

Aquaponic Plumbing

How To Hook The Parts Of An Aquaponic System Together

TCLynx (Aleece B. Landis)
Aquaponic Lynx LLC

Plumbing media/combination methods for home/small farm systems.



<http://www.aquaponiclynx.com/>

Aquaponics

⇒ Recirculating Aquaponics is raising Aquatic animals and plants in a symbiotic contained ecosystem utilizing Bacterial cycles and filtration to make it possible.

- The filtration and bacteria are the most important part to make it all work
- Requirements include
 - Water and dissolved oxygen for everything
 - Filtration space/surface (both solids and biological)
 - Plant growing space
 - Aquatic animal growing space
 - Feed to grow the plants and animals
 - Light for the plants
 - **A way to circulate everything to everything.**



This Is NOT a Siphon Class

- Siphons can work anywhere you have enough fall and can adjust the flow rate to suite the siphon size, but you must get the balance right.
 - So as you layout your system design, be sure to leave enough height below your grow beds for your siphons to work if you plan to use them.
 - Gravity is a law you just can't disobey.
 - Siphons don't get to disobey it either.



A way to circulate everything to everything.

⇒ In other words=Plumbing

- Lets talk about how to hook up an aquaponics system.
- When we talk of plumbing we are usually talking about how to have to water flow about the system.
- Tip, air can often be plumbed using much of the same stuff we might use for water.



Water Flow = the pump and plumbing

- ⇒ Water must move around the system for it to be a “system”
 - This is normally done with a pump of some kind.
 - You must also make sure the water can flow back to the rest of the system and choosing the right size plumbing is important
 - Drain methods, timers or siphons are also part of this element.
 - More complex plumbing/valves can be used to sequence flow.
 - Sump tanks, header tanks etc.



How does filtration size affect water level fluctuation

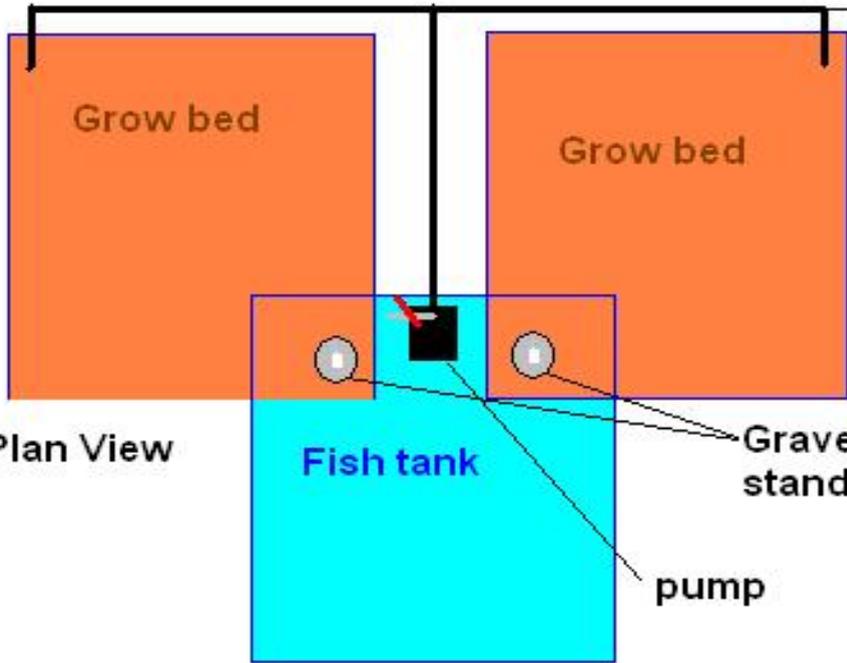
- ⇒ This is for flood and drain media bed aquaponics.
- ⇒ Figure Total grow bed volume.
- About 40% of that will be the water needed to flood the beds.
 - This means you can get away with equal grow bed and fish tank for a simple system.
 - or
 - Size your sump tank at least 50% or more of the total grow bed size (pumps usually can't pump the last few inches out of a tank and you don't want to be needing to top up the system every single day.)



Once you have chosen your basic system design

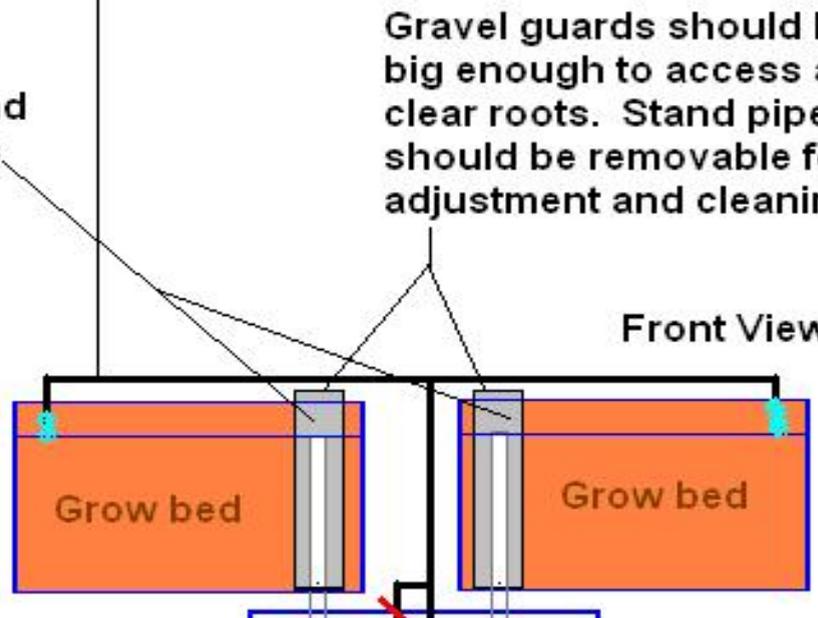
- ➔ It is time to figure out how to build it
- Lets start with a basic diagram of a simple system and a bunch of the little details that really help make a system work.





Plumbing from the pump minimum size based on pump fittings but up-sizing is often helpful.

Drain plumbing generally needs to be larger than the supply plumbing.



Gravel guards should be big enough to access and clear roots. Stand pipes should be removable for adjustment and cleaning.

Simple system plan and elevation showing a 1:1 fish tank to grow bed layout where water pumps from fish tank up to grow beds then drains back to the fish tank.

Stand pipes shown for timer or constant flood operation but siphons could be used too.

bypass valve to adjust flow to grow beds without throttling pump, provides extra aeration to fish tank

water level fluctuation for flood and drain operation

Pump off bottom for safety factor.

Float top up valve set just below normal low water level for automatic top up.

Important design tips

- ⇒ Pump bypass, note that you can T off the pump line and add a ball valve to spray water back into the fish tank or sump tank, this is a better way to reduce flow to grow beds than simply adding ball valves at the grow beds.
 - Better because it is less likely to restrict the pump.



Important design tips

- ⇒ Size the plumbing from the pump at least as large if not larger than the outlet fitting from the pump.
 - Up-sizing plumbing can gain you efficiency from your pump to a point.
 - Size your pump to at least move the volume of your fish tank at the height required.

DRAIN PLUMBING MUST ALWAYS BE LARGER.



Important design tips

- ➔ Keep your drains accessible. Always have a gravel guard to keep media back from the drain or siphon.
- Make your stand pipes removable for cleaning and adjustment
- You will need access for cleaning because roots will clog plumbing over time if you can't clean them out.



Important design tips

- ➔ Add an automatic float type top up valve below the normal low water level of your fish tank or sump.
 - This can really help avoid the disasters of forgetting you left the hose running and keep your system topped up just a little at a time.
 - If you can't do the float valve, get one of those hose timers that will shut off the hose after a period of time so you can't forget.



Important design tips, Backup in case of Disaster

- ⇒ If pump is in fish tank, perhaps elevate the pump off the bottom of the tank to avoid the disaster of pump draining the fish tank completely.
- Perhaps consider running two pumps, in case one dies the other can still keep the system going until you can fix the first one.
- It may even be wise to run the two pumps on two separate circuits, one of them might even have a battery backup to run it in a power outage.



Setting up an Aquaponics System Overview

- ➔ Figure out your general layout
- ➔ Get an idea of flow rates and needed pipe sizes
- ➔ Get tools and materials on hand
- ➔ Do the ground work (perhaps the hardest part)
- ➔ Hook up drain plumbing first
- ➔ Then run supply plumbing



▣ Figure out your general layout

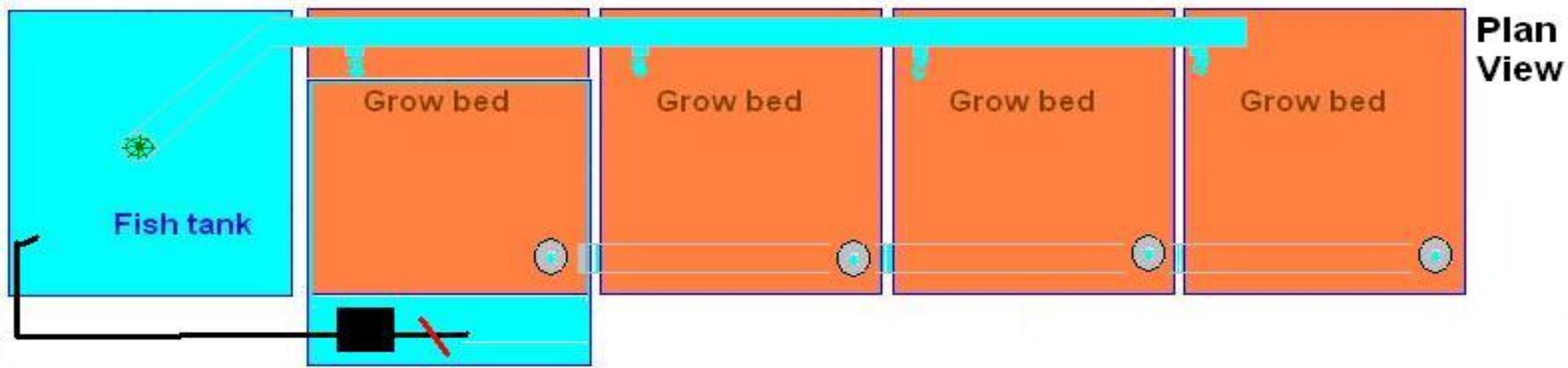
- ⇒ Space you have to work with
- ⇒ Parts you have to work with, Make lists
- Tape measure
 - Make a Drawing
 - Grow beds
 - Fish tank
 - Walkways
 - Or lay it out on site



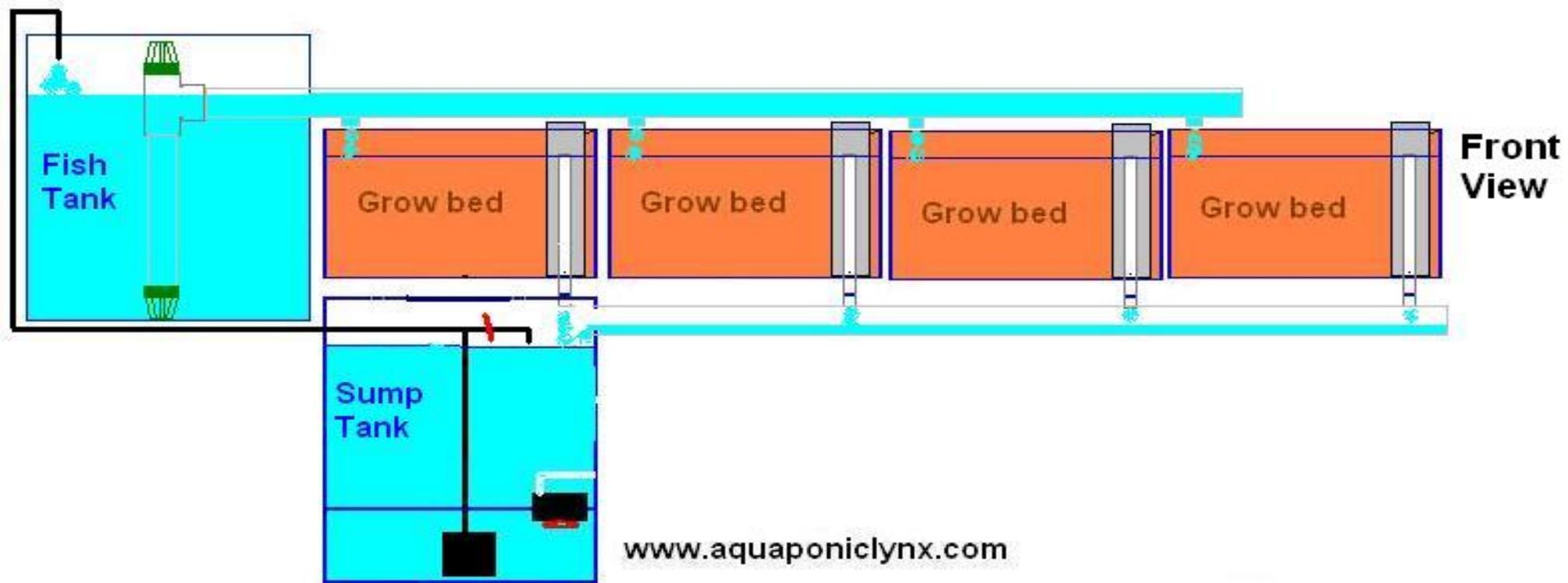
System design examples

- ➔ Lets look at some different system design layouts as we talk about hooking up a system.





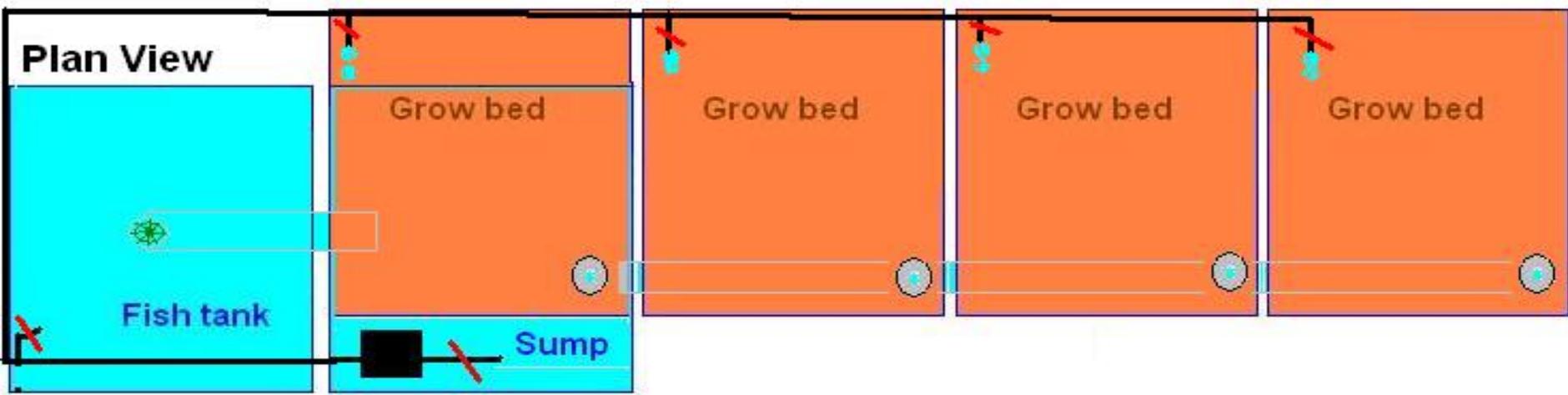
CHIFT PIST or CHOP



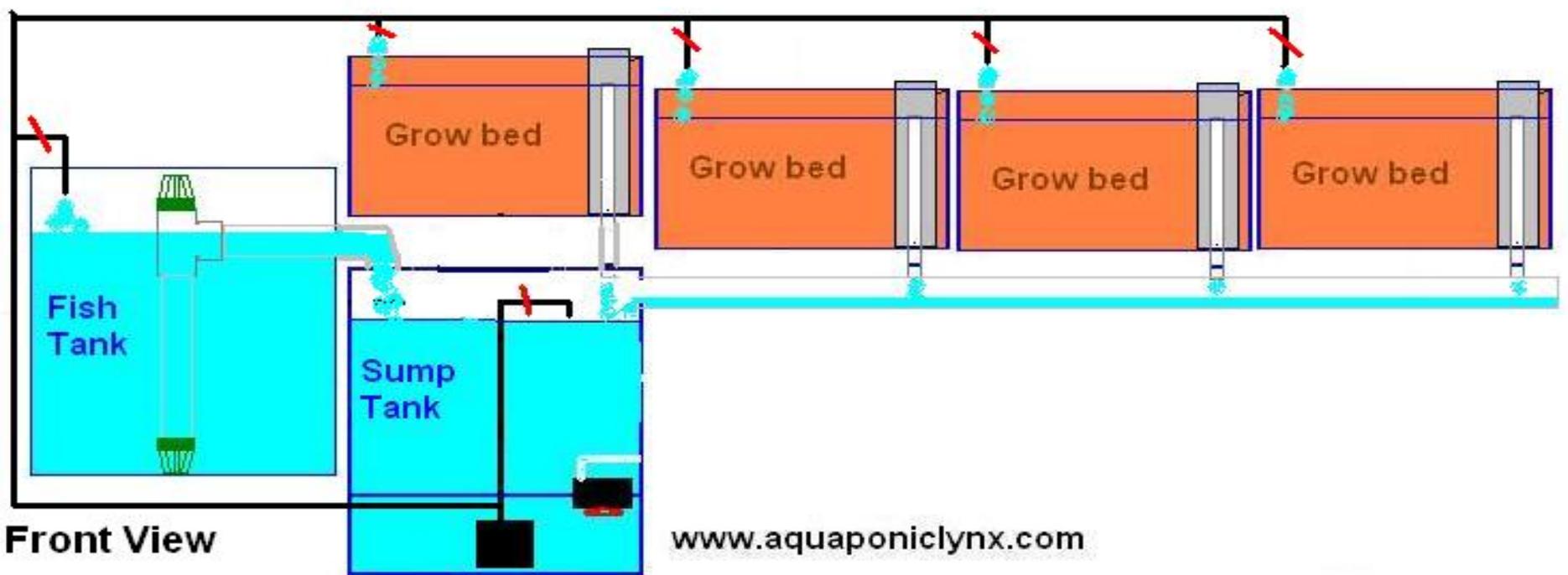
Important design tips

- ⇒ SLO drain. That stands for solids lifting overflow. This is a way to draw water from the bottom of a fish tank while still keeping the water level in the fish tank fairly constant.
- ⇒ CHIFT PIST Constant Height In Fish Tank Pump In sump Tank as in last slide provides a clean water sump. (Important note when you want clean filtered water in a combination system for some other element.)
- ⇒ CHOP stands for Constant Height One Pump
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CHOP Mark 2



Important design tips

- ➔ The CHOP Mark 2 method doesn't provide a clean water sump but it does provide more control and flexibility over layout.
 - You can control the flow to individual beds easier and not worry about the fish tank overflowing since it overflows to the sump tank. This makes balancing siphon operation easier.
 - Allows greater heights to design in without having to elevate the fish tank so much.
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Get an idea of flow rates and needed pipe sizes

- ⇒ I often start with the pump, what size plumbing does it take? Gonna up-size it?
- ⇒ Then make drain plumbing bigger, much bigger.
- ⇒ Siphons are a bit different, they require a balance
 - However, if siphons share a drain line, that shared drain line must be much larger than the individual siphons.



▣ Get tools and materials on hand

- ⇒ Use your layout and pipe size figures to help you estimate the amount of pipe and what fittings you will need to hook it all together. (go get to know the plumbing shop.)
- ⇒ Tools and safety glasses for cutting, Sandpaper
 - Dry fit everything
 - Make sure you have drain plumbing hooked up before adding water for testing!
- ⇒ PVC primer/cement (or other methods)
- ⇒ Gloves unless you like purple stained hands



Tools



Or Power Tools



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Don't Be afraid of PVC pipe

- ➔ Many people seem to want to use irrigation pipe because they feel it is more flexible and temporary but regular PVC pipe is not difficult to get, cut, or glue and the fittings are not that costly. You get far more flow through the PVC than you do irrigation pipe of the same size hooked together with barb fittings.
 - The chemical drawbacks of Rigid PVC have to do with it's manufacture, disposal, or burning it.
 - HDPE may be more ideal but there are drawbacks to it as well. Cost of large size pipe and fittings are either heat weld or compression.



PVC Cement or Silicone + stainless steel screw



Temporary PVC Options

- ➔ There are flexible couplers for PVC.
- ➔ Some plumbing with no chance of getting knocked apart can be left dry fitted.
 - And if you need to secure plumbing temporarily a stainless steel screw can keep it from being knocked apart and some silicone can keep it from dripping.



▣ Do the ground work

- ⇒ Place tanks and beds in correct location.
- ⇒ Do any digging and leveling. Very Important, compact and level bed bases, you don't want them tilting.
- ⇒ Prep trenches for pipes.
- ⇒ Look at everything and visualize the plumbing runs to make sure it will all work out.
 - Use a level or even fill the pipes with water to make sure it will drain in the correct direction.
 - It is ok to have water stay in pipes between cycles as long as it flows properly when it needs to.

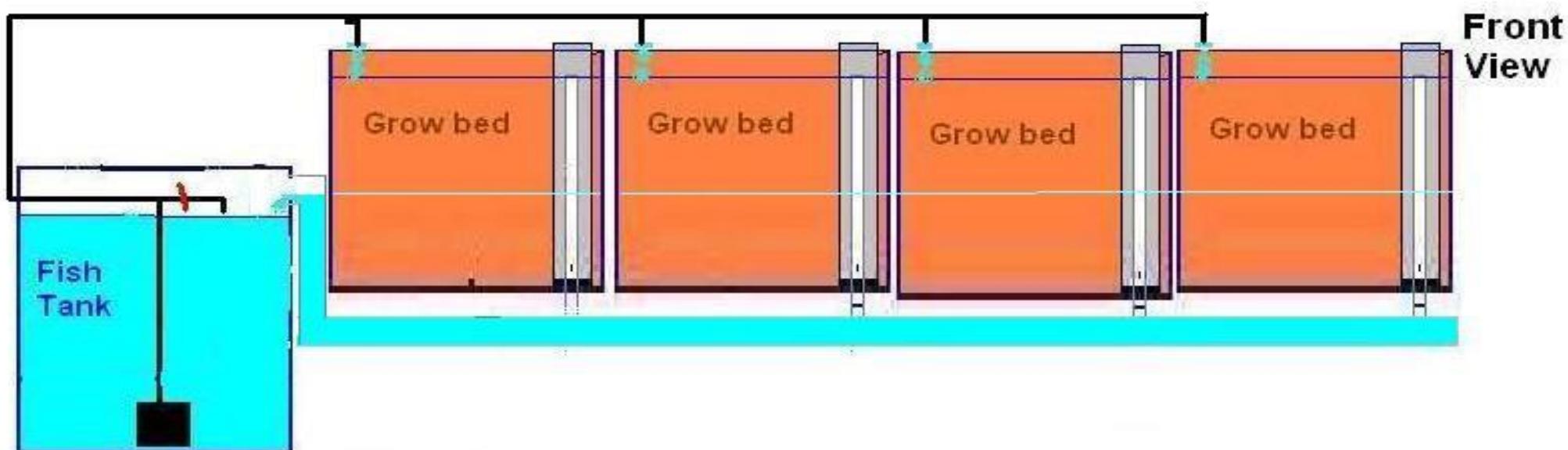


Gravity Double Check

- ➔ Drain plumbing outlet into sump or fish tank needs to be lower than the beds or water won't drain.
- Siphons need to drain lower, they can't ignore the law of gravity.
 - Vents may be needed if gravity plumbing goes up and down much or if a drain line is long and you want siphons to work
- ➔ Make sure you put the drain from a Constant height fish tank low enough.



For Deep grow beds being drained by stand pipes, it is not mandatory to drain them completely since the water will get mixed each time the bed floods and drains. 12 inches of flood and drain is sufficient and will allow deep beds to be installed at a reasonable height and still drain half way into a tank that is not below their bottoms.



▣ Hook up drain plumbing first

- ⇒ Drill holes for grow bed drains and install.
- ⇒ Make sure stand pipes are removable.
- ⇒ Fit gravel guards.
 - If running siphons add extra overflow

- Lay out drain piping and fittings.
- Hook it all up without glue first.
- Run some water to make sure drains work.
- ⇒ Glue or secure once satisfied.



Then Run supply plumbing

- ➔ From pump to beds or from pump to fish tank for CHIFT
- ➔ And from fish tank to beds for CHIFT (constant height in fish tank) system
 - If CHIFT plumb supply from pump to fish tank. Make sure the Gravity drain from fish tank is plenty large enough that the fish tank won't overflow.
 - Layout and dry fit first and make sure it all looks good before securing.



Plumbing and Initial Water Test

- ➔ Once it's all hooked up, test it out.
 - ➔ This is a good time to rinse everything off
 - ➔ Without media in you may not be able to really test flood and drain.
 - ➔ Run water around to let it air out and do a good test for leaks.
-
- After a day of circulating you can check your source water's “real” pH and also get a good baseline on other water tests. Prepare for gravel washing (test likely media for pH compatibility.)
 - Run Baseline water tests to know your water



So that was Basic

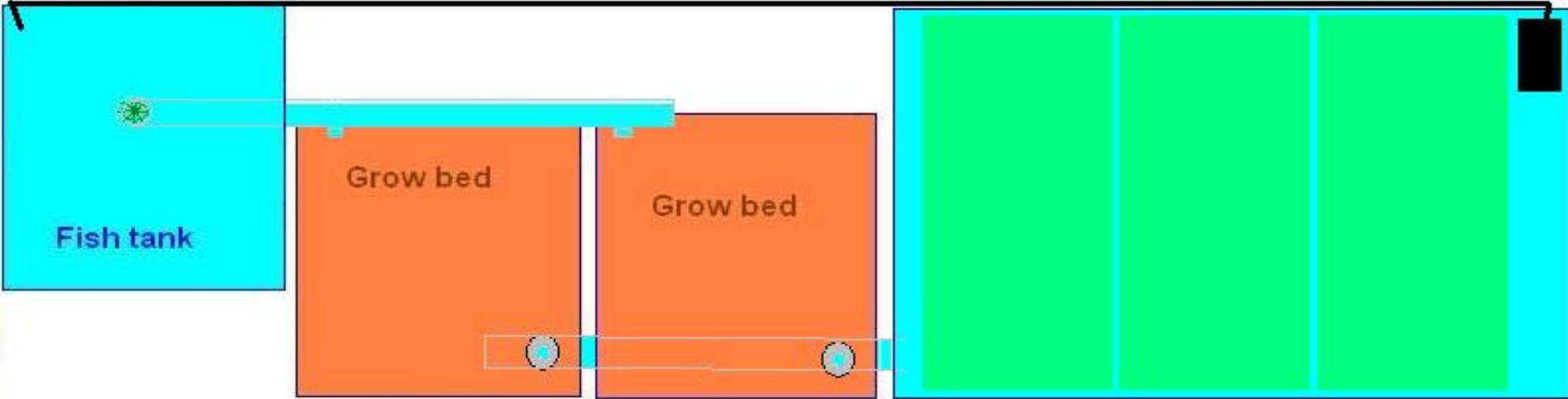
- What about hooking up...
- Rafts (DWC or deep water culture)
- NFT (nutrient film technique, pipe with holes)
- Towers
- etc



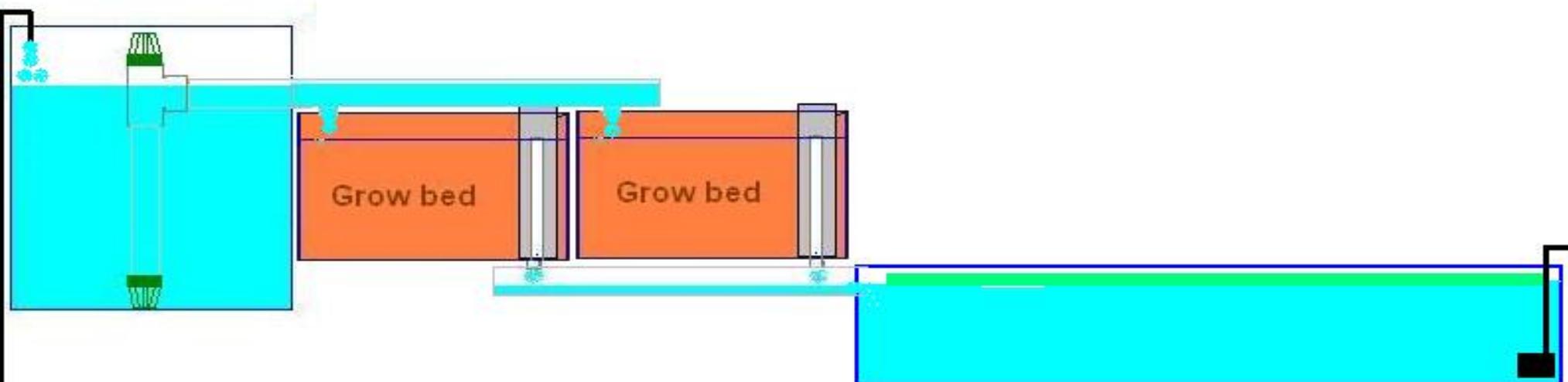
Clean Water Sump

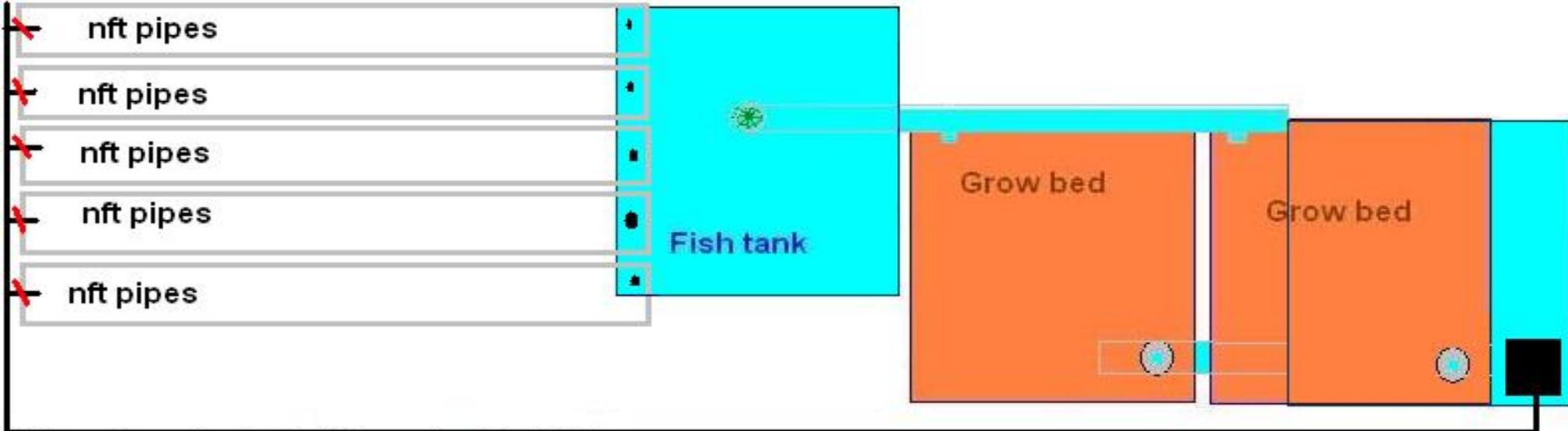
- ⇒ If you want a combo system a clean water sump CHIFT PIST (Constant Height in fish tank pump in sump tank) is a good way to go.
 - On the other had, if you do CHOP Mark 2 you can add additional filtration before the NFT, RAFTS or Towers if you add them.
 - Weigh the pros and cons since the CHOP 2 will require a larger pump to send water everywhere all the time.



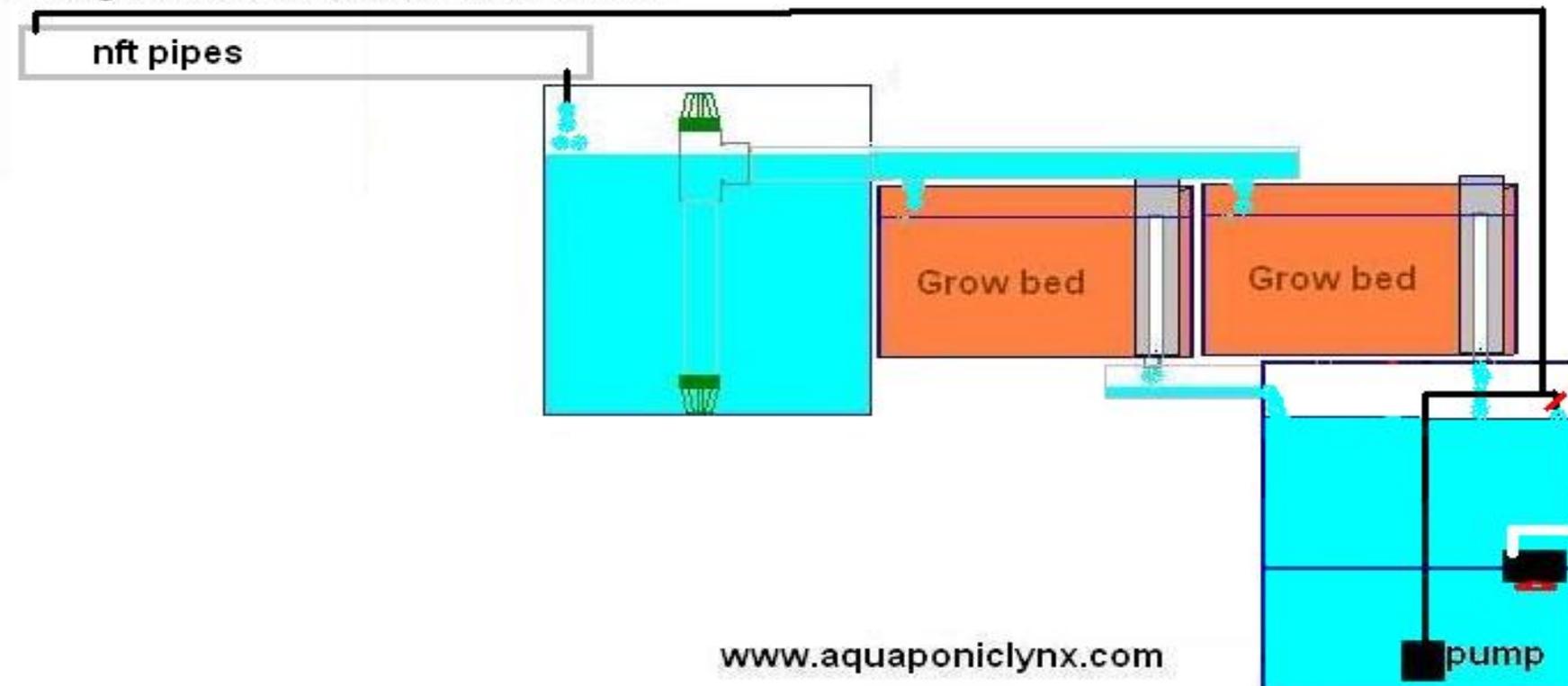


Using Grow beds to filter water for raft bed and the raft bed as sump.





Using Grow beds to filter water for NFT

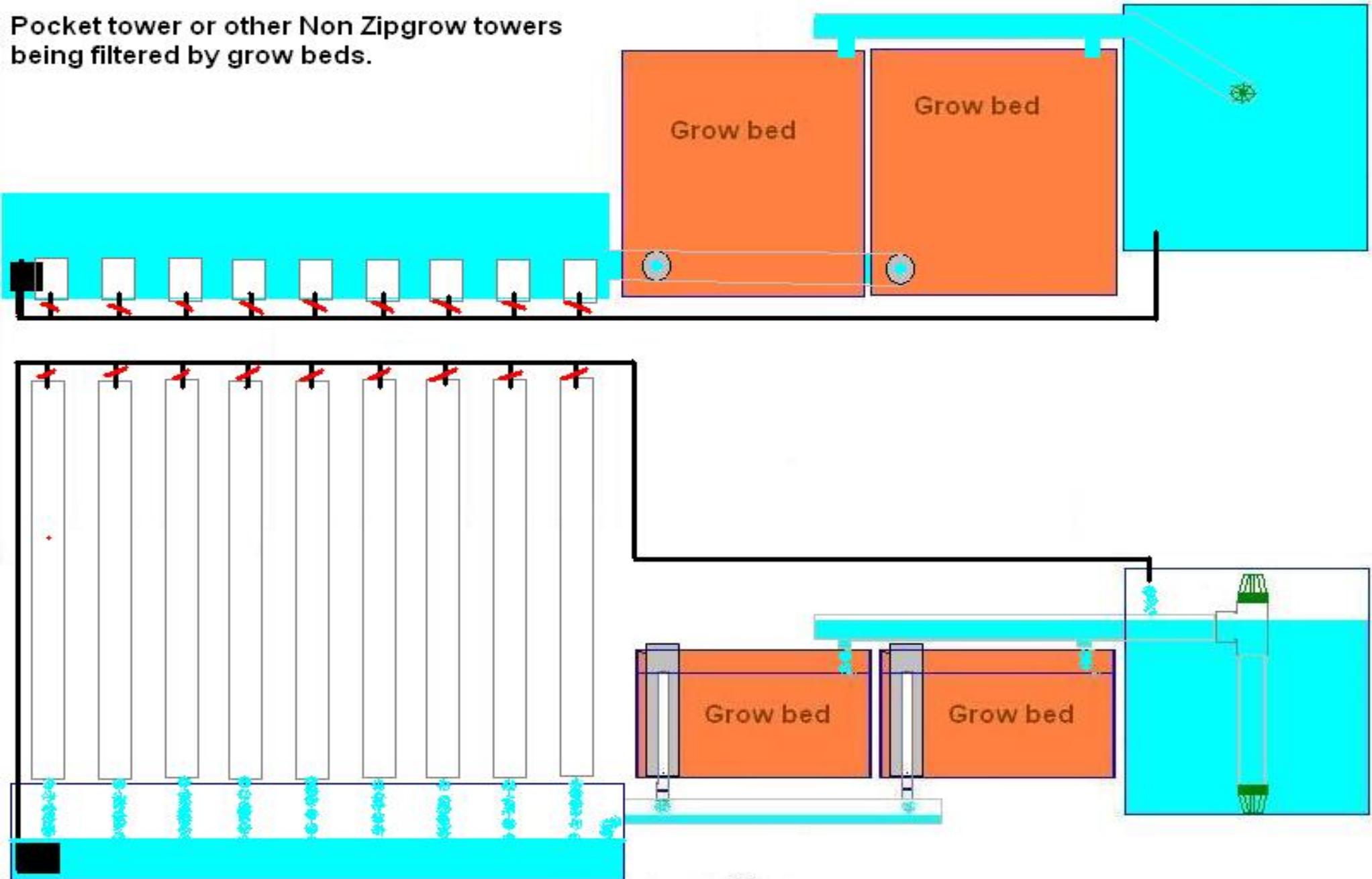


Towers

- ➔ There are different kinds of towers.
- ➔ Most require solids filtration and bio-filters.
- ➔ Zipgrow towers are the exception.

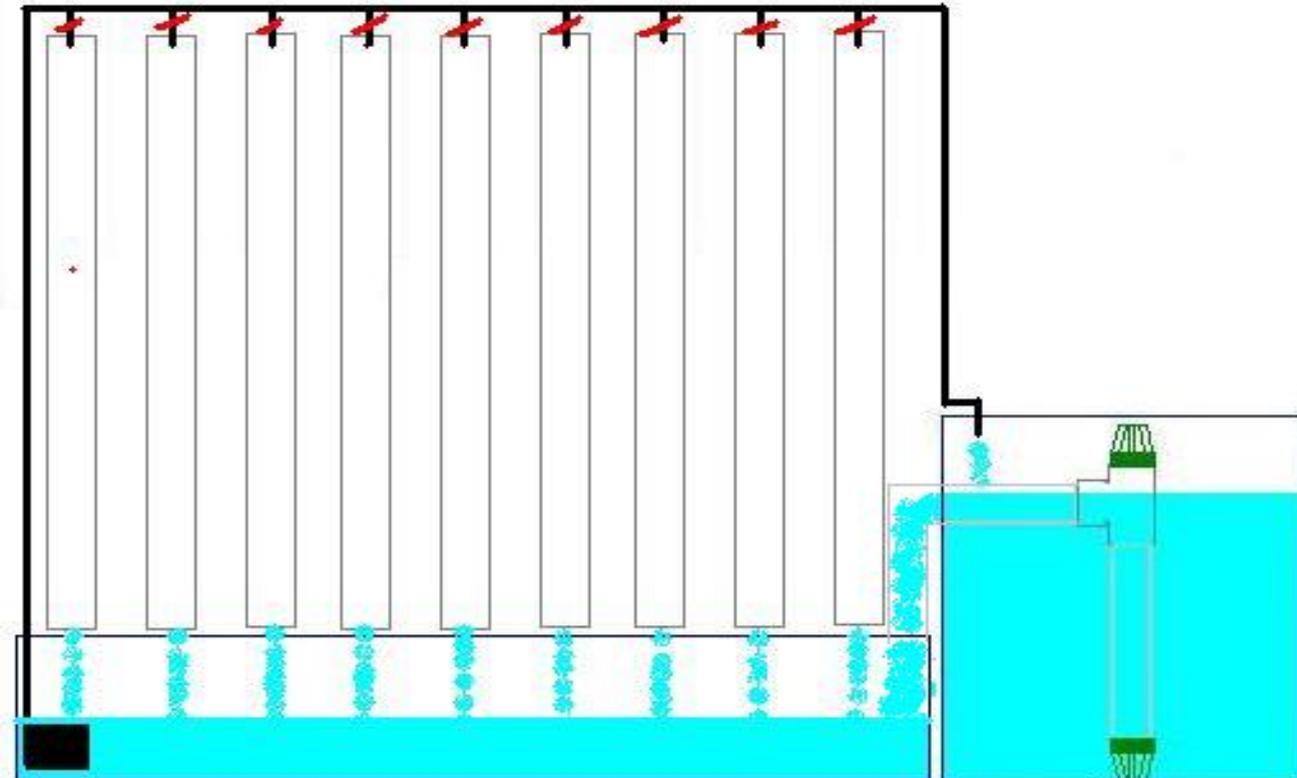
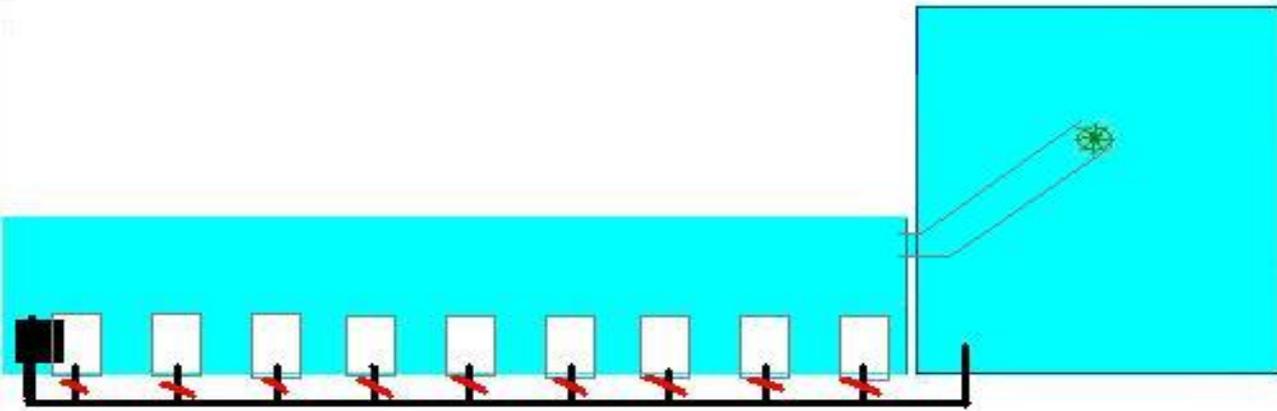


Pocket tower or other Non Zipgrow towers being filtered by grow beds.



Zipgrow towers don't require filtration before the towers though keeping debris from getting into the feed to the towers will reduce clogging issues.

The Sump acts as a settling tank and can have extra filtration added to it if desired.



How much Media grow bed do you need For a Mixed System?

- ⇒ That is still being determined.
- ⇒ It will depend on many things.
 - There are only a couple of commercial scale aquaponics systems experimenting with media bed filtration instead of settling tanks and bio-filters.
 - In a few years we will know better what the pros and cons are of mixed systems without solids removal.



What about Sequencing?

- ➔ Aquaponics Indexing Valves allow for more grow beds with less water level fluctuation for flood and drain situations.
- ➔ Think of them as a Timed flood and drain system but the pump only stays off for short periods or doesn't turn off at all if using automated diversion valves.
- ➔ DO NOT use indexing valves with siphons.
 - Sequencing with Aquaponics Indexing Valves is most appropriate to simple and Chop Mark 2 systems.
 - Pump sizing for flow and pressure is important For the Valve function.
 - Sequencing adds a layer of complexity to a system so only go there if you really want the train set (Like to tinker)



Aquaponics Indexing Valves or Sequencing Valves



- ➔ If you want assistance with pump sizing and making sure an indexing valve will work for you in Aquaponics. Please be sure to buy an Aquaponics Indexing valve and not simply an indexing valve designed for irrigation.
- Sorry, I can't help you with it if you buy irrigation valves.
- The Aquaponics Valves have been modified to work in aquaponics.
- They still require certain flows and pressures though.



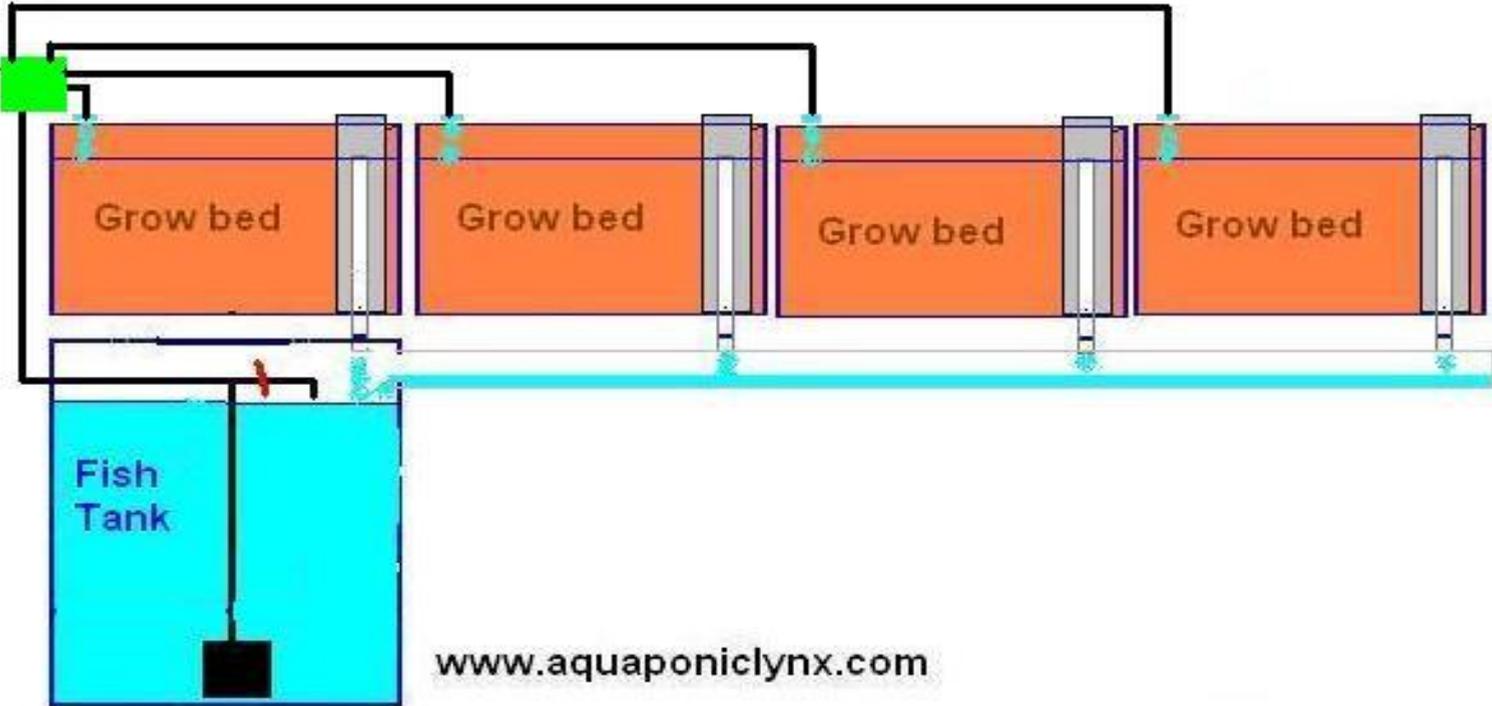
Stopping and starting the flows.



- ➔ The water flow must stop and start to the indexing valve for it to work. It is not motorized.
- ➔ You must either stop and start the pump or use some other method.
- ➔ Automated Pool diversion valves are an option.



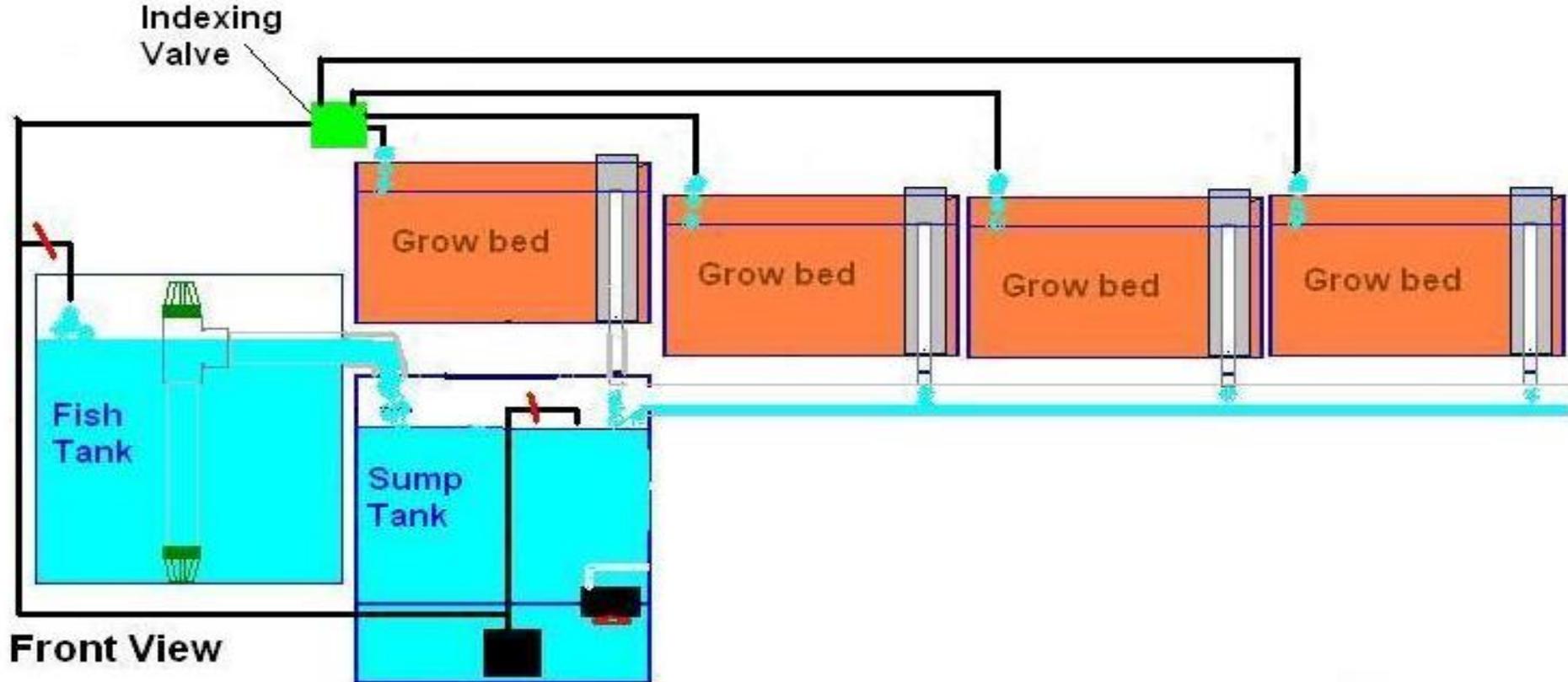
Simple System
Install with
Indexing
Valve



Front
View

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CHOP Mark 2 With Indexing Valve



Gravity Indexing is possible

- ⇒ I do some indexing using gravity flow but it requires lots of flow.
 - The devil is in the details here. Gravity indexing is for an advanced class, I don't have time now.



So Much to share, So Little time

For More assistance contact me

- ➔ On the Web www.aquaponiclynx.com
- ➔ Or TCLynx@aquaponiclynx.com



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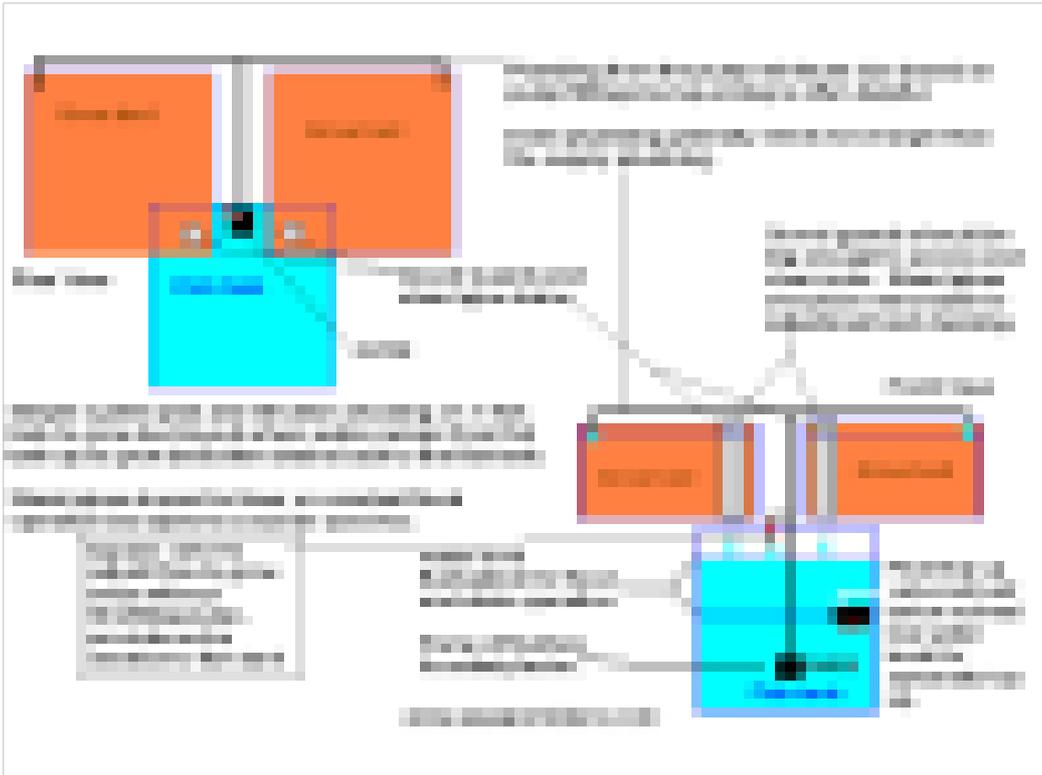
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System design examples

➤ Lets look at some different system design layouts as we talk about hooking up a system.



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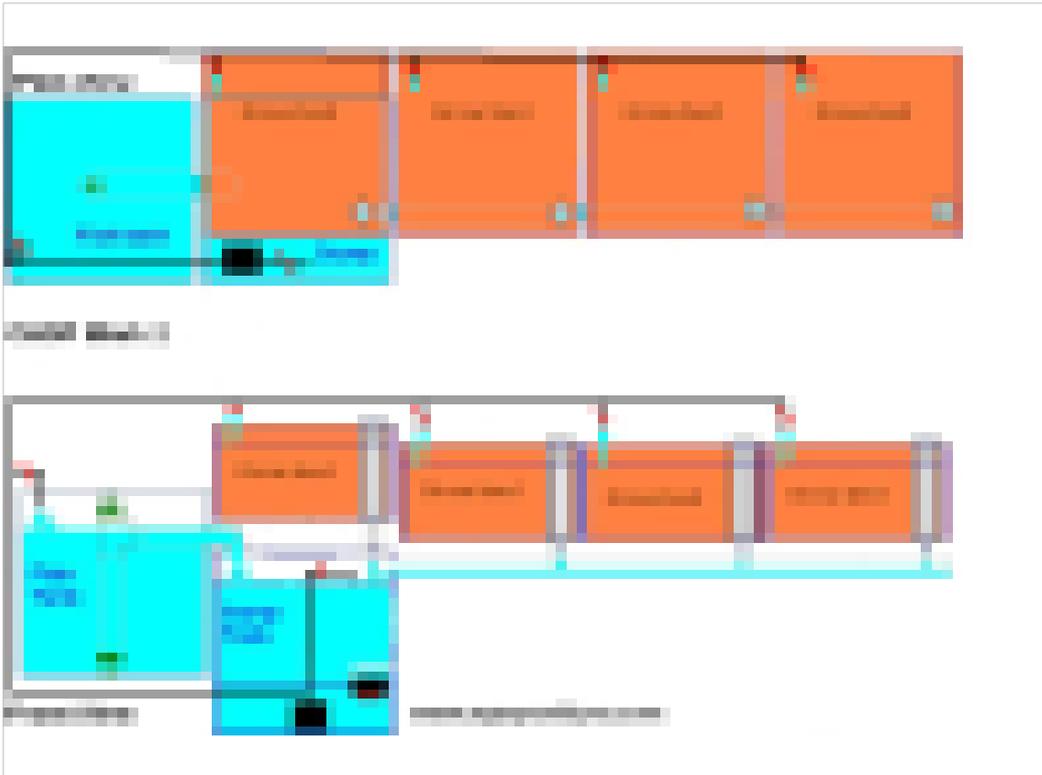


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Or Power Tools



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For the purpose of this study, a laboratory-scale experiment was conducted to investigate the effect of different concentrations of sodium hydroxide (NaOH) on the degradation of organic matter in wastewater. The experiment was carried out in a series of four stages, each with a different NaOH concentration. The results of the experiment are presented in the following table.

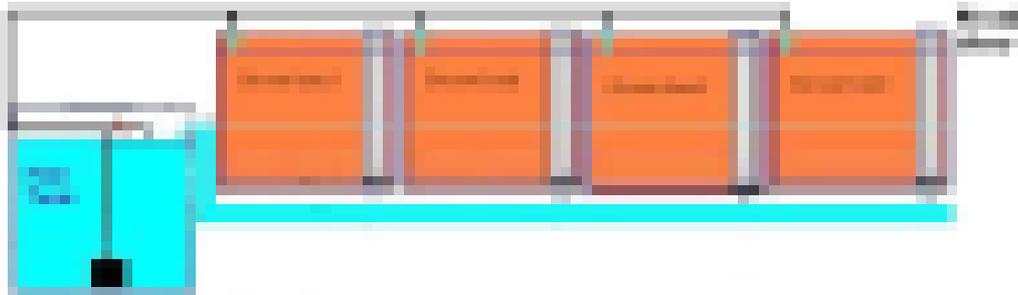


Figure 1: Schematic diagram of the wastewater treatment system.

☐ **Hook up drain plumbing first**

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- ☉ Make sure stand pipes are removable.
- ☉ Fit gravel guards.
 - If running siphons add extra overflow

- Lay out drain piping and fittings.
- Hook it all up without glue first.
- Run some water to make sure drains work.
- ☉ Glue or secure once satisfied.



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Then Run supply plumbing

- From pump to beds or from pump to fish tank for CHIFT
- And from fish tank to beds for CHIFT (constant height in fish tank) system
 - If CHIFT plumb supply from pump to fish tank. Make sure the Gravity drain from fish tank is plenty large enough that the fish tank won't overflow.
 - Layout and dry fit first and make sure it all looks good before securing.



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Plumbing and Initial Water Test

- ⇒ Once it's all hooked up, test it out.
- ⇒ This is a good time to rinse everything off
- ⇒ Without media in you may not be able to really test flood and drain.
- ⇒ Run water around to let it air out and do a good test for leaks.
 - After a day of circulating you can check your source water's "real" pH and also get a good baseline on other water tests. Prepare for gravel washing (test likely media for pH compatibility.)
 - Run Baseline water tests to know your water



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So that was Basic

- ⦿ What about hooking up...
- ⦿ Rafts (DWC or deep water culture)
- ⦿ NFT (nutrient film technique, pipe with holes)
- ⦿ Towers
- ⦿ etc



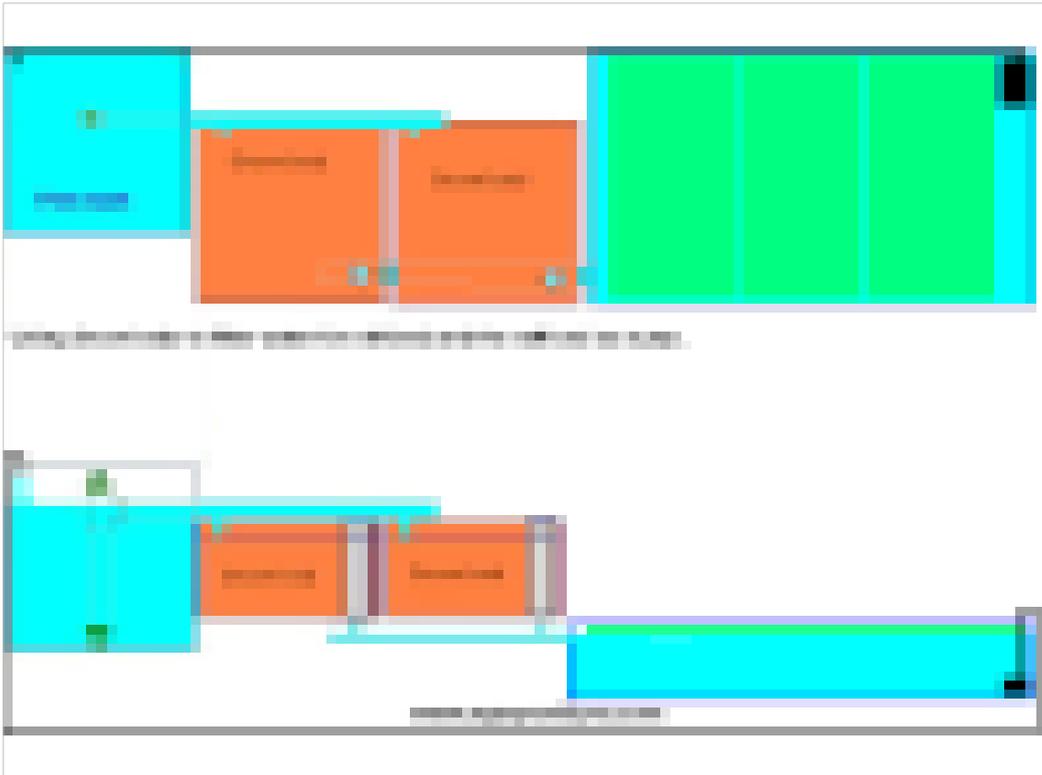
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Clean Water Sump

- ⇒ If you want a combo system a clean water sump CHIFT PIST (Constant Height in fish tank pump in sump tank) is a good way to go.
 - On the other had, if you do CHOP Mark 2 you can add additional filtration before the NFT, RAFTS or Towers if you add them.
 - Weigh the pros and cons since the CHOP 2 will require a larger pump to send water everywhere all the time.



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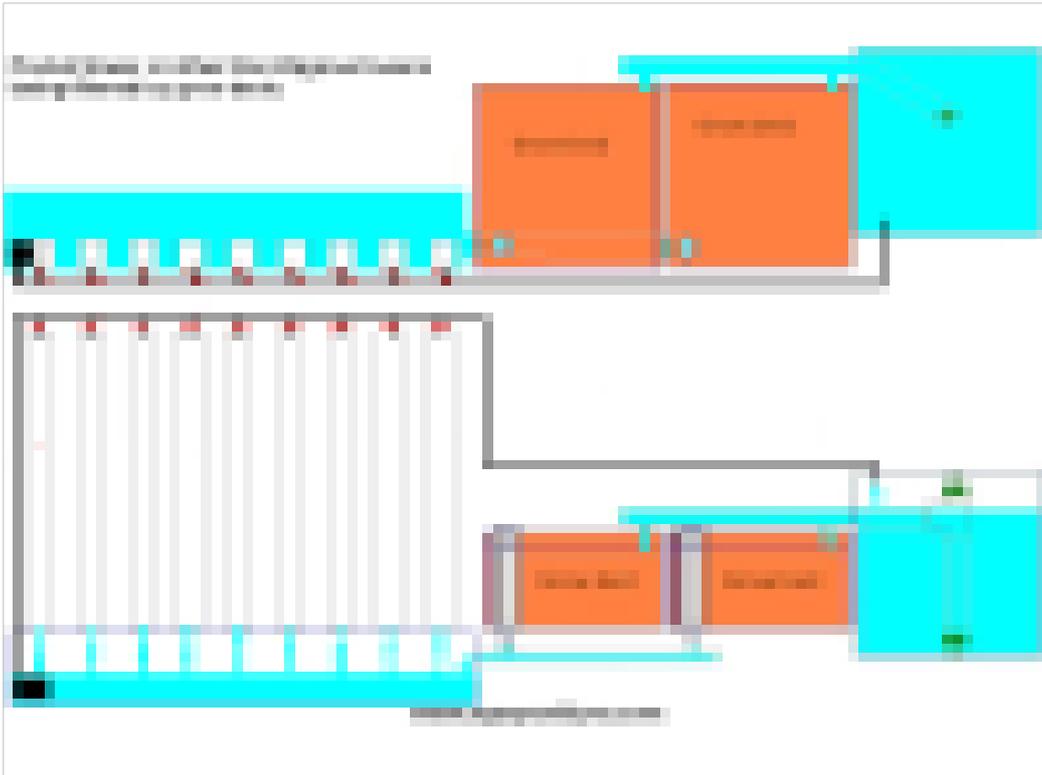


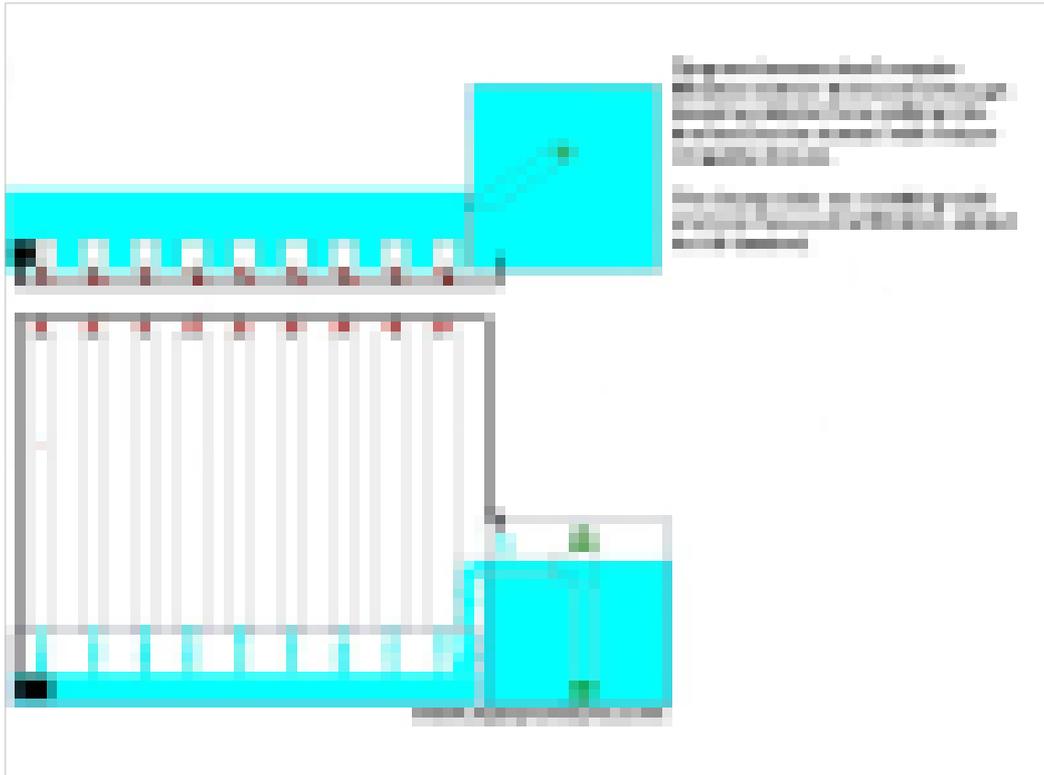
Towers

- ⦿ There are different kinds of towers.
- ⦿ Most require solids filtration and bio-filters.
- ⦿ Zipgrow towers are the exception.



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How much Media grow bed do you need For a Mixed System?

- ⇒ That is still being determined.
- ⇒ It will depend on many things.
 - There are only a couple of commercial scale aquaponics systems experimenting with media bed filtration instead of settling tanks and bio-filters.
 - In a few years we will know better what the pros and cons are of mixed systems without solids removal.



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What about Sequencing?

- ⇒ Aquaponics Indexing Valves allow for more grow beds with less water level fluctuation for flood and drain situations.
- ⇒ Think of them as a Timed flood and drain system but the pump only stays off for short periods or doesn't turn off at all if using automated diversion valves.
- ⇒ DO NOT use indexing valves with siphons.
 - Sequencing with Aquaponics Indexing Valves is most appropriate to simple and Chop Mark 2 systems.
 - Pump sizing for flow and pressure is important For the Valve function.
 - Sequencing adds a layer of complexity to a system so only go there if you really want the train set (Like to tinker)

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Aquaponics Indexing Valves or Sequencing Valves



- ⦿ If you want assistance with pump sizing and making sure an indexing valve will work for you in Aquaponics. Please be sure to buy an Aquaponics Indexing valve and not simply an indexing valve designed for irrigation.
- Sorry, I can't help you with it if you buy irrigation valves.
- The Aquaponics Valves have been modified to work in aquaponics.
- They still require certain flows and pressures though.



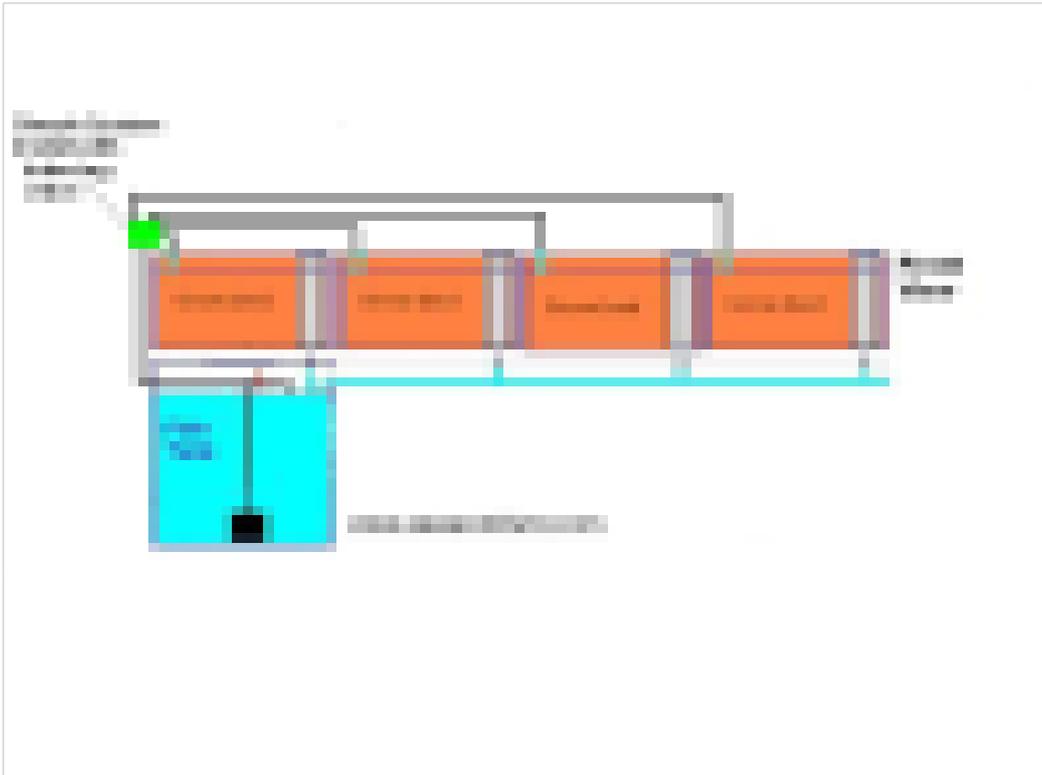
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Stopping and starting the flows.

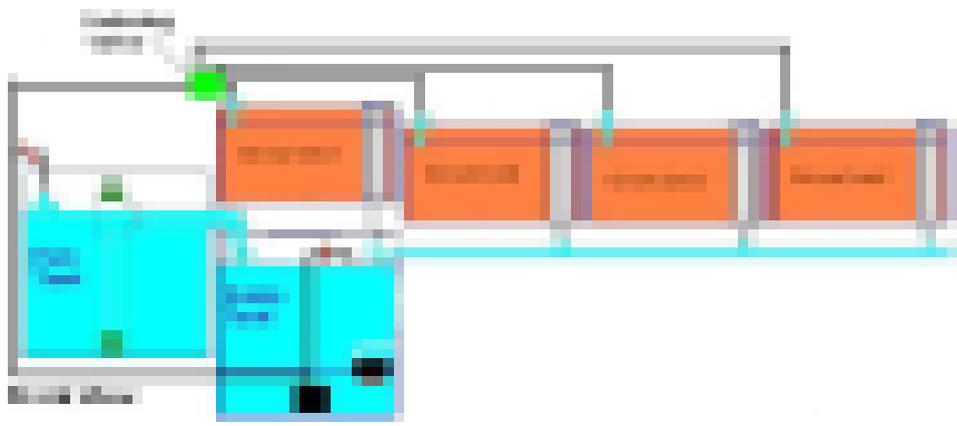


- ⇒ The water flow must stop and start to the indexing valve for it to work. It is not motorized.
- ⇒ You must either stop and start the pump or use some other method.
- ⇒ Automated Pool diversion valves are an option.

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WATER TREATMENT PLANT



Water Flow

Water Treatment Process

Gravity Indexing is possible

- ⇒ I do some indexing using gravity flow but it requires lots of flow.
- The devil is in the details here. Gravity indexing is for an advanced class, I don't have time now.



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So Much to share, So Little time

For More assistance contact me

- ⇒ On the Web www.aquaponiclynx.com
- ⇒ Or TCLynx@aquaponiclynx.com



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