

Toteponics

A three bed D.I.Y. Aquaponics system built from recycled Totes (IBC's) utilising the CHOP Mark 2 operating system.

Congratulations on deciding to build your own Aquaponics system using Tote tanks / IBC's.

You will find that the finished system will give you excellent service and will provide an abundance of fresh fish and vegetables to your table.

The exciting thing is you will be putting some pre used materials to good use. The possibilities are endless using this build method.

You can add a single grow bed when needed, or add groups of three as a satellite cluster.

These will all be easily integrated into your system utilising the CHOP Mark 2 operating system.

This set of instructions has all the information necessary for you to complete a successful Aquaponics project and enjoy fresh fish and vegetables at your place.



ABOVE:- Murray Hallam from Practical Aquaponics.

The photo to the right is a three bed Tote system made from 3 x recycled Tote tanks or IBC's as they are also known.

This is the end result of following these instructions. It is easy to do if you have basic handyman skills and some basic tools.

At the time this photo was shot, this system was 22 days old....that's right, 22 days from planting of the first seedlings and just 15 days with fish in the system.

See the fantastic growth of the salad vegetables in the front two beds and the sweet corn in the back bed.

You will see that we have added some vertical towers to this system. This helps utilise vertical space. How-to do this is described in a later set of instructions.

We dressed the system up with some bamboo skirting. The system would look very nice in any backyard garden area, or even on a back patio.



ABOVE:- Some vertical Strawberry Towers have been added to the system making use of vertical space. You can grow strawberries, lettuce and soft herbs very well in vertical towers.. We will soon publish instructions "How to make vertical towers"

The first thing we need for the project is three Totes (IBC's)

For the rest of the instructions I will refer to them as IBC's.

IBC's are used to ship all manner of liquid goods around the world. Some have been used to transport dangerous chemicals, some have transported not so bad chemicals such as acids or detergents, and some have been used to transport foodstuffs.

Make sure you avoid the IBC's that have been used to transport any chemical that cannot be easily washed out with soap and water. It

is especially good to avoid IBC's that have contained any sort of agricultural chemicals. You may pay a little more for the better IBC's, but it is worth spending the money. Remember, the fish you are going to grow out and consume will be living in the IBC's for a year or more so leaching of bad chemicals from a dirty or contaminated IBC into your fish is highly likely.

Try to get three IBC's that are the same in construction, the same cage construction and tank colour etc. This will make your finished system look better and provide ease of construction.

IBC's are obtainable almost anywhere. They are able to be purchased as used in excellent condition or new unused. Look in your yellow pages or business directory for merchants who trade in shipping containers and / or packaging materials. Usually these businesses will sell the Totes / IBC's or they will know somebody who does. Contact shipping companies to see if they have second hand ones that may be available.

Tools that are needed to complete the task.

See Page 18 & 11
For a complete list of tools needed.

If you are a person who loves a project you will most likely already have most, if not all of the tools needed.



Murray and Lee are about to cut one of the IBC plastic tanks down to make grow beds and a sump. The plastic tank has been removed from the metal cage.



CHOP Mark 2 Operating System.

In brief, the CHOP Mark 2 operating system pumps water from a sump, with a single pump, to the grow beds and to the fish tank. The water returns from the fish tank to the sump by gravity. The water returns to the sump from the Grow Beds by gravity and the return flow is regulated by the use of Auto Siphons in each Grow Bed.

The advantages of CHOP Mark 2 operating system are:

- Ease of water flow control.
- Only one pump is necessary.
- Constant water height in the fish tank, even if the pump stops.
- Remote placement of the Fish Tank and at what level and where is convenient on your building site.
- Place Grow Beds at different levels if desired.
- No need to have Grow Beds at exactly the same level in relation to each other.
- Fish Tank or Grow Beds can be isolated for maintenance periods easily.
- Grow Beds can be turned off easily on cold nights to preserve heat in the Fish Tank.
- Isolate and drain Fish Tank easily for harvesting while Grow Beds continue as normal.
- Isolate Fish Tank if treatment of sick fish is required while Grow Beds continue to operate.
- External filters can be easily added to the system if desired, and isolated or removed if desired.

See animation of CHOP system [HERE](#)

Let's get started.

Examine the three IBC's you have and make a selection as to which one will be the fish tank and then the remaining two to be cut up into three grow beds and one as a sump.

First, select the IBC that is to become the Fish Tank. One of the things to be considered about the suitability of this tank is, the good condition of the pallet base. This will remain as part of the system so it needs to be a good one. Sometimes IBC bases have suffered fork lift damage. As the bases are discarded when making the Grow Beds and Sump, an IBC with damaged base can be used for the Grow Beds.

The cage needs to be firm and straight, and is not bent or damaged.

Examine the galvanized coating on the metal. Is there rust in places? If so you may need to consider painting the cage with some cold galvanizing paint.

The top of the IBC that is to become the Fish Tank needs to be cut out to allow easy access to the fish. Perhaps the IBC with the least attractive top and a good base may be the best choice for use as the fish tank.



ABOVE:- Two of our three IBC's ready for transformation into an Aquaponics System.

FISH TANK CONSTRUCTION

Now that you have selected the IBC that is to be the fish tank, **Take out the top cross braces** that go from side to side at the top of the IBC.

Extract the plastic tank from the cage.

When the braces are removed we can extract the plastic tank from the cage and base. The easiest way to remove the plastic tank is to lay the IBC on its side and lever the tank out gently. Some tanks however, prove to be difficult and then you may have to remove the base in order to get the tank from the cage. Make sure you keep the small bolts so that you can re-assemble the base and cage later.

Cut the top out of the plastic tank.

Mark a line around the top of the IBC 120mm (5") in from the edge. Use the set square to determine where the edge for measurement purposes.



ABOVE:- Mark a line on all four sides. To guide your cut. This photo was taken after the plastic tank was put back in the cage and the top braces re fitted.

Use your jig saw to cut the top out of the plastic tank. (See tools list.)

Paint the cage and base.

If the galvanizing is damaged or there is rust evident it is a good idea to paint the cage and base to protect the metal from further degradation. It is also a good idea for aesthetic reasons. Just because we are making use of recycled materials does not mean that it can't look neat and tidy in your back yard.



ABOVE:- Easier and a little more expensive alternative is to use pressure can paints. Easy and clean to use to freshen up the steel work..

Cold galvanizing paint, or "Silver Frost" as it is known in some places is a good paint for the purpose. If you do not have a spray gun and compressor you may choose to brush the coats of paint. .

Paint plastic tank. The plastic tank will need to be primed in order for your colour coat to stick. Automotive supply shops have just the right primer for the purpose as most modern day cars are plastic and metal. There is also plastic primer paint available in pressure pack. Choose a dark colour for your top coat / finish coat if possible. Dark colours block out the light better.

We are painting the plastic tank for two reasons.



1. To protect against UV breakdown of the plastic tank.
2. To provide a light blocker. This prevents sunlight penetrating the sides of the tank and therefore minimizing the growth of green algae on the inside surfaces of the tank when the system is in operation. (will not stop algae formation but will reduce it significantly.)

Re-assemble the cage, base and tank.

Re bolt the base to the cage and insert the plastic tank. Fit the two top support cross braces.

Support cross braces



ABOVE:- Top braces/rails being removed from the IBC.

MAKING THE GROW BEDS and SUMP

Separate the base, cage and plastic tank on the remaining two IBC's. This will require the use of your battery drill together with the appropriate driver bit. You may encounter different types of fasteners used to secure the cage to the base.



ABOVE and RIGHT:- We have found that these are the bits needed most often to remove the machine screws holding the cage to the base. Sometimes ordinary hex headed machine screws are used.

We can now cut the cage and tank to make our grow beds and sump.



245 mm
(9 3/4")
This may vary slightly from IBC to IBC

400 mm
(15 3/4")
This may vary slightly from IBC to IBC

BELOW:-

Lay the cage on its side to make the cuts. It is best to use thin abrasive cutting discs. Very fast and clean cut.



LEFT:- Clean up any sharp edges using a sandpaper flap wheel on your grinder. A flat file will also do the job if you do not have a flap wheel..

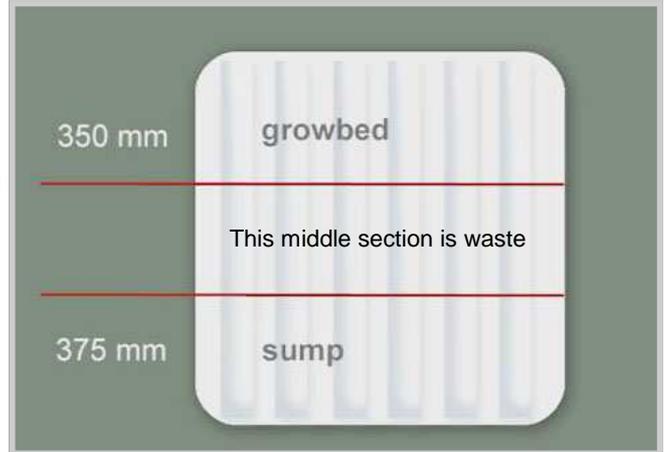
CUTTING the PLASTIC TANKS.

Two of the plastic tanks will be cut to provide three grow beds and one sump.

The 375mm (15") piece will be a sump, and the same cut piece from the second plastic tank will form the rear grow bed. This piece is from the bottom of the plastic tank and will contain the tap / valve that is part of the IBC plastic tank.

The 350 mm (14") piece will be a grow bed. This will be from the top of the IBC plastic tank. The same sized piece cut from the second IBC tank will make the second front grow bed.

We now have three grow beds and one sump.



Above:- Use the large set square to determine the correct measurement from the bottom of the tank. In this image the plastic tank is laying on its side for measurement and cutting.



Above:- Mark the tank for cutting, using the felt marker pen and a straight edge.

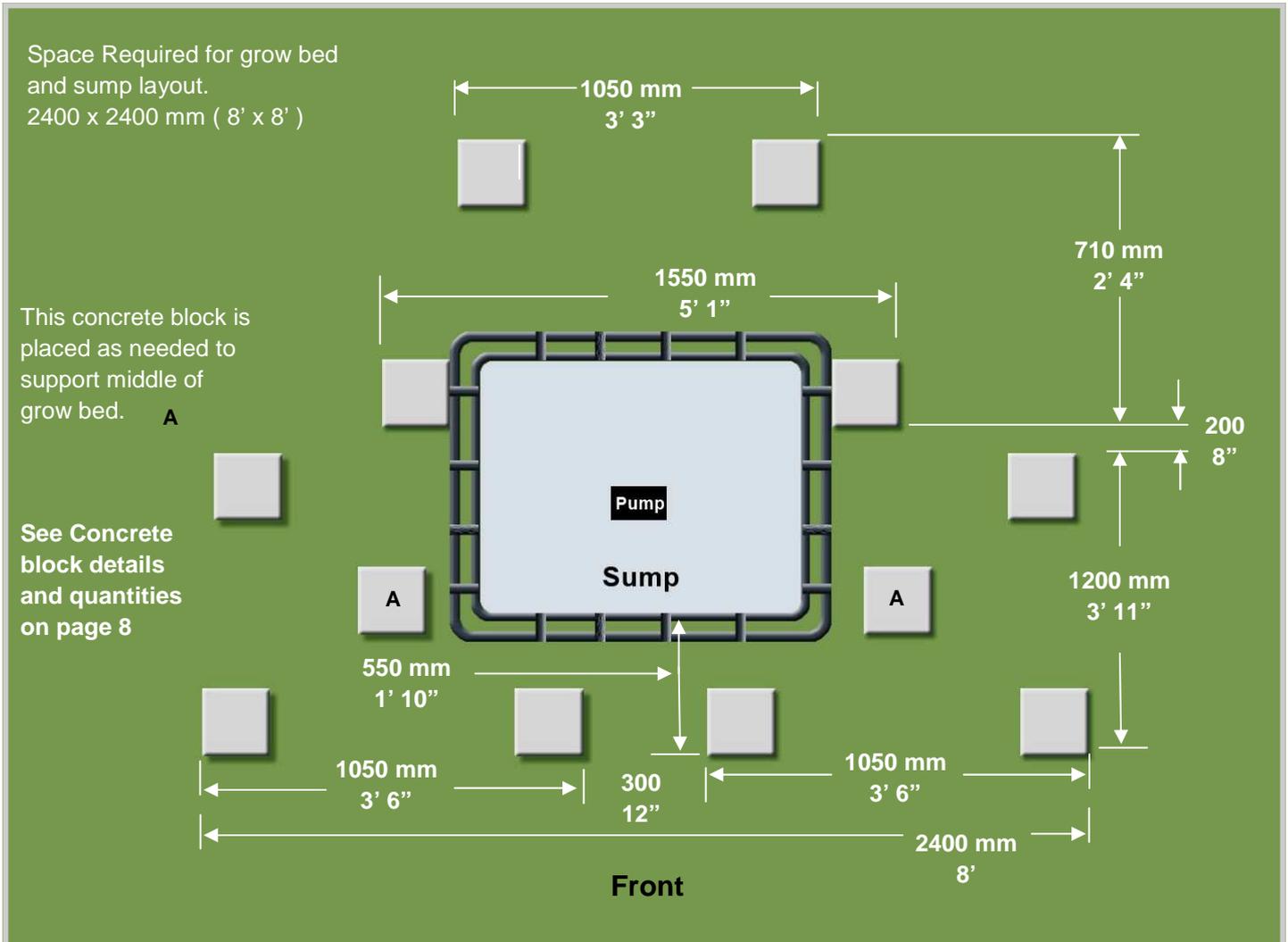


Left:- The cut parts that are now ready for painting. Note the screw on lid that is part of the top of the plastic tank. Make sure this is securely tightened. If the seal is not good, or you are not sure, secure with SIKAFLEX or silicone sealant.

You will notice that we do not have the auto siphon outlet going out through this lid. The auto siphon is better located out towards the edge of the grow bed.

LAYOUT the JOB.

The space required can be seen in the drawings that follow. Allow 2400mm x 2400mm or 8 foot x 8 foot of space plus some walk around space so you can tend the garden when finished.



Place the sump allowing room front and back and at each side for the grow beds, and the fish tank. See the drawing on the next page about fish tank placement.

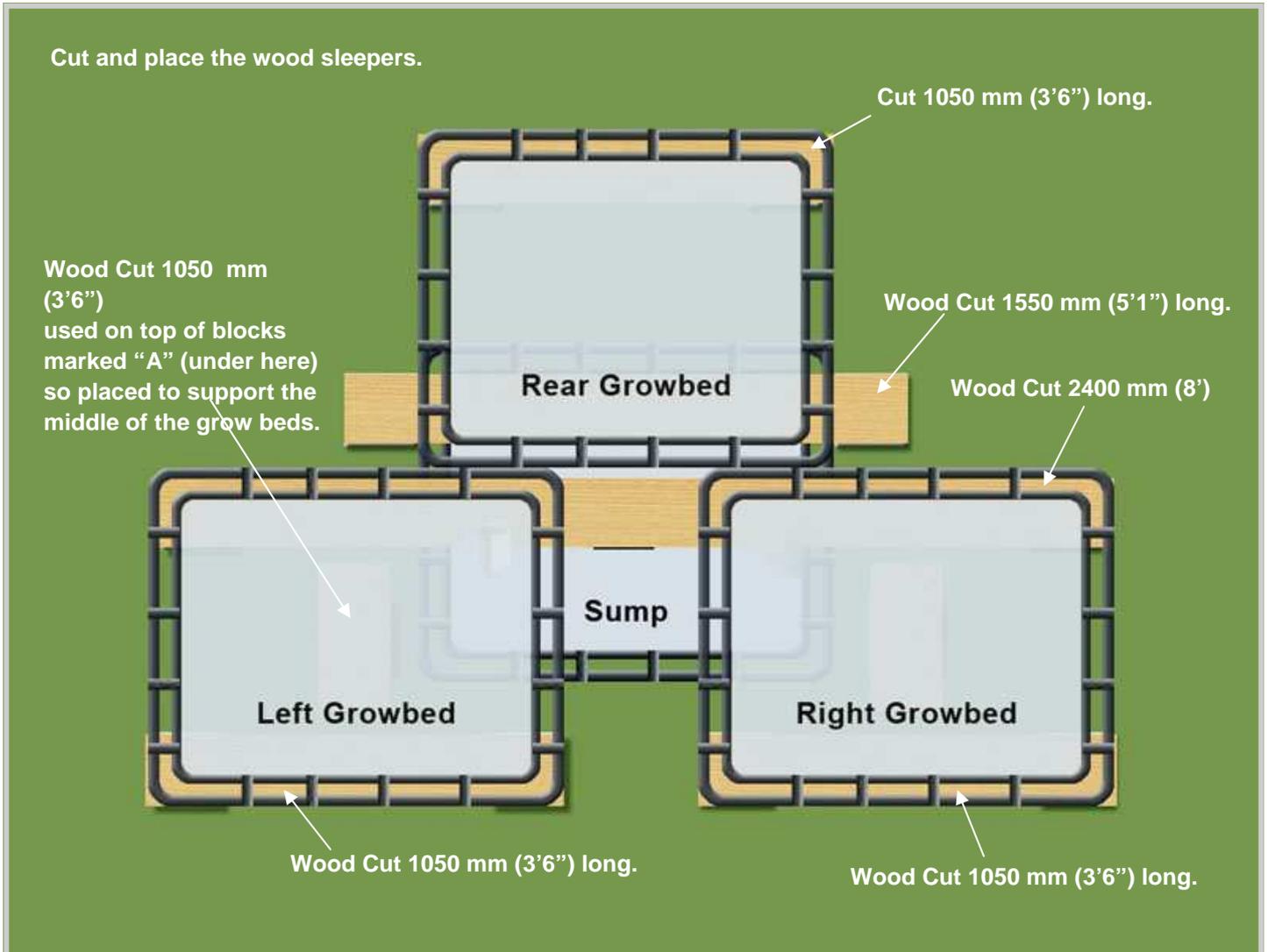
Start laying out your concrete blocks by striking a line parallel with the front of the sump and 550 mm (1' 10") out from the front of the sump. This is the line for the front row of concrete blocks.

Work out from the middle to the left and the right placing the blocks as per the measurements above.

Then work back from that front line and place the blocks as per the drawing above. Please note, blocks marked "A" will need to be placed as per your own need depending on the shape of the bottom of your own particular grow bed. It is important to fully support the middle bottom of the two front grow beds.



Cut and place the sleepers. The sleepers or timber / lumber is 200 x 50 x 2400 mm in size. (2" x 8" x 96") If this size is not available then 100 x 50 x 2400 mm (2" x 4" x 96") and double them up to get the same overall width. My preference is treated softwood although hardwood is fine.



The sleepers / timbers are cut to
1 x 2400 mm long (8')
3 x 1050 mm long (3'6")
1 x 1550 mm (5'1")
2 x 300 mm (1') for placement on blocks "A"

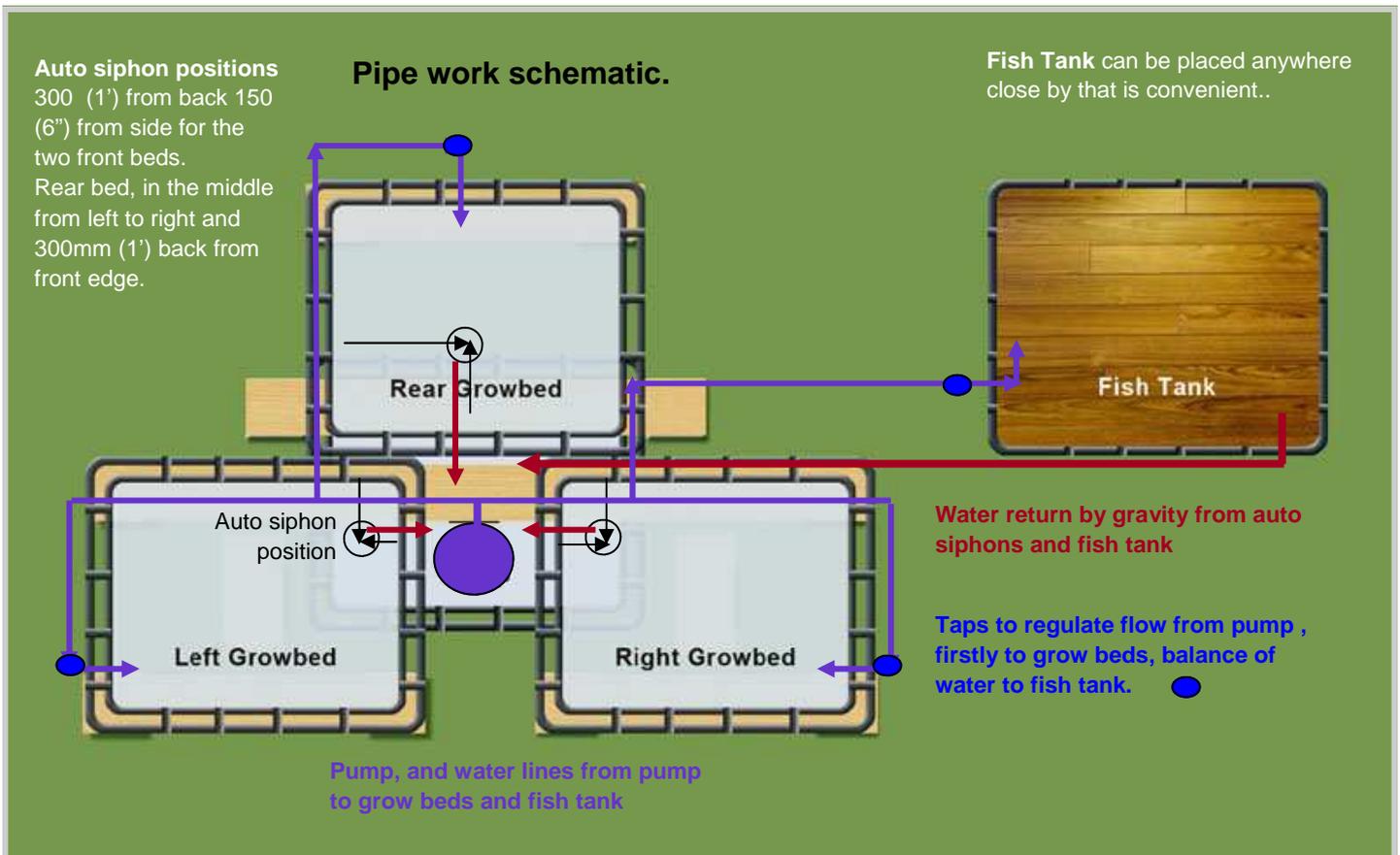
Concrete blocks. Standard 390 x 195 x 195 mm (15 1/2" x 7 3/4" x 7 3/4") concrete blocks. For economies sake you can use **12** concrete blocks standing on their end to give the right height, but the system will be more stable if **24** blocks are used and stacked on their sides.

Notes:-

Placement of the fish tank. Tank is placed nearby where it is convenient for the space you have available. Where illustrated is good, as it is close enough for the pump to remain efficient and allow room to work and have access around grow beds and fish tank.

Pipe work from the pump is best in 25 mm (1") pvc or poly pipe, reducing to 19 mm (3/4") at the tap. This allows good flow and pumping efficiency.

Pipe work from the pump is run under the grow beds and underground to the fish tank.



Return lines from the auto siphons are 25 mm (1")

Return line from the fish tank is best in 50 mm (2")

NOTES:-

TOOLS Needed



Sanding Board. This is used to remove rough edges after making a cut in the plastic. Not really necessary, but makes the job easier. You could substitute a piece of timber with some course sandpaper attached to do the job.



Metal set square. You need a large one typically one builders would use when setting out a house frame. 600mm x 300mm in size or thereabouts. (2' x1') This is used to mark out and measure to get an accurate measurement by determining the location of the edge.



Power circular saw. Used to cut to length the timber supports for the Grow Beds. A sharp hand saw will do the job just as well but will require some muscle power.



Rubber Hammer. This is used to adjust the concrete blocks when the Grow Beds are in place and loaded and perhaps one or two of the blocks need some small positional adjustments. This tool can be substituted by an ordinary claw hammer, but if using an ordinary claw hammer, be careful not to shatter the blocks.



Grinder fitted with 100 mm (4") very thin abrasive metal cutting disc. You will use 5 of these cutting discs in cutting up the cages for the Grow Beds and Sump. If you do not have a 100 mm grinder, you can cut up the cages with an ordinary hack saw, but it is a lot of work.



Flap Wheel. This is used on the 100 mm (4") grinder to take the burs off the steel cage after it has been cut using the cutting disc. Often there is a very sharp burred edge left which needs attention to prevent cuts to hands when using the finished Aquaponics system. If you cannot obtain one of these then a flat file can be used to attend to the burred edges.



Box Cutter knife, or Stanley knife.



Spirit level. The longer the better. This is used to level the blocks that will support the grow beds and to level the base for the fish tank.

TOOLS Needed



Driver bits. The type of screw / bolt found on IBC's needs one or all of the following bits to remove them.. They are called "Security Bits" The sizes needed are T-30, T-35 , T-40.



Shifter. This tool may be needed to undo hex head bolts when removing the base from the IBC cage. Only some IBC cages (Tote Tanks) have hex head bolts. It is more likely that you will need the Driver bits shown above.



Felt marker pen. Used to mark the plastic tank as a guide for cutting. Any colour is fine as long as you can see it well enough to make a good straight cut.



Jig Saw. Used to cut the plastic tank. It is best to select and fit a blade for cutting plastic or wood for the job. Metal cutting blades will quickly clog.



Power Drill. This can be a battery operated drill or a regular mains power drill. This is used to remove the machine bolts / screws that hold the cage on its base. Also used together with hole saws to make holes for the pipe inlets and outlets for the auto siphons, water entry and exits.



Hole Saws. The easiest way to make correct sized holes in the plastic tank and grow beds is to use a hole saw powered by your battery-drill shown above. Low cost hole saws can be successfully used as the plastic is easy to cut.

PLUMBING fittings needed.



Three IBC tanks are needed. Preferably identical in cage and plastic tank construction. Get the best you can. Make sure they have not been used for the transport or storage of dangerous chemicals.

Required = 3



Pipe: Rigid PVC pipe shown at left of photo. 25 mm (1") is the preferred size and pipe. See also in the right of the photo a roll of black flexible poly pipe, the type used by farmers for irrigation. This type can be used but is not as neat or as easy to work with.

Required = 15 mtrs (45 foot) x 25 mm (1") pipe
= 5 mtrs (10 foot) x 50 mm (2") pipe (see next page)



Elbows for the PVC pipe work.

Required = 16 x 25 mm (1") elbows
= 5 x 50 mm (2") elbows



Tank fittings, sometimes known as Bulkhead fittings.

Required = 1 x 50 mm (2") For gravity return from fish tank. Listed also on page 13 and shown in assembly photo.



Elbows, Black.

This elbow is used at the end of the lines to the Grow Beds.

Required = 6 x ELBOW BSP 1" M+F



Valve Socket. Used to join the 25 mm (1") PVC pipe to the threaded end of the tap/ ball valve that regulates the water flow to each grow bed and into the fish tank.

Required = 5 x Valve Socket 1"



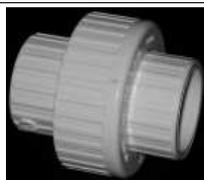
"T" Fittings

Required = 3 x 25 mm (1") "T" fittings



Plastic Ball Valve

Required = 5 x 25 mm (1") threaded ball valves.



Barrel Union. Joins the pump to the pipe work for easy removal of the pump for service

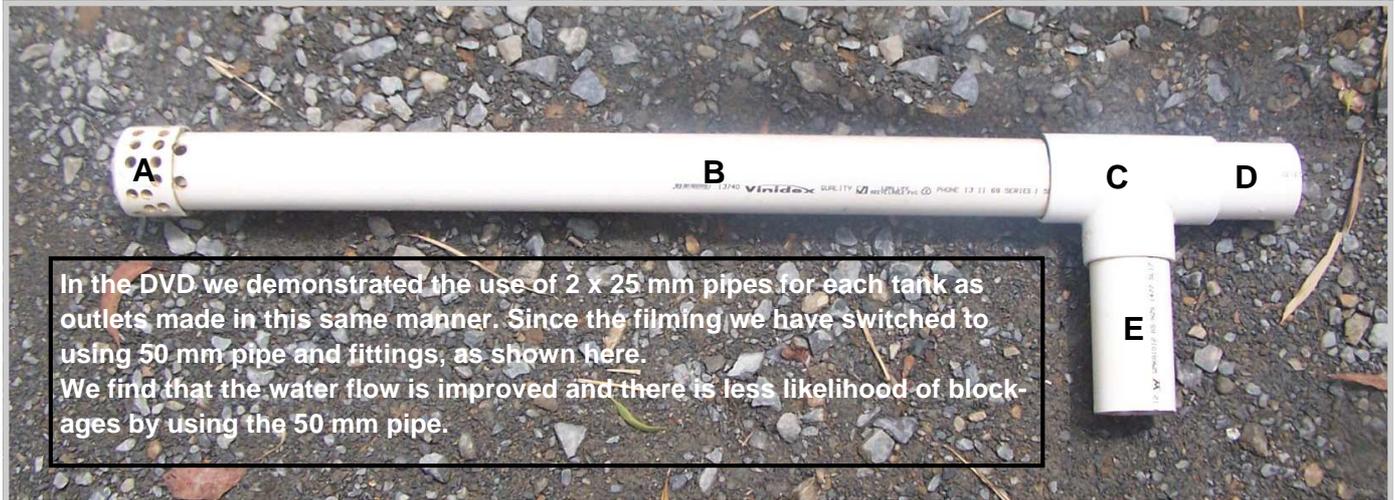
Required = 1 x 25 mm (1")



Faucet Socket. Used at the base of the pump take off under the barrel union.

Required = 1 c 25 mm (1")

Make up the outlet that comes from the fish tank to return water back by gravity to the sump. This is made from 50 mm (2") PVC pipe. We have found that this gives best results. This is made up in order to bring the water from the bottom of the tank, up and out and back to the fish tank. The only part that is glued is the bottom cap. The rest just push together so that they can be easily pulled apart for cleaning.



Please note, the total amount of 50 mm (2") pipe you will need will depend on the placement (distance) of the fish tank from the sump and grow bed assembly.

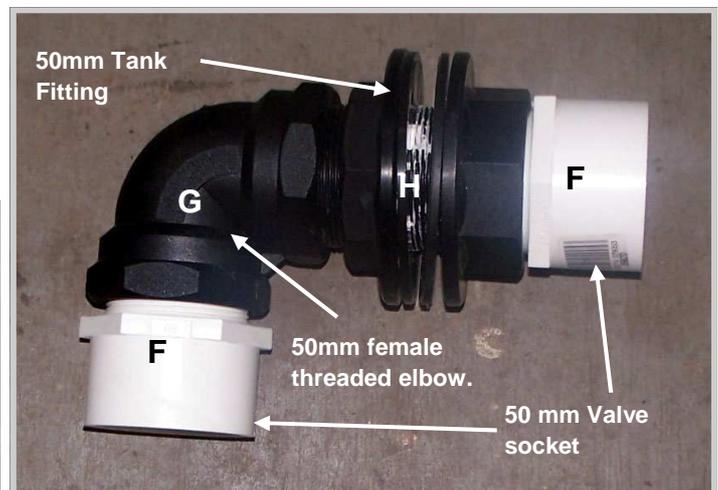
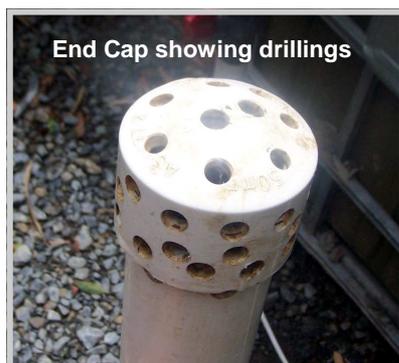
Parts List for Fish Tank Outlet from fish tank to sump

Part #	Qty	Description
A	1	End cap to suit 50 mm (2") high pressure pipe.
B	1	710 mm (28") of 50 mm (2") high pressure pipe. This may vary depending on your particular IBC tank, but when in place the bottom of the outlet should just touch the bottom of the tank.
C	1	"T" to suit 50 mm (2") pipe
D	1	85 mm (3 1/4") of 50 mm (2") PVC pipe
E	1	130mm (5") of 50 mm (2") PVC pipe
F	2	50 mm (2") valve socket
G	1	50 mm (2") female threaded elbow
H	1	50 mm (2") tank fitting.
	5	Mtrs (10') of 50 mm (2") PVC pipe to sump
	3	50 mm (2") 90 degree elbows .



Above:- View showing how the made up assembly fits into the outlet fittings.

End Cap drillings are 6 mm (1/4") holes as many as you can fit in while maintaining the strength of the end cap. This allows water and suspended solids to pass, not small fish.



Above:- Fittings to bring water out from fish tank and on its way to the sump .



Water inlets to grow beds and fish tank.
See fitting / parts quantities on page 12.

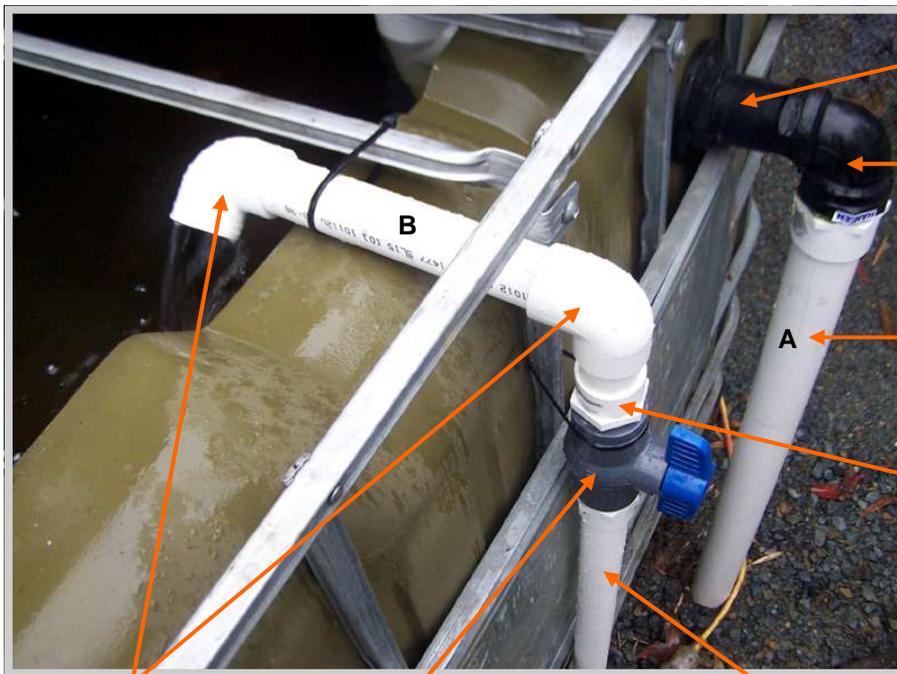
Elbow BSP M+F 1". X 2 These are used to make a "U" shape to direct the water over and down into the grow bed.

Plastic Ball Valve, threaded 1" BSP. These are used to regulate the flow into each grow bed and the fish tank. The colour of the handle and body of the ball valve varies from brand to brand and is unimportant.

Valve Socket. Threaded end into Ball Valve, glue other end to 25' mm (1") PVC pipe.

25 mm (1") PVC pipe. Cut to length as necessary.

Elbow 90 deg 25 mm (1") use as necessary.



50mm (2") Tank or Bulk-head fitting.

50 mm (2") Female threaded elbow. See page 13 for more detail and qty required.

50 mm (2") pipe bringing water back from fish tank to the sump by gravity. **Assembly A.**

Valve Socket. Threaded end into Ball Valve, (each end) glue other end to 25 mm (1") PVC pipe

This pipe and fitting assembly brings water by pump from the sump to the fish tank. **Assembly B.**

Elbows 90 deg 25 mm (1") as needed.

Plastic Ball Valve, threaded 1" BSP. These are used to regulate the flow into each grow bed.

25 mm (1") PVC pipe. Cut to length as necessary.

Auto Siphon Parts List

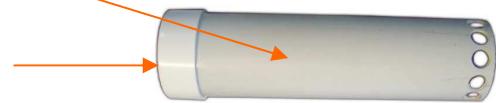
- 1 Piece of 100mm (4") id PVC pipe cut to 235 mm (9 1/4") long.
This is for the outer to keep the media back from the bell and upright. Needs to be drilled as per photos on other pages.
Pipe cap and sleeve to suit 100mm pipe
Cap has 6mm hole drilled to allow air passage.



- 1 100mm (4") cap and sleeve.

- 1 65mm (2 1/2" inch) PVC pipe cut to 260 mm (10 1/4") long
For the bell of the auto siphon

- 1 Glue on end cap to suit 65 mm (2 1/2") PVC pipe.
For the bell of the auto siphon



- 1 Tank fitting 25 mm (1") It has rubber washers included.
To go through grow bed bath tub to fit auto siphon up stand and outlet.



- 1 PVC Valve socket 25 mm (1") to suit 25 mm cat 12 PVC pipe
Spears number 338-010 **For base of up stand.**



- 1 Reducing coupling 25 mm x 32 mm (1" x 1 1/4")
Spears number 429-168 **For top of up stand**



- 1 PVC pipe 25 mm (1") cut to 140mm long
For the pipe to complete the up stand. This is the piece of pipe measurement not including the fittings for each end..

- 1 Faucet adapter 25 mm (1")
For the bottom of the tank fitting leading back to fish tank.
Please note this can be replaced with threaded elbow if avbl in your area, as seen on the next page.



- 2 90 degree elbows 25 mm (1") to suit PVC pipe 25mm
To come off the Faucet adaptor and lead back to the bath tub (fish tank) below.



- 1 1000 mm (3'3") approx of 25mm (1") PVC pipe to cut to suit.

- 1 Tube of construction grade SIKAFLEX , or if you can't find that some roof and gutter sealant.



90 degree elbow socket
Spears # 408-010

90 degree elbow. One end is a glue socket and the end shown is threaded to suit 25 mm (1") Threaded end can be clearly seen.

Use this fitting to screw directly onto the black tank fitting coming from the bottom of the auto siphon.

Spears # 307-010

This fitting may not be available in all areas. If it is not you will need to use a faucet adapter.



32 x 25 mm
(1 1/4" x 1")
reducer for top of
up stand.
Spears # 429-168

Overall height of
this type of up
stand is 210 mm "
(8 1/4")

Valve Adapter
25 mm (1")
Spears # 336-010

Note the type of up stand, shown at left, with the reducing coupling on top instead of a straight ended up stand.

In theory it assists the siphon to start more easily.

In close tests we have found that it is more beneficial in assisting the siphon to break or end when the tank has been siphoned down.

It also appears to give the siphon a wider flow operating range, although the advantage is not that much.

Auto Siphon.

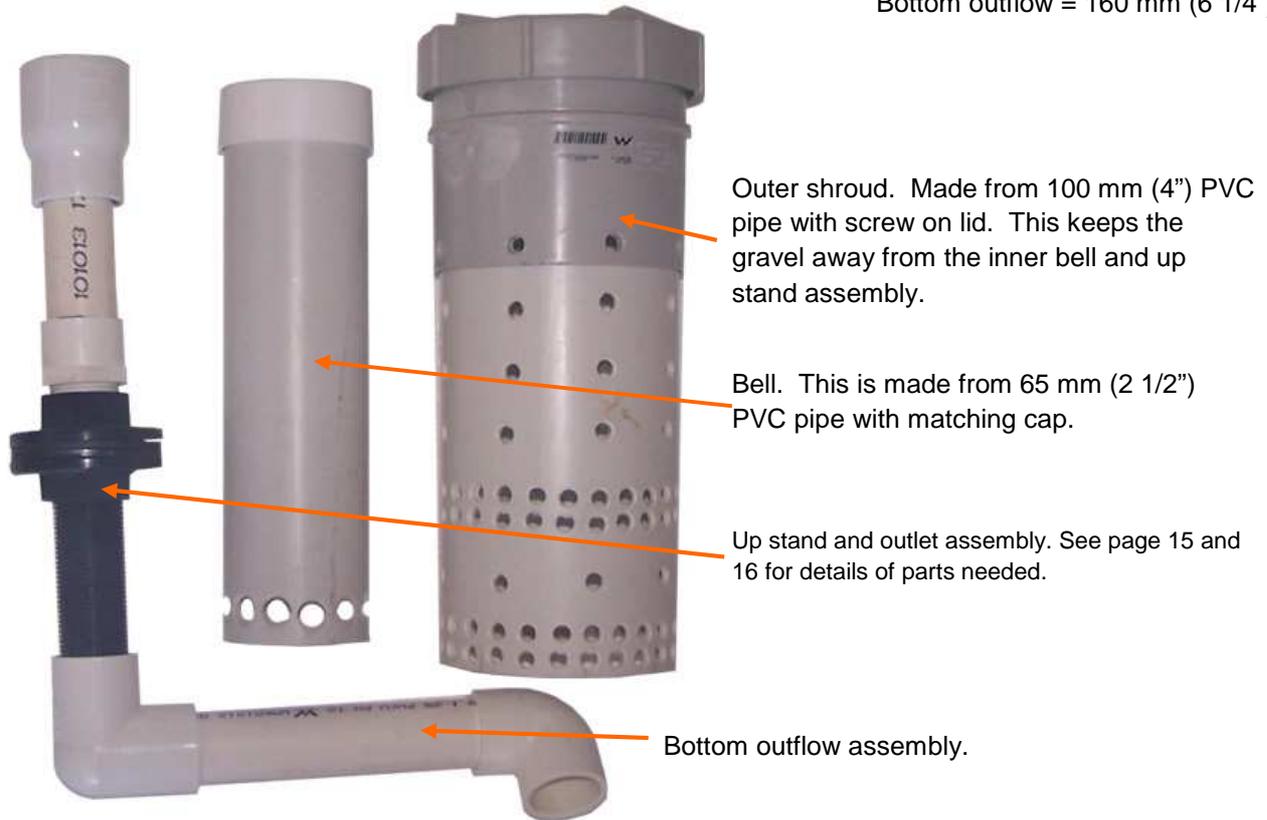
Pipe lengths.

Bell body = 260 mm (10")

Shroud body = 235 mm (9 1/4")

Up stand = 85 mm (3 1/2")

Bottom outflow = 160 mm (6 1/4")



We post auto siphon assemblies all over the world. If you would rather we make auto siphons instead then send me an email and we will arrange postage.

Email admin@PracticalAquaponics.com

Auto Siphon adjustments.

Carefully adjust the taps to balance the water flow to the grow bed. Watch it fill and empty.

To get the auto siphon to work correctly remember:

Not enough water flow, the auto siphon will not start.

Too much water flow, the auto siphon will not stop.

Make adjustments to the tap in very small increments and be patient.

Watch and make another small adjustment's.

It will work and work very well for you.

Pump Requirements

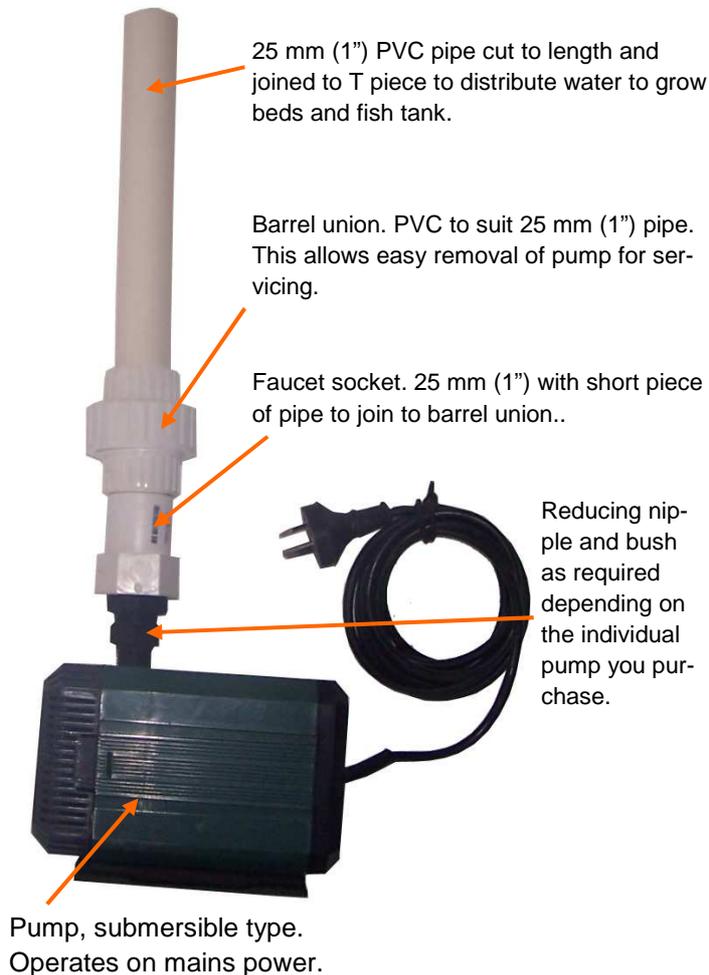
For this particular design you will need a pump with a capacity of around 3000 litres (700 US gallons) per hour.

In theory you should only need a pump of about half that capacity, but we have found that the majority of submersible pond pumps do not provide much "head" or capacity to lift the water. When a pump manufacturer quotes a capacity (volume per hour) for the pump, that is at the pump with no pipes attached. Once you attach pipes, elbows, taps and the like, the volume of water that can be delivered to the grow beds and fish tank is greatly reduced.

It is important to make your pipe work neat and with the minimum of bends. This will assist the maximum delivery of water to the end points. This is why we recommend the use of 25 mm (1") pipe work. This sized pipe assists the easy delivery of water especially when using a low cost submersible pump for your project.

Spare Pump. Pumps are mechanical devices and are therefore subject to failure. It is wise to have a spare pump on the shelf in your workshop ready to press into service at a moments notice should you have a failure.

Clean your pump. It is good to regularly clean the filter of the pump. I check and clean my pumps fortnightly. You may need to check your pump more regularly than that depending on your local conditions. For example if you find debris such as leaves regularly find their way into the sump and are picked up by the pump.



Notes:

Operational Guide Lines

It is often pointed out that it would be a good idea to have some basic rules-of-thumb for Aquaponics gardening. Why? Because they will help in getting started without needing to spend weeks researching. The finer points can be studied and implemented as the project goes along.

Dr. Wilson Lennard from Australia has formulated the guidelines that follow below. Dr. Lennard has earned one of the few PhDs in Aquaponics in the world.

Nothing listed below is set in stone and there are exceptions to almost every one of the listed rules-of-thumb given certain conditions. However, they do offer a set of generally accepted principles that, if adhered to, will put you on the path towards successful Aquaponic gardening.

One final caveat. These rules are intended for media-based backyard or hobby systems only. If you are intending to get into Aquaponics commercially, then please seek a professional training course that will help you design an optimal system that has a chance to generate a profit.

This version of the document has been edited to metric measurements and an additional system cycling method as an alternative. An imperial version can be seen on Sylvia Bernstein's website [here](#).

Rules-of Thumb.....

System type – Media bed is recommended for new, Hobby growers.



CHOP Mark2 system built from recycled IBC's

Why not NFT or Deep Water Culture (aka, raft or DWC)?

A media bed performs three (3) filtering functions;

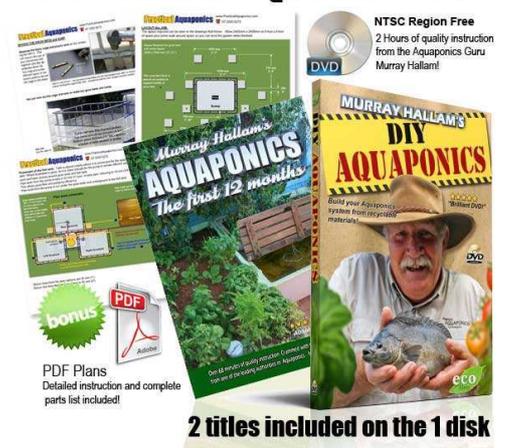
- 1 mechanical (solids removal)
- 2 mineralisation (solids breakdown and return to the water)
- 3 bio-filtration

Because the media bed also acts as the place for plant growth, it basically does everything all in one component – making it all simple.

Media also provides better plant support and is more closely related to traditional soil gardening because there is a media to plant into.

The cost of building the system is lower because there are fewer components.

NOW YOU HAVE NO EXCUSE NOT TO GET INTO AQUAPONICS!



Our latest DVD has two titles on the same disk including this PDF instruction file.

You can order the new [DVD HERE](#)



It is easier to understand and learn.

Grow Bed

The industry standard is to be at least (300 mm) deep to allow for growing the widest variety of plants and to provide complete filtration.

Must be made of food safe materials and should not alter the pH of your system (again, beware of concrete).

Fish tank

If you have flexibility here, (1000 litres) or larger seems to create the most stable Aquaponics system. Larger volumes are better for beginners because they allow more room for error; things happen more slowly at larger volumes.

Must be made of food safe materials and should not alter the pH of your system (beware of concrete, for example).

Stocking Density

20kg of fish per 1000 ltrs. This is a very safe stocking density for new systems.

(see further instructions on [stocking density](#))

Steps for Planning your System

Determine the total grow bed area in square metres.

From grow bed area, determine the fish weight required (kg) using the ratio rule 5 kg of fish for every square metre of grow bed surface area, assuming the beds are at least 300mm deep. Determine fish tank volume from the stocking density rule above.

For example, if you plan to have 2 x 1 sqm grow beds, total of 2 sqm of growing area. Plan to stock so you have a mature weight of no more than 10kg of fish which will require 500 litre fish tank.

Media

Must be inert – i.e won't decompose or alter the pH of the system.

LECA (Lightweight Expanded Clay Aggregate, AKA Hydroton or CANNA clay), Lava Rock, and Gravel are the most widely used media types. If you choose gravel, understand its source and avoid limestone and marble as they could affect your pH.

Water Flow

You should flood, then drain your grow beds. The draining action pulls oxygen through the grow beds.

If you are operating your system with a timer you should run it for 15 minutes on, and 45 minutes off. If you are running auto siphons, they will determine the time of the flood and drain cycle.

You want to flow the entire volume of your fish tank through your grow beds every hour if possible. Now consider the "head" or how far against gravity you need to move that water and use the sliding scale that is on the pump packaging to see how much more pump capacity you need.

Starting your System or "Cycling"

See articles [in my on-line Forum](#). And [BLOG](#)

Ammonia, Nitrites, Nitrates – after cycling,

Ammonia and Nitrite levels should be less than .75 ppm

If you see Ammonia levels rise suddenly, you may have a dead fish in your tank.

If you see Nitrite levels rise you may have damaged the bacteria environment in your system.

If either of the above circumstances occur, stop feeding your fish until the levels stabilise, and, in extreme cases, do a 1/3 water exchange to dilute the existing solution. Nitrates can rise as high as 150 ppm without causing a problem, but much above that, you should consider adding another grow bed to your system.

Oxygen

Be sure there is plenty of oxygen in your fish tank. You can do this through the use of a separate aeration device and by diverting part of the water from flooding and draining your grow beds directly into your fish tank. The only way you can have too much oxygen in a fish tank is if you are literally blowing your fish out of the tank. If you don't



have enough oxygen being infused into your tank your fish will be gasping for air at the water surface, but if you reach this stage you may have done permanent damage to your fish's respiratory system.

When to add plants

As soon as you start cycling your system, but accept that they may not grow well for the few weeks required for cycling to occur.

If you add Maxicrop Liquid Seaweed to your tank when planting or Seasol at the rate of ½ litre per 1000 litres, your plants will establish themselves much more quickly. (then at the rate of one CAP full per day until system is established)

When to add fish if you are using a Fishless Cycling technique

Add fish once nitrates are present and the ammonia and nitrite levels have peaked and declined below 1.0 ppm. (see again instructions on cycling)

Feeding Rate

As much as your fish will eat in 5 minutes, 1 – 3 times per day. As soon as the fish start to lose interest in feeding. Stop feeding. An adult fish will eat approximately 1% of its bodyweight per day. Fish fry (babies) will eat as much as 7%. Be careful not to over feed your fish.

If your fish aren't eating they are probably stressed, outside of their optimal temperature range, or they don't have enough oxygen.

Worms

Add a handful of composting red worms to each grow bed once your system is fully cycled and fish have been added. Red wigglers are most favoured.

pH

Target a pH of neutral, or 7.0, in your Aquaponics system. This is a compromise between the optimal ranges of the fish, the plants, and the bacteria. For fish, this is a pH of around 6.5 to 8.0. For plants, this is a pH of around 5.0 to 7.0 and for bacteria it is a pH of 6.0 to 8.0.

Test pH at least weekly, and as frequently as 3 – 4 times per week. During cycling pH will tend to rise.

After cycling your systems, pH will probably drop below 7.0 on a regular basis and require being buffered up. If you need to lower pH it is generally because of the water source (such as hard ground water) or because you have a base buffer in your system (egg shells, oyster shell, shell grit, incorrect media).

Best method for raising (buffering) pH if it drops below 6.6

Calcium hydroxide – “hydrated lime” or “builder's lime”.

Potassium carbonate (or bicarbonate) or potassium hydroxide (“pearlash” or “potash”). If possible, alternate between these two each time your system needs the pH raised. These also add calcium and potassium, which your plants will appreciate. While they work, be cautious about using natural Calcium Carbonate products (egg shells, snail shells, sea shells). They don't do any harm, but they take a long time to dissolve and affect the pH. So, you add it, check pH two hours later and nothing has changed, so you add more. Then suddenly, the pH spikes because you have added so much.

Best methods for lowering pH, in order of preference, if it goes above 7.6

pH Down for Hydroponics- (be careful of using the aquarium version as this has sodium that is unhealthy for plants).

Other hydroponic acids like nitric or phosphoric as the plants can use the nitrate or phosphate produced. Other acids, such as vinegar (weak), hydrochloric (strong), and sulphuric (strong) – last resort as directly adding these acids to your system could be stressful for your fish.

Use caution when adding anything to your system containing sodium as it could build-up over time and cause harm to your plants.

Do not use citric acid as this is anti-bacterial and will kill the bacteria in your bio-filter.