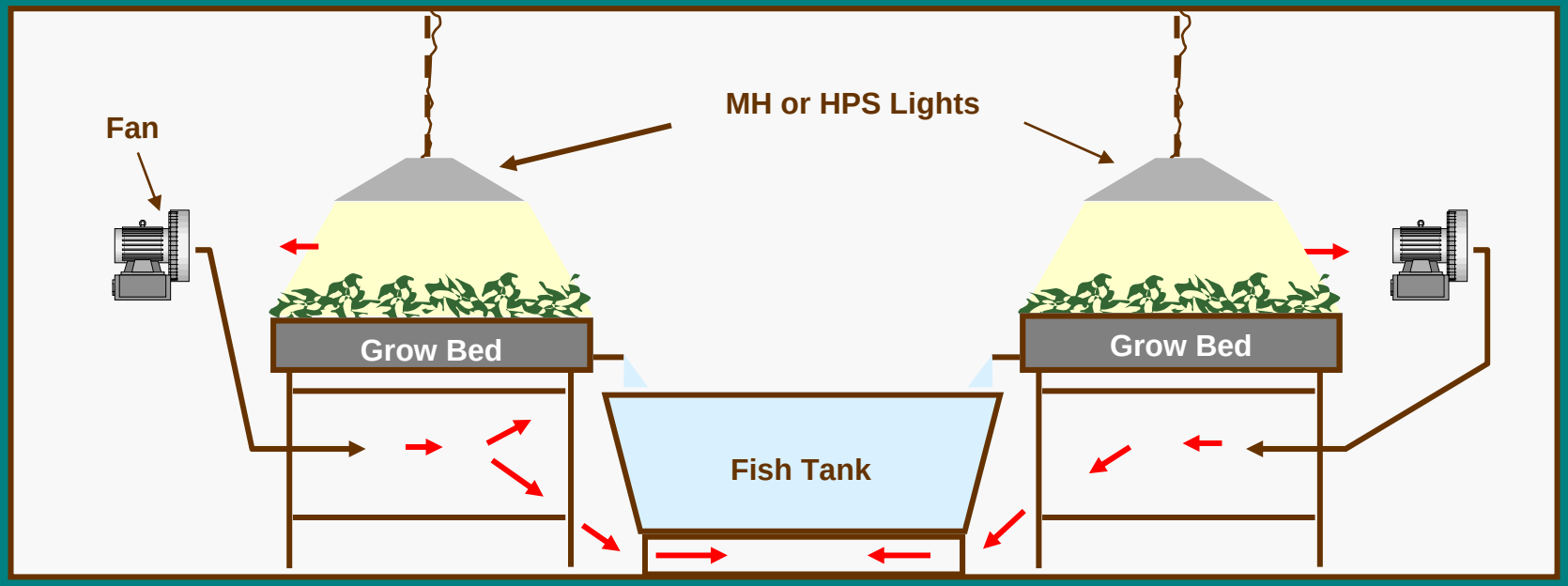
A sun-facing greenhouse will allow year round production of vegetables and herbs.



A pit greenhouse is economical to build and the centre walkway affords easy access to the grow beds.

A simple shade over the NFT system ensures that delicate plants don’t get sun-burned.

Indoor Gardening



Indoor Aquaponics provides the opportunity to precisely manage the production parameters for both fish and plants with a view to enhancing the growth potential of both. If the waste heat from the lighting for the plants is used to keep the fish tank at the optimum temperature, then the cost of the lighting is spread across both the lighting and heating functions. This efficiency is leveraged even further by the nutrients provided by the fish.

Feeding your Fish

In this section, we look at proprietary fish rations and some of the DIY options that are available to backyard fish farmers.

Proprietary fish pellets come in a variety of formulations and sizes. They are convenient to use and usually consist of a balanced diet for the species for which they were formulated. They are also expensive to buy and may contain a large proportion of fishmeal. This fishmeal content raises the issue of sustainability when it comes to the use of proprietary rations. Increasingly, aquaponicists are exploring various do-it-yourself fish food options.

DIY Animal Protein

A Black Soldier Fly – friend of the backyard fish farmer.

Animal Protein Options

- Black Soldier Fly larvae
- Worms
- Mealworms
- Blowfly/Housefly larvae
- Feeder Roaches
- Silkworms
- Feeder fish

BSF Benefits

The bottom of a compost bin….where most people get their introduction to the Black Soldier Fly. These amazing creatures turn low value food scraps into high protein larvae and worm bedding.

Soldier Fly larvae are 40% protein (dried weight) and have an impressive array of vitamins, minerals and amino acids.

They self-harvest and go straight into the freezer. Fish and poultry will eat them straight out of the freezer.

BSF show no interest in you or your house and there is no proven connection between BSF and disease in humans.

They convert large quantities of organic waste into soil conditioner that can be used to enrich your gardens.

The larvae can be dried and combined wth other ingredients (like duckweed) for other backyard livestock like quail, chickens and ducks.

They are quick and easy to produce.

A home-made BSF harvester – we placed the compos containing the larvae into the tub on the left. When the larvae are ready, the climb up the ramps and drop into the tub on the right.

Another home-built BSF larvae harvester – a slot in the raised end of the black trays allows the larvae to exit the trays and drop into the white collection tray.

Soldier Fly larvae are genetically programmed to remove themselves from their food source prior to undergoing metamorphosis. They can climb a 45 degree slope.

A good harvest of larvae.

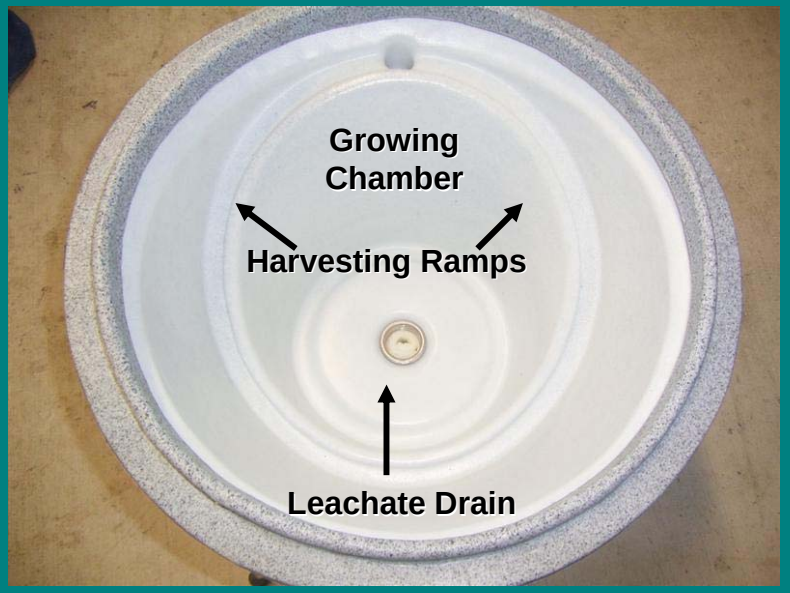
Did you know….?

Adult BSF have no functional mouth parts so they do not eat and nor can they regurgitate on human food.

BSF only live for 5 – 8 days – just long enough to breed and lay eggs.

Soldier flies may actually reduce housefly numbers by up to 95% …by denying the flies access to food.

BSF larvae are dry to the touch and have no odour.



The BioPod – for hassle-free BSF larvae production.

Kitchen scraps are placed into the growing chamber. The female soldier fly enters the unit through a vent in the lid and lays her eggs.

Once the larvae have grown, they self-harvest by crawling up the ramp in the growing chamber and dropping down into the collection bucket.

Duckweed – the smallest flowering plant in the world – high quality plant protein.

Duckweed

- 35 – 40% protein
- Easy and cheap to grow
- Removes nutrients from water
- Grows quickly
- Easy to harvest and store
- Can be fed on its own….
  ….or as part of a ration

Shards of frozen duckweed

Surplus larvae are frozen and stored for later use – fast food for fish and chickens.

A fish salad….from the fish' perspective….duckweed and BSF larvae.

Growing Systems

In this section, we look at the diverse range of growing system options that are used by Aquaponicists.

Grow Beds

While these robust units are designed to take gravel, grow beds can be made from a variety of materials including plastic, wood, plywood (fitted with a liner) and recycled bath tubs and drums.

While gravel is commonly used as a media, other options include, expanded clay, perlite, vermiculite and coco coir.

Growing System Media

Growing Media Comparison

	Gravel	Perlite	LECA*	Vermiculite	Coco Peat
Durability	Excellent	Low	Good	Low	Good
Weight	Heavy	Light	Modest	Light	Modest
Cost	Low	Modest	High	Modest	Modest
Plant holding	Good	Poor	Poor	Good	Good
Drainage	Good	Good	Good	Good	Good
Aeration	Excellent	Good	Good	Fair	Good
Water Retention	Poor	Modest	Poor	Excellent	Excellent
Ease of Handling	Poor	Excellent	Good	Excellent	Excellent
Lifespan	Excellent	Fair	Good	Fair	Excellent

* Light Expanded Clay Aggregate ** Coco Peat is fully recyclable

This gravel grow bed belongs to Martin A1 from Berowra, NSW and is made from a galvanised tank section.

Gravel Grow Beds – at 10 days

Gravel Grow Beds – at 17 days

Gravel Grow Beds – at 28 days

Gravel Grow Beds – at 42 days

Satellite Pots

Satellite Pots

- Continuous Flow irrigation
- Well-suited to large plants
- Relocatable

Tray System

A simple, lightweight and highly productive growing system.

The Autopot System

Nutrient Film Technique (NFT

Ideal for growing lettuce and soft herbs.

NFT Roots

Rampant root growth is a feature of NFT growing systems.

Aquaponic Potatoes

Square Foot Gardens

- Involves 50% of the cost
- Uses 20% of the space
- Needs 10% of the water
- Uses 5% of the seeds
- Requires 2% of the work

….of a conventional garden.

Raised Sheet Mulch Beds

- Water-wise
- Comfortable working height
- No digging – little weeding
- Highly productive

We operate four raised sheet mulch beds.

Growing System Setup

All of our growing systems are set up at a comfortable working height.

PLANTS

In this section, we look at just a few of the plants that can be grown in Urban Aquaponics systems.

Tomatoes are a high value crop that grows well in several different types of aquaponic growing systems.

If you can grow it in soil, then you can probably grow it using hydroponics…. or aquaponics.

We use herbs in large quantities. They grow very well on fish tank nutrients.

These two recycled fibreglass grow beds belong to Milne Matthews from Victoria. Recycled materials are a feature of Milne's aquaponics units.

Normal plant spacing can often be ignored in a grow bed. The plants are not required to compete with each other for water or nutrients.

Silver beet grows like a weed in an aquaponics system. We eat it ourselves and use it for green feed for fish, chickens and quail.

We grow potatoes and carrots in coco peat.

Integrated Backyard Food Production

In this section, we get an insight into the range of other backyard food production integrations that are possible.

Integrated Backyard Food Production

Integration is the secret to successful backyard food production. In fact, integration is the secret to sustainable food production… period!

If you set out to emulate commercial farming (which is neither integrated nor sustainable), your home-grown food will always be more expensive than the stuff you buy at the local supermarket, largely due to the economies of scale.

If, however, you can source your plant nutrients, livestock fodder, and water at little or no cost, you can shift the balance in your favour…..and therein lies the key to producing food cheaper than the big players in agriculture.

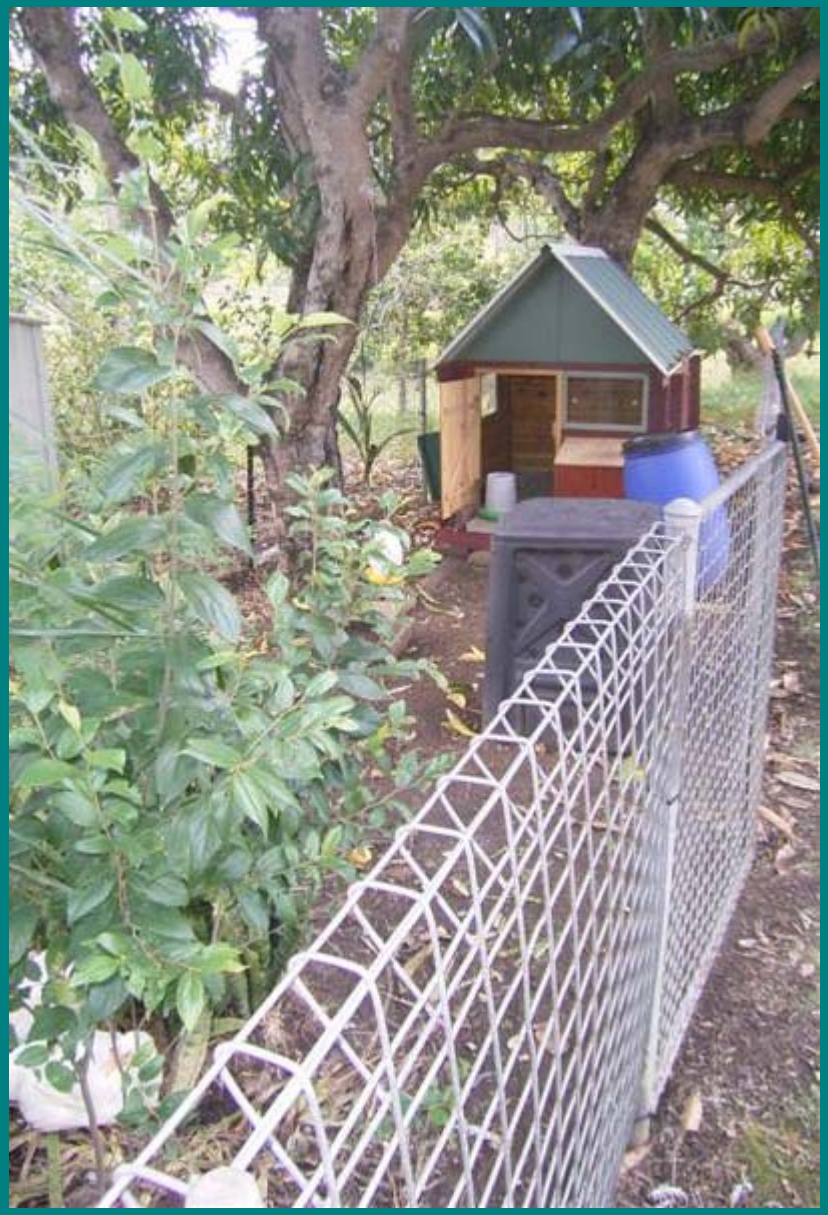
Integration occurs when we combine two or more food production systems to leverage their efficiency.

Integrated systems are always more than the sum of the parts. They're the agricultural equivalent of 2+2=5 (or more).

IBFP Options….

- Freshwater Fish and Crayfish
- Plants - vegetables, herbs, soft fruits & fodder
- Trees for fruit, nuts and fodder
- Chickens for meat and eggs
- Japanese Quail for meat and eggs
- Muscovies and waterfowl
- Rabbits
- Snails
- Mushrooms and other fungi
- Other micro-livestock – goats, pigs, sheep and cattle
- Live animal protein – BSF, worms, feeder roaches
- Plant protein – duckweed and azolla

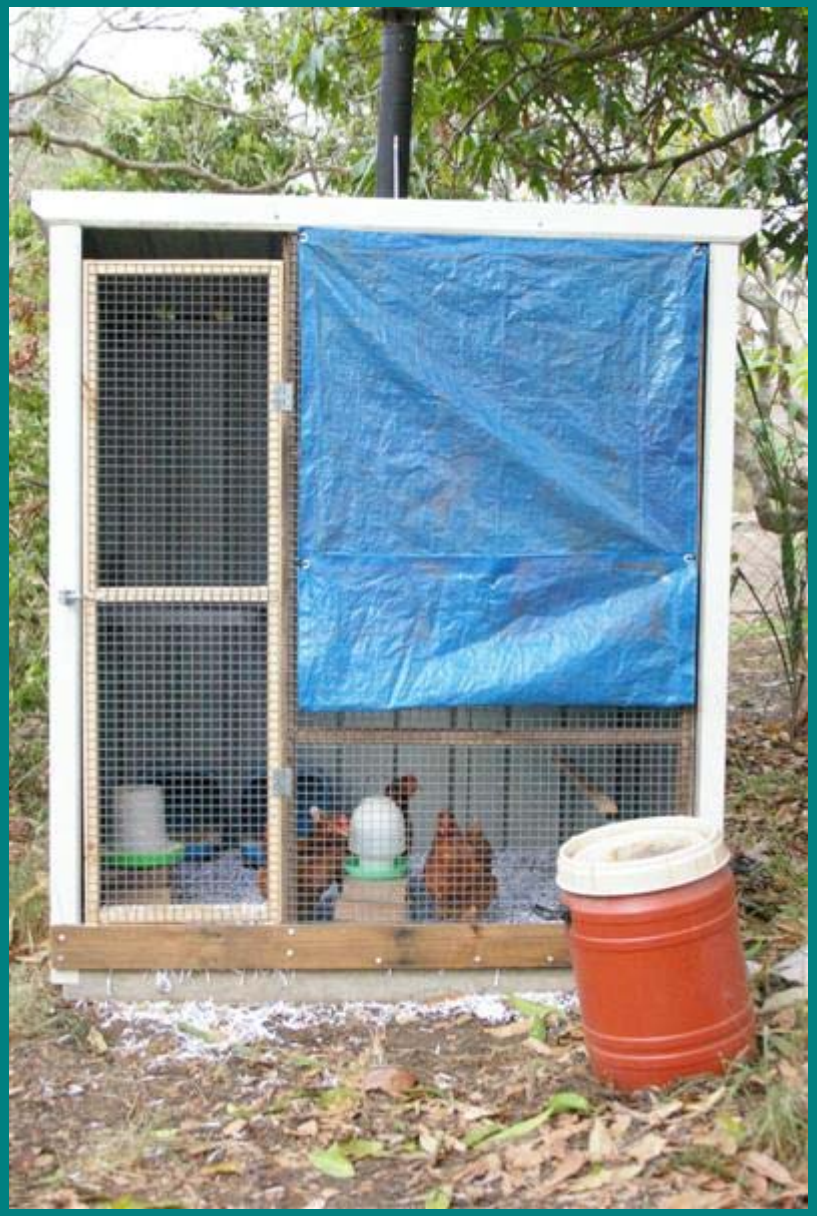
Meat Chickens



We rear our own meat chickens in this little hut.

Meat chickens at about seven weeks of age – and ready for processing.

Meat chickens at just two days of age.



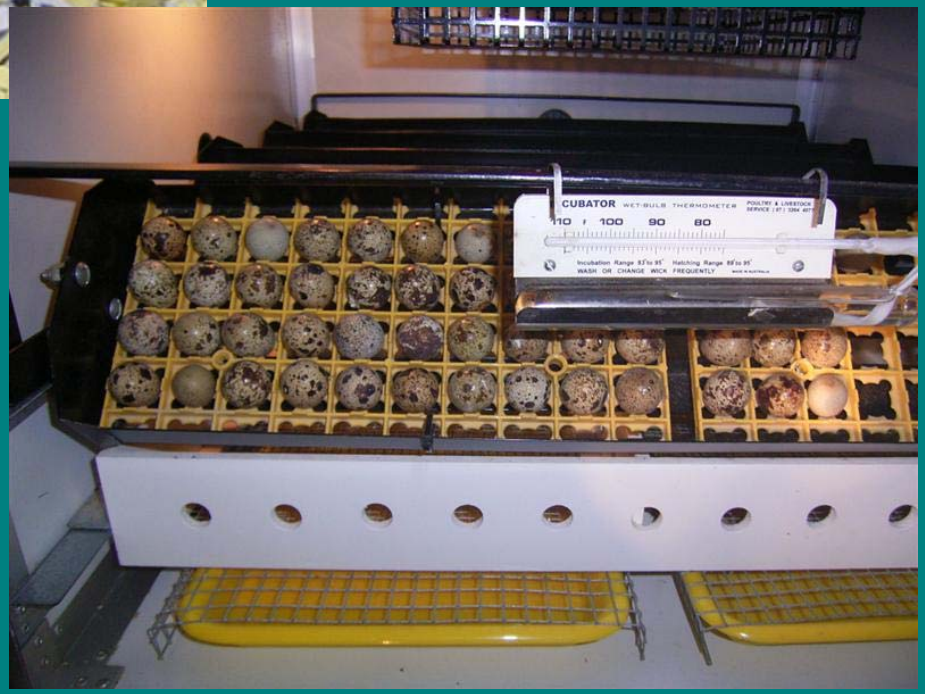
Laying Chickens

We keep three laying chickens which provide us with plenty of free range eggs and more than a little amusement.

Our layer chicken night quarters – keeps birds secure against predators and protects them from weather extremes.

Japanese Quail

A male Japanese Quail cockerel.



Our fan-forced electric incubator loaded with quail eggs.

The Quail Palace – used for rearing quail and meat chicks – doors on both sides for easy cleaning – removable internal partitions – plywood floors - shredded paper waste for deep litter.

5 Quail eggs weigh as much as one chicken egg. They taste the same and can be used for similar dishes - 10 – 12 quail eggs for an omelette.

Bio-Security Warning

No organism from an Aquaponics system should be allowed to make its way into any natural watercourse.

Plants or animals from an Aquaponics system that are introduced into the wild may be carrying disease organisms that can be transmitted to wild plants, animals or fish.

Well, that's it!

We hope that you enjoy your copy of The Urban Aquaponics Manual….and that it leads you to build your own Integrated Backyard Food Production systems.

We invite you to keep an eye on what we're doing by visiting:

www.urbanaquaponics.com.au

If you'd like to communicate with a small but pleasant group of like-minded Aquaponics enthusiasts, you might like to visit our discussion forum:

www.aquaponicshq.com