Irrigation

...a few good things to know

part of a continuing series
of water-wise workshops

by
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Irrigation 101

Introduction

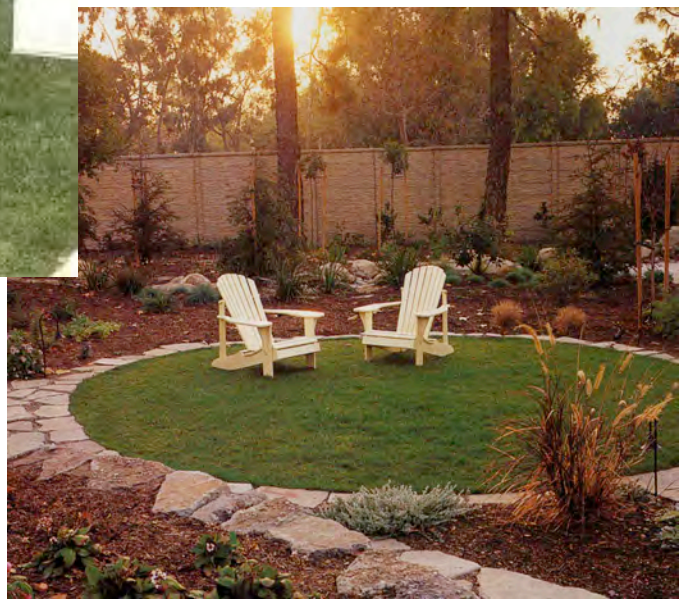
The intention of this workshop is to give you some information, tips and pointers regarding the use of irrigation in the landscape, with an emphasis on water-wise applications. We will discuss sprinkler irrigation and drip irrigation.

Reduce Turf Areas: One of the first principles in water-wise landscape design is reduction of turf areas. Here is something to consider:

Our lawns tend to be comprised of cool season grasses – these grasses require 40 to 60 inches of water a year to stay green. The climate in Corona provides 10 to 13 inches of precipitation a year. In drought years, this amount can be as little as 3 inches, as was the case a few years ago. The math is pretty simple. Grass uses more water than any other element in the landscape. The traditional approach of wall to wall lawn as the go-to landscape solution is not sustainable. We need to re-think it.

Alternatives to Turf: We can do better. Along with the conservation issues, you have the general aesthetics – how the landscape looks. When you get down to it, visually wall to wall lawn is just plain boring. Water-wise design is a springboard for fresh creative alternatives. When we begin to re-think the issue, we find not limits, but opportunities. Instead of turf, consider the creation of new pathways and sitting areas. Edible landscape, a habitat that attracts birds & butterflies. There are hundreds of low water usage plant materials from colorful ground covers to shrubs and trees that can be added to landscape rather than large expanses of lawn. One last word - this is not necessarily about *no lawn*, although that certainly is one option. You can have a lawn and still be water-wise – but it is a smaller lawn. With this new approach, the lawn area is considered as one element within the overall landscape, rather than being the *entire* landscape. When this happens the lawn requires much less water, is easier to maintain and becomes a jewel in the garden.

Left: Typical of many backyards – wall to wall turf. Not only is it a waste of water, it is visually boring, boring, and more boring... We can do better.
Below: This perfect circle of lawn is part of the over-all landscape. Used this way, the turf area becomes an important element within the design.



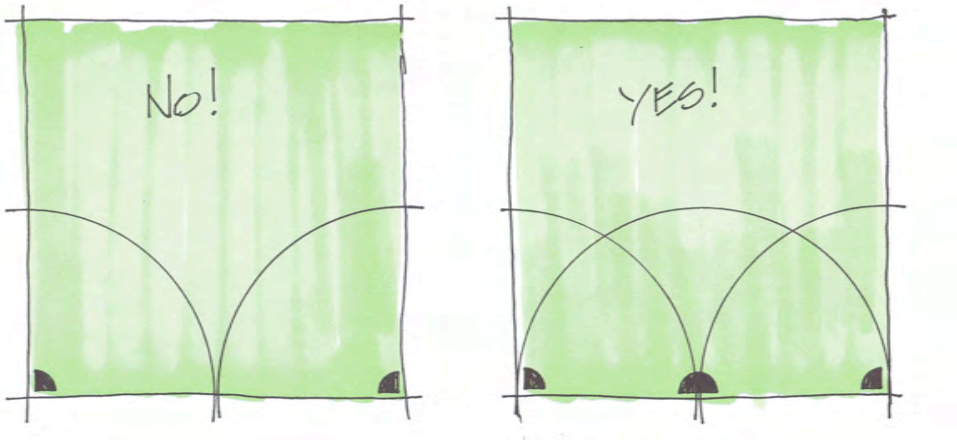
Irrigation 101 – Over Head Irrigation

Sprinkler Irrigation

Designing a system for sprinklers and designing a system for drip irrigation are two different animals. We will handle the fundamentals of sprinkler irrigation here. Generally I recommend sprinkler or over-head irrigation only for Turf areas. For every other space in the landscape, drip irrigation is recommended. The science of irrigation design has come a long way, but we still depend on over-head spray irrigation to effectively apply water to lawn areas.

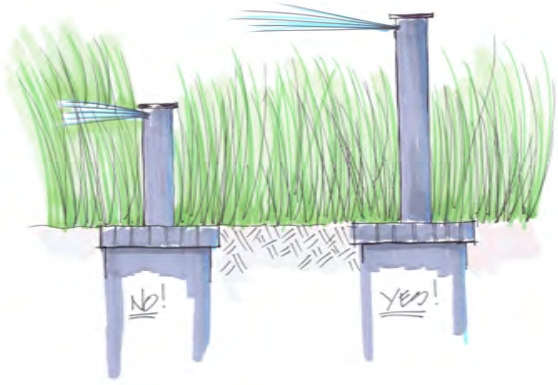
When irrigating a lawn, the primary goal is to provide complete uniform coverage to the area. Most problems with lawns (brown spots, fungus, etc.) are directly related to a poorly designed sprinkler system. This is not rocket science but there are a few important steps that need to be taken for success.

Head to Head Coverage



Head to head coverage means that the placement of the sprinklers allows the spray of one sprinkler (or the radius) to completely meet the head of the next sprinkler. In the illustration above the sprinklers on the left have no head to head coverage, there is no overlap, and guaranteed, in warm weather there will be brown spots in this lawn.

The sprinklers to the right are correct – the spray completely meets the head of the sprinkler next to it.



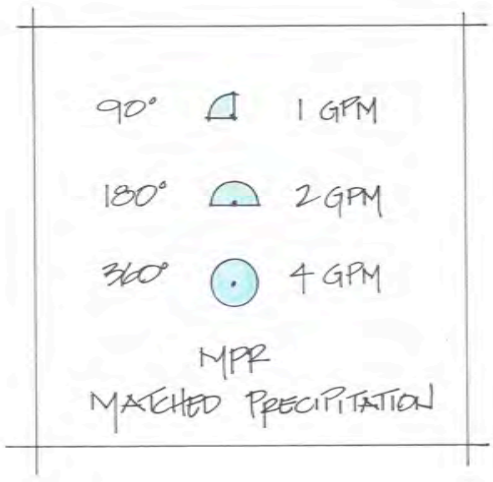
Sprinklers that are too short:

Pop up sprinklers should be 6 inches tall for the most efficient delivery of water. Tall fescues lawns are most common and before mowing day can easily get tall enough to get in the way of the spray pattern of shorter sprinklers.

Exceptions to this would be Hybrid bermuda lawns such as Tiffgreen

Irrigation 101 – Over Head Irrigation

Mixing and Matching Nozzles:
There is something called Matched Precipitation Rate – MPR. This means the nozzles, regardless of the radius, are putting out a matched amount of water, thereby ensuring an even distribution of water. These days that work has pretty much already been done for you by the manufacturer. Where we can get into trouble, is mixing different brands of nozzles on the same system, say a few are Toro and the rest are Rainbird.



This principle also applies when mixing different types of nozzles within the same brand. For example; a standard MPR 180° spray nozzle from Rainbird with an 8 ft radius puts out .52 GPM. (GPM = gallons per minute). A Rainbird VAN (variable arc nozzle) with an 8 ft radius at 180° puts out twice the amount of water – 1.19 GPM. This makes a difference, one area will be soaked and the other may be too dry. Note: Rainbird does have matched precipitation for their VAN nozzles and standard MPR nozzles in 12 ft, 15 ft and 18ft radius.

Designing a new system – Sprinkler Placement
Head Layout. When designing a new system, begin with the head layout. This is the term used for sprinkler placement in the design. Start by drawing a scaled outline of the area to be irrigated. Then figure the closest common denominator for your radius. The example shown is a 24 ft square. The arcs represent a 12 ft radius nozzle. Set a compass scaled to this measurement. With your arc scaled to the proper radius begin drawing, as shown below.
note:
Sometimes people mistakenly assume that there is a 'rule' about having a certain number of sprinklers per valve. Not true. Design the layout for complete head to head coverage, add up the amount of GPM the nozzles will deliver, then add the numbers. This is how you determine the number of valves on a system.

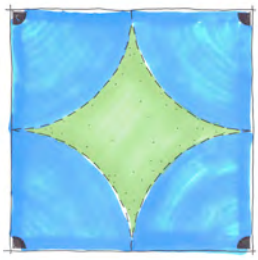


fig 1

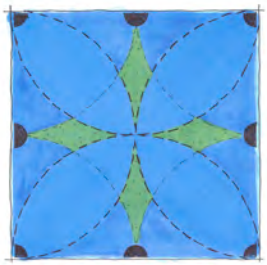


fig 2

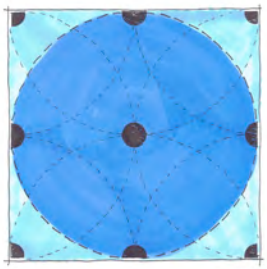


fig 3

1 – Start with the corners first. Then fill in the sides (fig #2), ensuring head to head coverage. The diagram #2 shows the areas in green that are covered by the spray of only one sprinkler. Head to head coverage means you need to have double coverage, the green areas are weak spots. In fig #3 we add one 360° nozzle to take care of those weak spots. The lawn area now is completely covered and will not have those pesky brown spots in the heat of summer.

Irrigation 101 – Over Head Irrigation

2 – Now add up the demand of your sprinkler system as it is designed. This means you need to know how much water these nozzles will be putting out. It is called GPM = gallons per minute. This how we determine demand. Assuming these are Rainbird MPR nozzles the demand is:

12' Q = .65 x 4 = 2.60 gpm
12' H = 1.30 x 4 = 5.20 gpm
12' F = 2.60 x 1 = <u>2.60 gpm</u>
total demand = 10.40 gpm

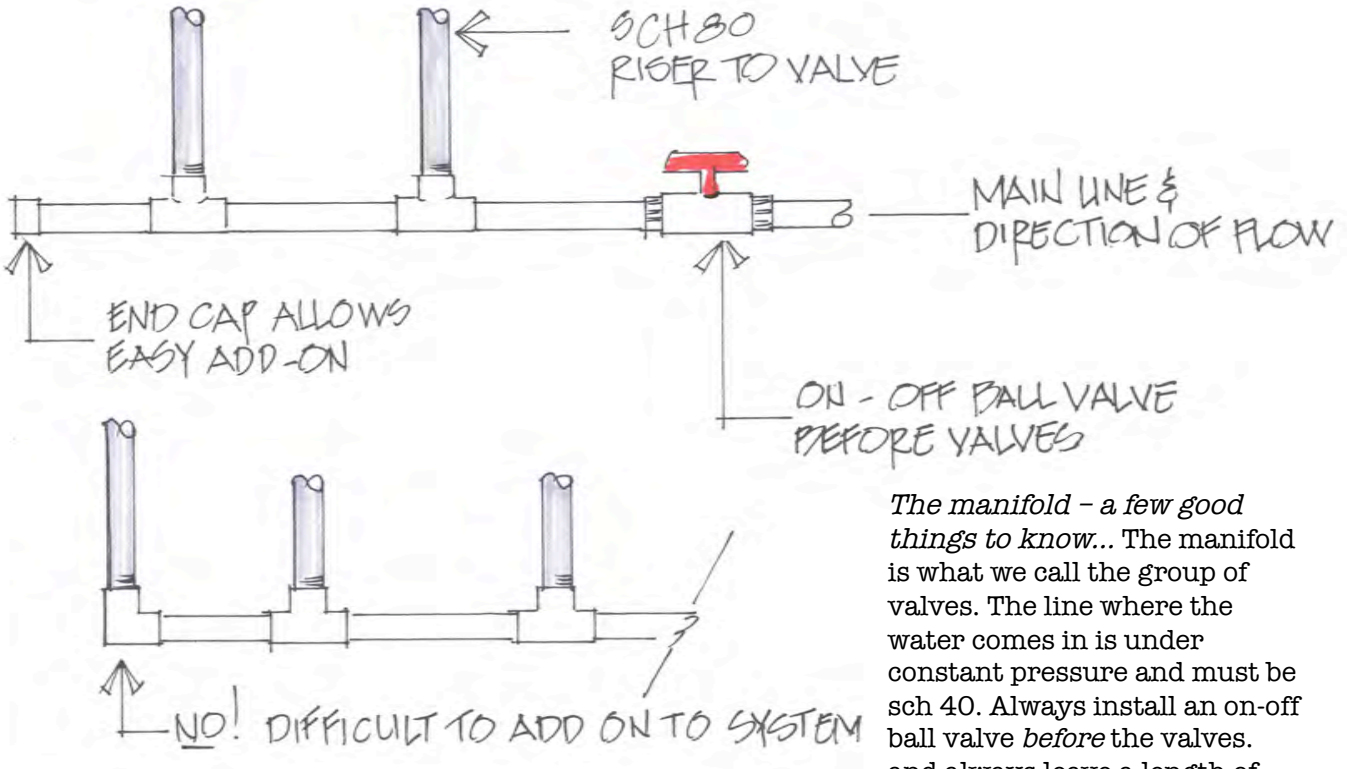
3 – Next you need to determine the amount of water your system can deliver. On page 5 is a work sheet to help figure that out.
Based on that worksheet, lets say you have 60 PSI and a ¾" water meter. This means the maximum amount of water that you can expect to deliver per valve will be 9 gpm. But your design calls for 10.40 gpm. You will install 2 valves.

12 SERIES MPR

30° Trajectory ■ ▲

Nozzle	Pressure psi	Radius ft	Flow gpm	Precip in/h ■	Precip in/h ▲
12F	15	9	1.80	2.14	2.47
	20	10	2.10	2.02	2.34
	25	11	2.40	1.91	2.21
	30	12	2.60	1.74	2.01
12TQ	15	9	1.35	2.14	2.47
	20	10	1.58	2.02	2.34
	25	11	1.80	1.91	2.21
	30	12	1.95	1.74	2.01
12H	15	9	0.90	2.14	2.47
	20	10	1.05	2.02	2.34
	25	11	1.20	1.91	2.21
	30	12	1.30	1.74	2.01
12T	15	9	0.60	2.14	2.47
	20	10	0.70	2.02	2.34
	25	11	0.80	1.91	2.21
	30	12	0.87	1.74	2.01
12Q	15	9	0.45	2.14	2.47
	20	10	0.53	2.02	2.34
	25	11	0.60	1.91	2.21
	30	12	0.65	1.74	2.01

4 – One more thing you gotta do: Pipe size. Sch 40 on sprinkler laterals is highly recommended. This gives what we call 'shovel protection'. Class 200 hundred can be used because the laterals are not under pressure as the main line is (sch 40 is always used for pressurized mainlines), but class 200 is thin and you won't save that much $$ - so go with sch 40. The pipe ¾" sch 40 has a maximum capacity of 8gpm. You can see that even if you had a ton of water and pressure you still would need 2 ¾ inch valves.



The manifold – a few good things to know... The manifold is what we call the group of valves. The line where the water comes in is under constant pressure and must be sch 40. Always install an on-off ball valve *before* the valves. and always leave a length of pipe and end with a cap.

PRESSURE MAINLINE - SCH 40

Sprinkler System Design Capacity

B. Determine System Design Capacity

When planning an efficient automatic irrigation system, you must first determine the correct Sprinkler System Design Capacity—how much water is available for residential irrigation. If the system will be installed using city water, follow the steps below. If the water will be drawn from a lake or well, your Hunter dealer or the pump installer will have the specifications for pressure and volume.

1. Water pressure (PSI)

To check the water pressure, attach a pressure gauge to the outside faucet closest to the water meter. Make sure that no other water is flowing at the residence. Turn on the faucet and record the number in the area provided to the right. This is the static water pressure in pounds per square inch or PSI.

2. Water volume (GPM)

To determine the volume of water available for the system, you need two pieces of information:

A. What size is the water meter?
Water meters will generally have the size stamped on the meter body. The most common sizes for residential meters are 5/8", 3/4", and 1". In some areas the water supply hooks directly into the city main without the use of the water meter. In these cases, simply enter the size of the service line in the space provided.

B. What size is the service line?
Measure the outside circumference of the pipe that runs from the city main to the house. An easy way to do that is to wrap a piece of string around the pipe, measure the string, and use the table to the right to convert the string length to pipe size.

3. System Design Capacity

Using the System Design Capacity Chart on this page, locate the three numbers you just recorded to determine the Sprinkler System Design Capacity in gallons per minute (GPM). Record this number in the GPM box. Next, locate your system's static pressure and move down that column and find the system's working pressure; record it in the PSI box. Working pressure will be used when choosing sprinkler heads and designing the system.

You have now established the maximum GPM and the approximate working pressure available for the sprinkler system. Exceeding these maximums may result in inefficient watering or a condition referred to as water hammer, which could cause serious damage to the system. These two numbers will be used in the design process.

To check water pressure, attach a pressure gauge to the outside faucet nearest the water meter. A pressure gauge can be obtained from your local Hunter dealer.

Enter Static Pressure Here: _____

Enter the Size of the Meter Here: _____

Write the Service Line Size Here: _____

SERVICE LINE SIZE						
APPROXIMATE STRING LENGTH	2 3/4"	3 1/4"	3 1/2"	4 1/8"	4 3/8"	5 1/4"
Size of Copper Pipe	3/4"		1"		1 1/4"	
Size of Galvanized Pipe		3/4"		1"		1 1/4"
Size of PVC Pipe		3/4"		1"		1 1/4"

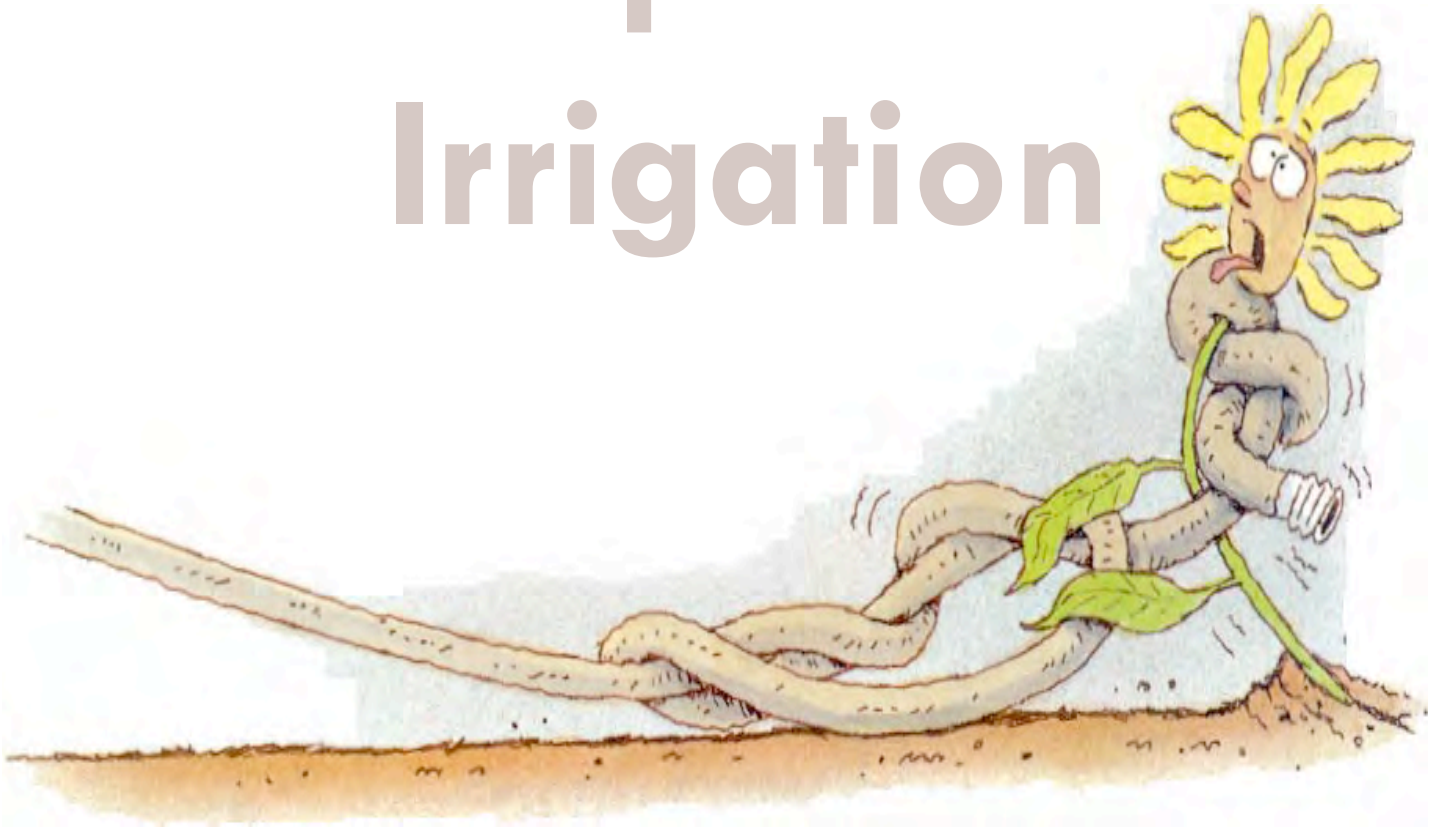
SPRINKLER SYSTEM DESIGN CAPACITY							
STATIC PRESSURE		**30**	**40**	**50**	**60**	**70**	**80**
WATER METER	**SERVICE LINE**	**MAX GPM**	**MAX GPM**	**MAX GPM**	**MAX GPM**	**MAX GPM**	**MAX GPM**
5/8"	½"	2	4	5	6	7	7
	¾"	4	6	8	8	10	12
	1"	4	7	8	10	13	15
3/4"	¾"	4	6	8	9	10	12
	1"	5	7	10	14	17	20
	1 ¼"	5	12	17	20	22	22
1"	¾"	4	7	8	9	12	12
	1"	5	8	14	18	20	20
	1 ¼"	5	14	24	26	30	34
Working Pressure		25	30	35	45	50	55

Service lines are based on 100' of Sch 40 PVC. Deduct 2 GPM for copper pipe. Deduct 5 GPM for new galvanized pipe.

Working pressure is the approximate working pressure at the head, and should be used only as a guide when choosing the proper sprinkler heads and designing the system. The numbers in the Design Capacity Chart are based on generally accepted flow rates (velocity). In some cases, designers increase the velocity in copper pipe only from the accepted 7 ½ feet per second (fps) to 9 feet per second (fps). If you do not deduct the 2 GPM for copper pipe, the rate is approximately 9 feet per second (fps). The friction loss is substantially increased at this speed, and the working pressure will be affected. In order to use the numbers in the chart, the length of copper service line should not exceed 50' if you decide not to deduct the 2 GPM.

GPM	PSI
Design Capacity	*Working Pressure*

Drip Irrigation



made *super* simple....

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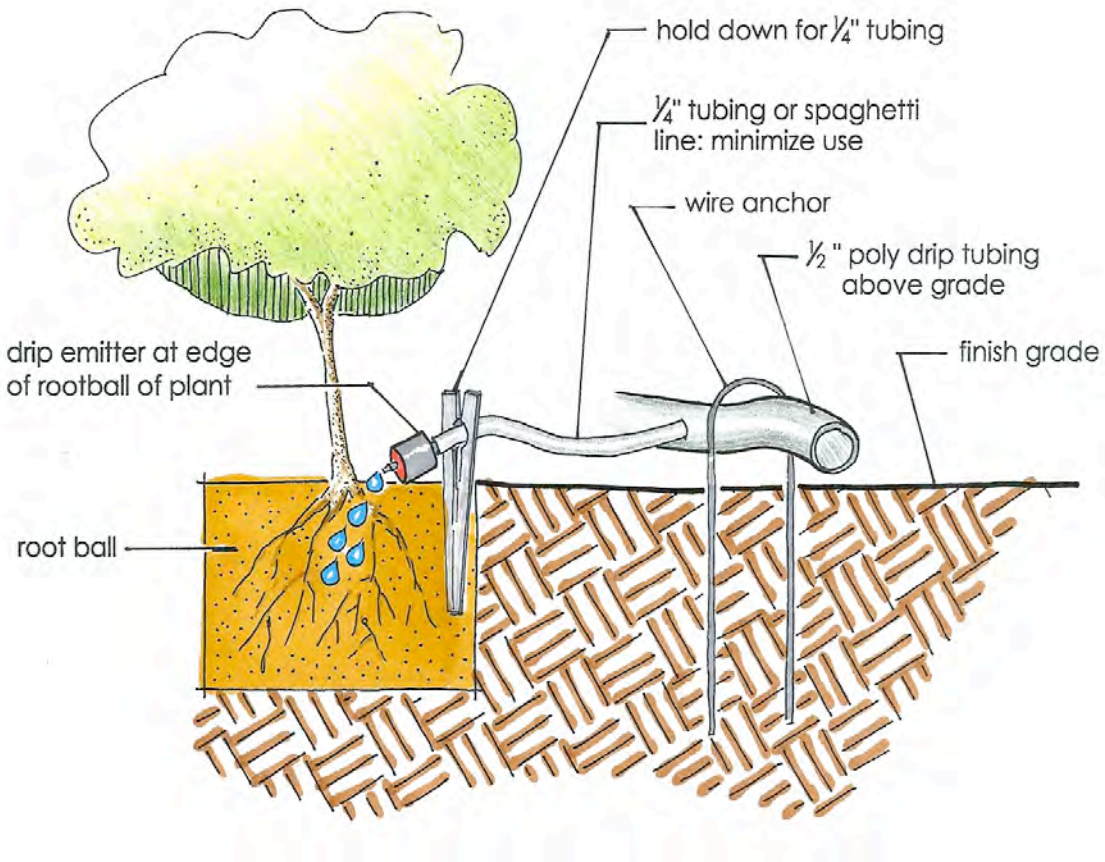
Drip Irrigation 101

- Drip irrigation is a low pressure system that delivers water very slowly over a longer period of time vs. sprinkler systems which throw a lot of water out in a shorter period of time. Drip systems are rated at GPH (gallons per hour) sprinkler systems are rated at GPM (gallons per minute).
- The beauty of drip irrigation is that it is a simple 'low-tech' system and installation is relatively fool-proof as long as quality components are used and a few basic guidelines are followed. It is a realistic project for most homeowners and retro-fitting an existing sprinkler system to a drip system is a pretty simple operation.

The basic system:

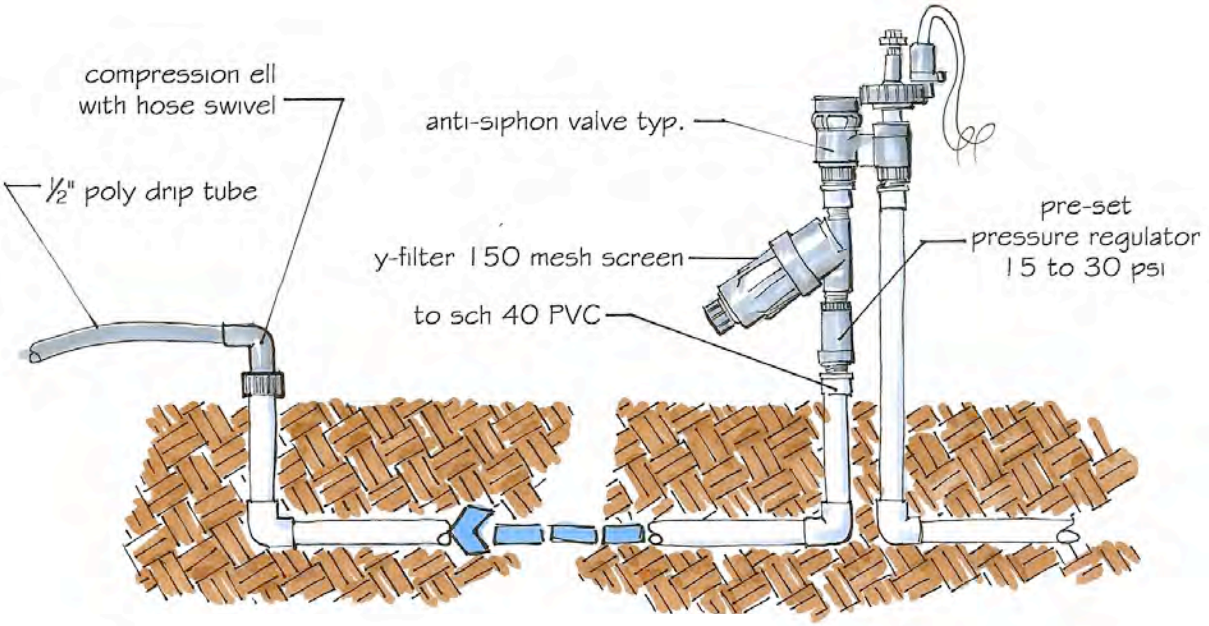


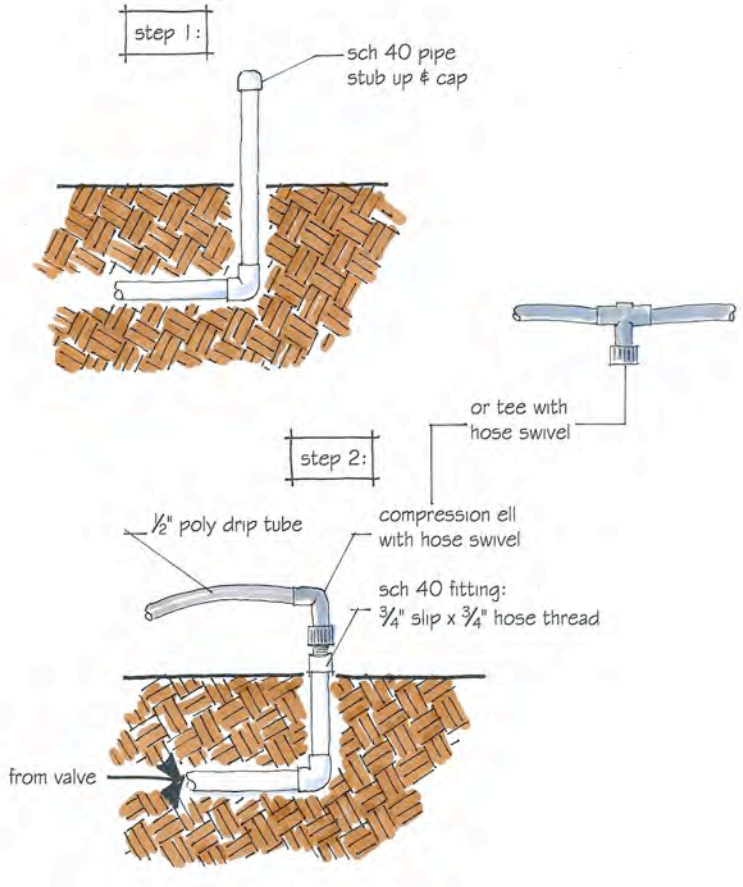
Drip Irrigation – The Basic System

- **Pressure Regulators:** This is a low pressure system – operating PSI is between 15 and 30. A pre-set pressure regulator is necessary.
- **Filters:** Filtration is recommended, 150 to 200 mesh screen will do the job. Typical is a Y filter or a T filter – these are simple inexpensive components.
- **Pipe or Tubing**: The main pipe used for drip irrigation is polyethylene tubing. Standard main line tubing is ½ inch. Stick with commercial grade products. The tubing can be buried but more often is laid above ground. Use garden clippers to cut tubing. No glue of any kind is used to fit tubing with connectors.
  - There is also ¼ inch tubing, commonly referred to as 'spaghetti' line but it should be kept to a minimum – rule of thumb: do not exceed 12 inches in length for any run. Too much of this small stuff becomes a maintenance nightmare.
  - On average the ½ inch tubing can deliver 220 GPH – if a tee is used at the source of water this is true for each direction. The tubing can run up to 200 linear ft.
  - When building a system use plenty of what I am calling 'hold downs' or anchors. This ensures that the tubing stays put when your Labrador decides to take a short cut through the garden at 40 miles an hour.... Even when an emitter is working, if it is 4 inches away from the root ball and it has little to no effect.
- **Connectors:** These are fittings that connect pipe – tees, elles (90's) or couplers. They come in ½" and ¼" sizes to match pipe size. This is all they do – connectors do not control the flow of water. I prefer compression fittings for ½" tubing.
- **Flow Controls:** These are components that control the amount of water delivered. The flow is rated at GPH (gallons per hour). Flow Controls include: emitters, drippers (same thing), bubblers & sprayers. A word about sprayers and bubblers: these components typically sit on little plastic risers not intended for weed whackers, dogs, kids etc. They do not hold up well in a general landscape application – especially micro-spray – expecting to water ground cover with these sprayers is asking for trouble. Most of the fine mist just blows away; it is not efficient. Regular sprinklers used sparingly on a water-wise ground cover makes more sense. Where these do make sense: I love the shrubbler-bubbler for watering roses, and maybe a few trees. The micro-spray is the best way I have found to water pots and containers.
- **Other Components:** *Goof plugs* – like it sounds, these little gizmos plug holes when you have changed your mind, or made a mistake... Easy. *Hold downs* – these are anchors that keep tubing in place – I use wire anchors on the ½" main tubing about every 4 ft. Build it like a Buick and you can spend your Saturday doing something other than irrigation repair. *Hole punch* – you need to punch a hole in the tubing to insert emitters or fittings.
- **Other Stuff to Know:** If components have threads they will typically be hose thread (MHT or FHT) this is different from pipe thread and it makes a difference – trying to screw something with pipe thread to a hose thread component will result in a leaky connection.
- **Mulch:** The final step – apply a 3 inch layer of medium grind wood mulch over entire bed once planting is done. This minimizes weeds and covers the tubing.
- **Valves or Zones:** First, the term zone is interchangeable with the term valve. Simple. As with any irrigation system it is critical to understand that planting areas assigned to a valve must be compatible in terms of the frequency (how many times per week or month the valve runs) and duration (the amount of time this valve runs) . Understand that a perennial garden is going to have a very different requirement than say, a stand of trees. I always give trees their own valve. Typically I run this valve once every 10 days for 12 hours. A veggie garden needs its own valve, pots and container plantings need their own valve, etc. As long as this criteria is met, you can irrigate a TON of plant material on a single valve.

Drip Irrigation – Starting at the Valve

- **Valve with Hard Pipe:** Ideally this is the way I would set up a new system if starting from scratch – goes back to the Build it like a Buick philosophy. The filter (a Y filter with 150 to 200 screen mesh) then the pressure regulator is added to the valve assembly as shown. From there hard pipe – sch 40 PVC – is run under ground and stubbed up at the locations needed. One valve can be stubbed up at different locations in a yard as long as the irrigation requirements are all compatible .

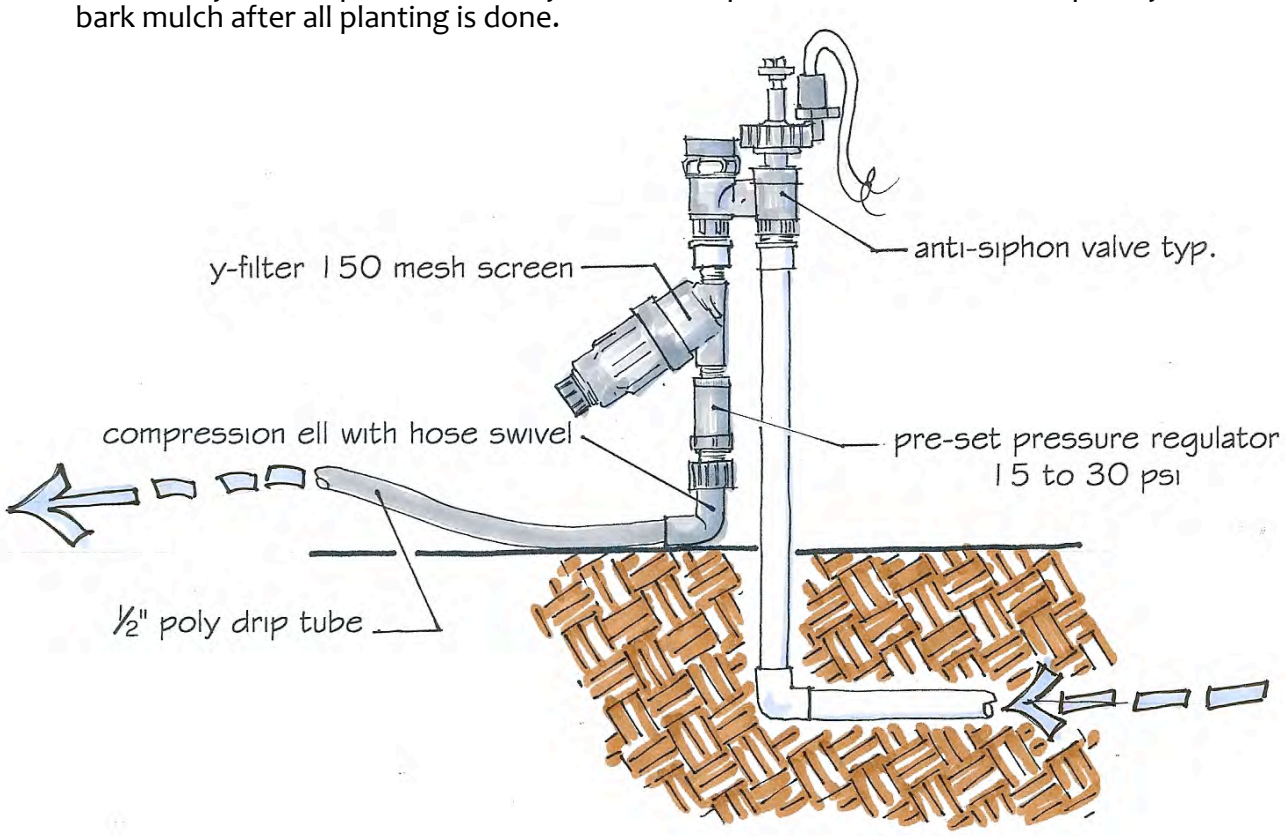




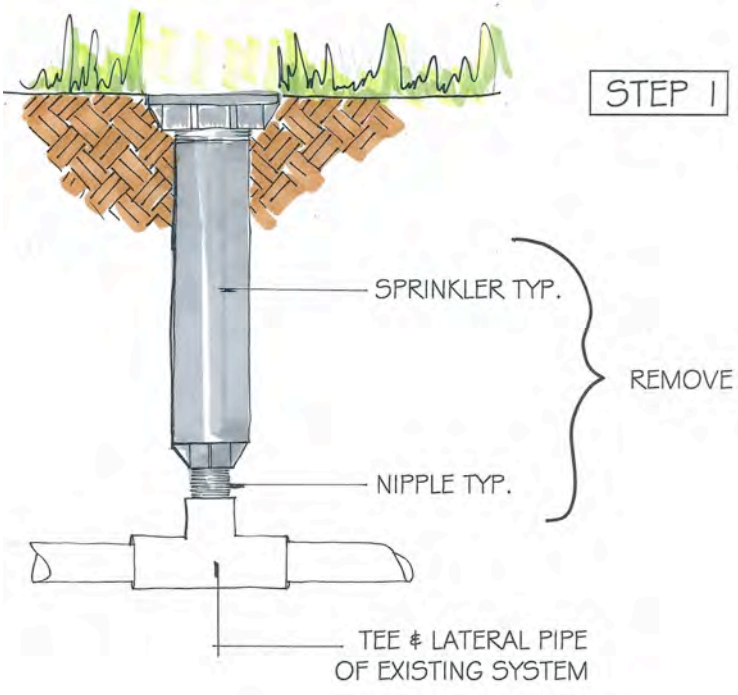
Stubbing up hard pipe – sch 40 PVC - for a new system. In step one the pipe is brought above grade and a cap is glued on, the rest of the landscape construction can continue and when final grade is achieved, the pipe is cut and a slip fitting with ¾" MHT (male hose thread) is glued on allowing a fitting with a hose swivel to be connected: step two.

Drip Irrigation – Starting at the Valve

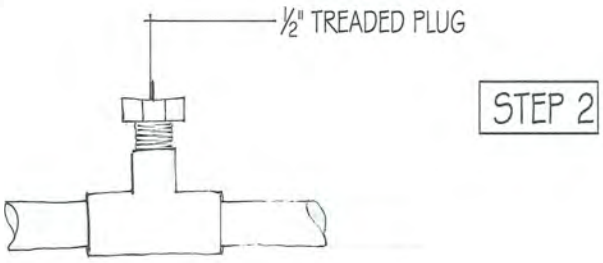
- **Valve with Drip Tubing:** A valve can also be set up with the drip tubing coming directly off the valve. The tubing is then laid on top of the ground. Remember to anchor the tubing with sturdy wire staples about every 4 ft. The drip line will be covered completely with bark mulch after all planting is done.



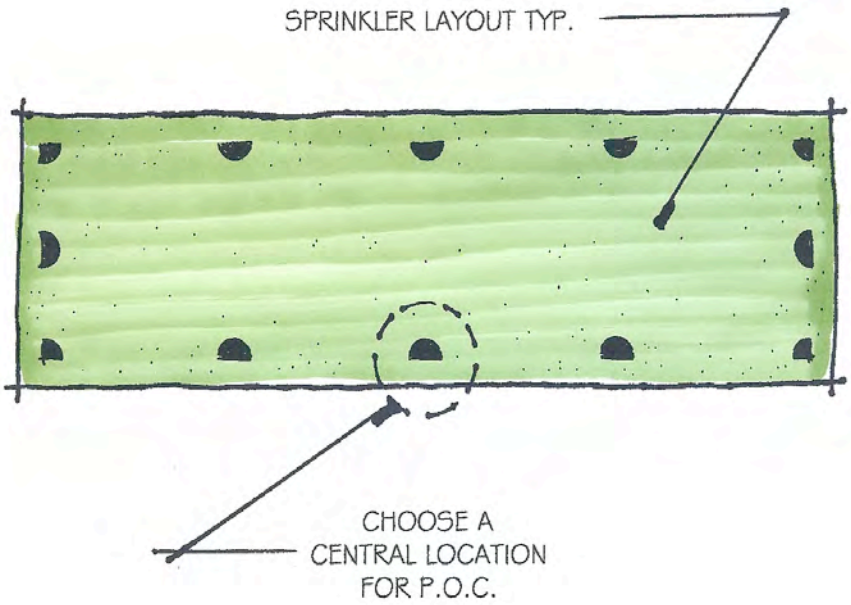
Drip Irrigation – Retro-Fit and leave the valve alone



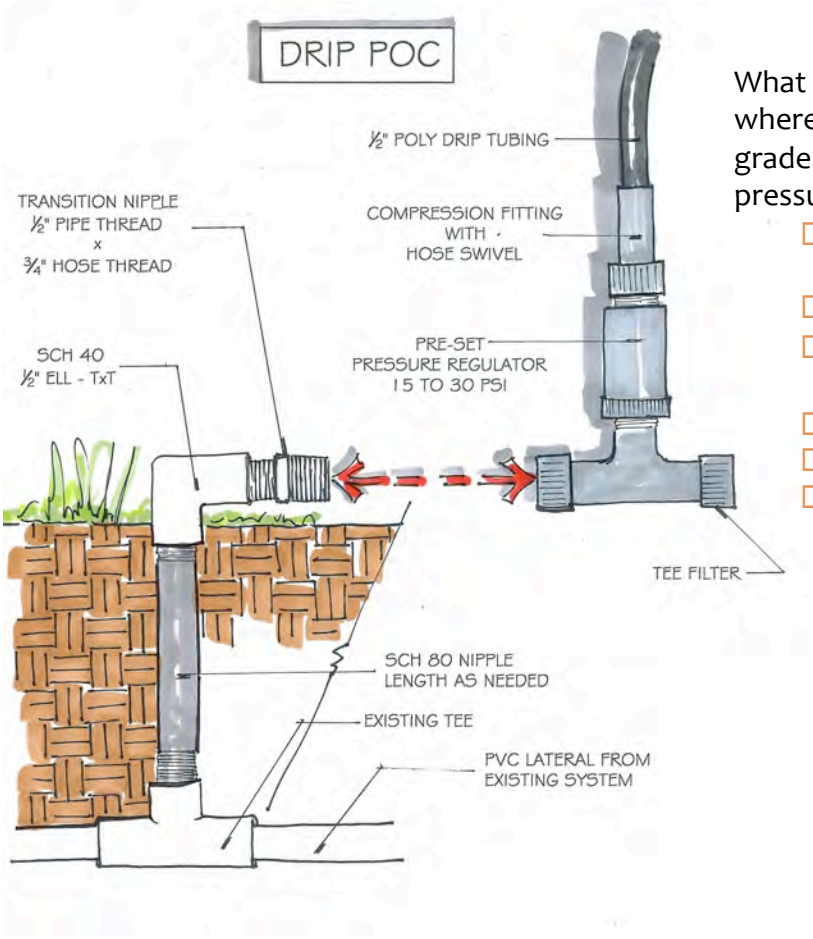
- **Retro-Fitting :** Sometimes it is just a whole lot easier to leave the valve alone when switching to drip on an existing sprinkler system. You can add the pressure regulator and the filter downstream from the valve at the site. Remove and plug all sprinklers as shown in steps one and two, except in one location where you will make your connection.



Drip Irrigation – Retro-Fit and leave the valve alone



Pick your location: Select one location where you want to install the riser for the 'point of connection' or POC. A central location is good but not critical. Remove and cap all other sprinkler locations as shown on the previous page.

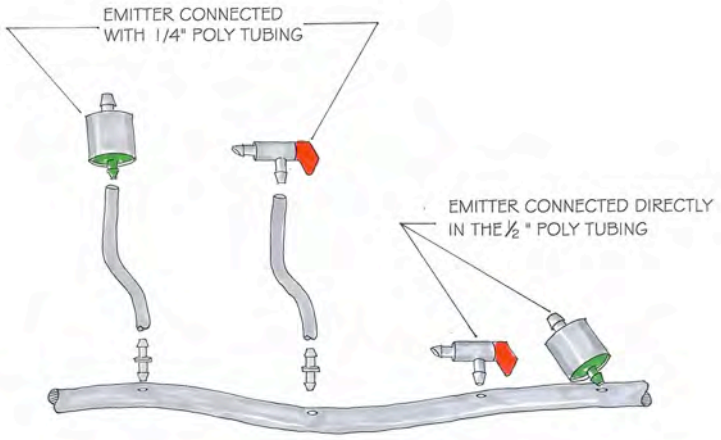


What I am calling the POC is the location where you will bring a sch 80 riser up to grade then build the assembly with filter and pressure regulator - install in order:

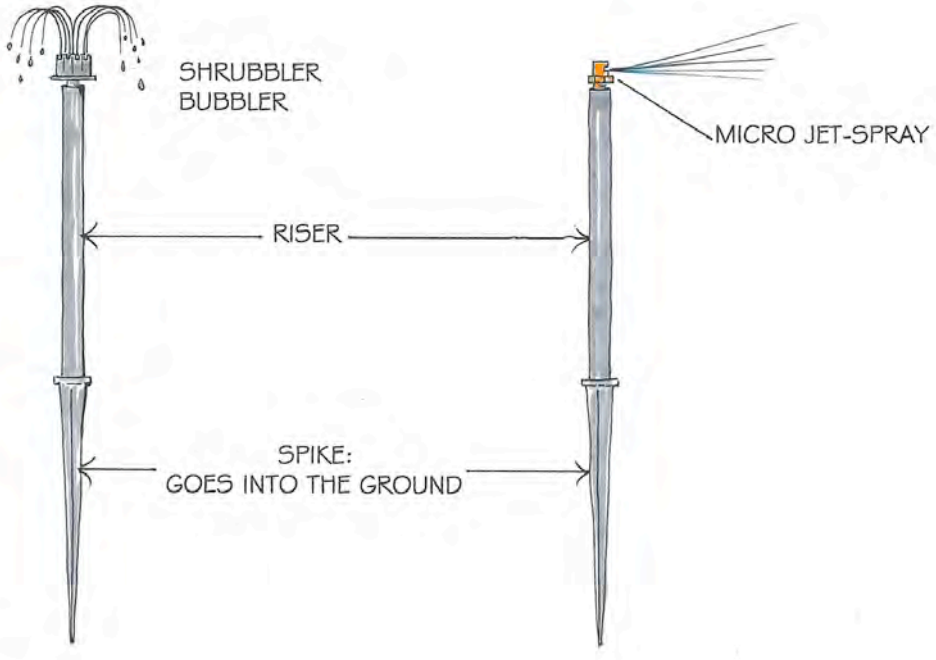
- ☐ Sch 80 nipple – ½" x length as necessary.
- ☐ Sch 40 ½" ELL TxT
- ☐ Sch 40 ½ " MPT x ¾" MHT transition nipple
- ☐ Tee Filter
- ☐ Pre-set Pressure Regulator
- ☐ Compression fitting with hose swivel connector

Drip Irrigation – Flow Controls

- **Emitters:** Also called drippers, they regulate the flow of water - from ½ GPH to 4 GPH is typical. Emitters come in a variety of shapes and sizes. I use only 1 GPH emitters in my garden (with a very few exceptions) . I would rather put less water on for a longer amount of time – that way I know there is no run-off. It is HIGHLY advisable not to get too precious with the different emitters available, putting 4GPH on one plant and ½ GPH on another, mixing types and brands – you are just asking for a headache; choose one emitter and stick with that - if a plant needs more water just add another emitter – simple. I like Bosmith brand emitters for ultimate bullet-proof performance, but the little Toro (used to be Hardie) emitters are much less expensive and work great too. Your best bet is to purchase components from a professional Irrigation Supply store.

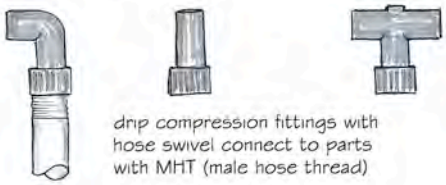


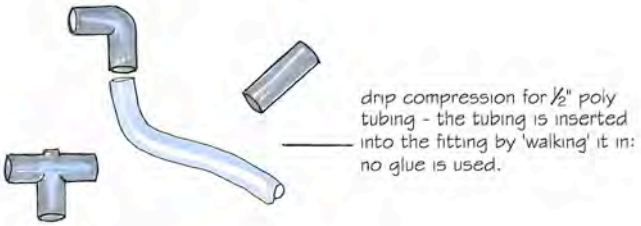
- **Sprayers & Bubblers:** These have their place but I limit use to a few applications. On the micro spray please do not try to water large areas of ground cover with these components – the mist is so fine it blows away in the wind (very inefficient) and the little spike riser set-up that is typically used to elevate the sprayer is not tough enough for general landscape use. Where the micro spray works best is watering pots and containers – I have tried many different methods and this is still the most effective. Bubblers are great for roses and a few trees.



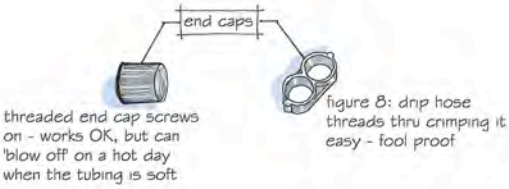
Drip Irrigation – Connectors

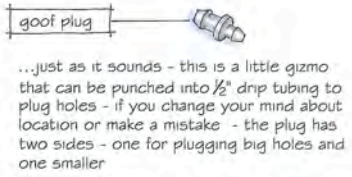
- **Fittings**: What I am calling connectors are more commonly referred to as fittings. These components do not control water flow they only connect one piece of pipe to another, that's all they do. I prefer compression fittings for ½" drip line, they seem to hold better. I have found that barbed fittings for ½" blow apart eventually. Fittings come in sizes to match the size of drip tubing. It is important to note that 'cheaper' brands tend to be a bit off in sizing and this becomes a real pain in the neck when trying to fit pieces together. Stick with major brands from Irrigation Supply stores and you should not have a problem.

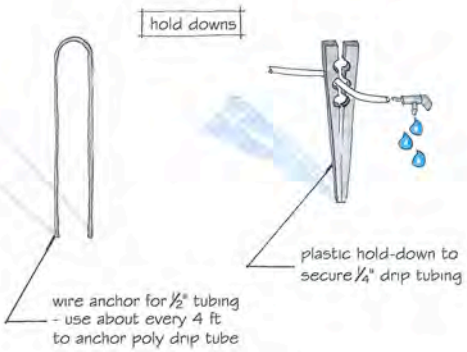




Drip Irrigation – Other Stuff







- **End Caps:** You need something to keep the water from running out the end of the tube – an end cap or figure 8.
- **Goof Plugs**: Life should be this simple – if you make a mistake, just plug the hole with one of these.
- **Hold Downs:** My word for anchors that keep the tubing in place where you want it.
- **Hole Punch:** You need to punch holes in the tubing to put emitters or fittings in.
- **Nut Driver:** You need this to help push emitters and fittings into drip tubing – a lot of little tools are out there that serve as combination punch and push tools, but a nut driver works great too.