

# IRRIGATION ESSENTIALS: 4 STEPS FOR DESIGNING AN EFFICIENT DRIP IRRIGATION SYSTEM IN COMMERCIAL CULTIVATION

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## INTRO: FROM THE BIOLOGY TO THE HARDWARE OF IRRIGATION SYSTEMS

In our last white paper, “**Irrigation Essentials: Basics, Biology and Best Practices**” we explained the biological importance of irrigation, how it can improve yields, and how drought stress can limit a crop’s productivity even without visible symptoms. The white paper also introduced what we feel is the most efficient method of irrigation for crops grown in soilless media: drip irrigation.

Now, we want to delve a little deeper into this time-tested practice. Since the first prototype in 1959, drip irrigation has experienced widespread adoption and many technological improvements. Modern drip irrigation systems are able to achieve more uniform distribution of water (and nutrients, in the case of hydroponic applications) than any other irrigation system.

## IN THIS PAPER

Despite its popularity, many cultivators are still unsure how best to integrate drip irrigation into their space, and what equipment is required to do so. In this white paper, we’ll explore the answers to these and other questions many growers are afraid to ask.

You’ll learn:

- How drip irrigation differs depending on the size of your facility
- Tips and recommended products for customizing drip irrigation for your environment
- Steps for planning an efficient drip irrigation system



## DRIP IRRIGATION, AT ANY SIZE

Whether you’re a hobbyist grower or a large-scale commercial operator, you can take advantage of the incredible timesaving and potentially yield-increasing benefits of drip irrigation. It is important to keep in mind, however, that the scale of your environment will dictate the equipment required for your setup.

For example, a cultivator growing a few fruiting or other high-production crops in a backyard, indoor tent, or basement will likely be able to use a simple system consisting of open-flow emitters, tubing, and a low-pressure pump.

However, a system like this, in particular equipment like low-pressure and open-flow parts, are not intended for use in commercial applications. Large-scale growers will require industrial equipment like filtration, pressure compensation, and high-pressure pumps. This white paper will primarily focus on best practices for setting up a drip irrigation system in a modern production facility.

← Rudimentary indoor irrigation setup

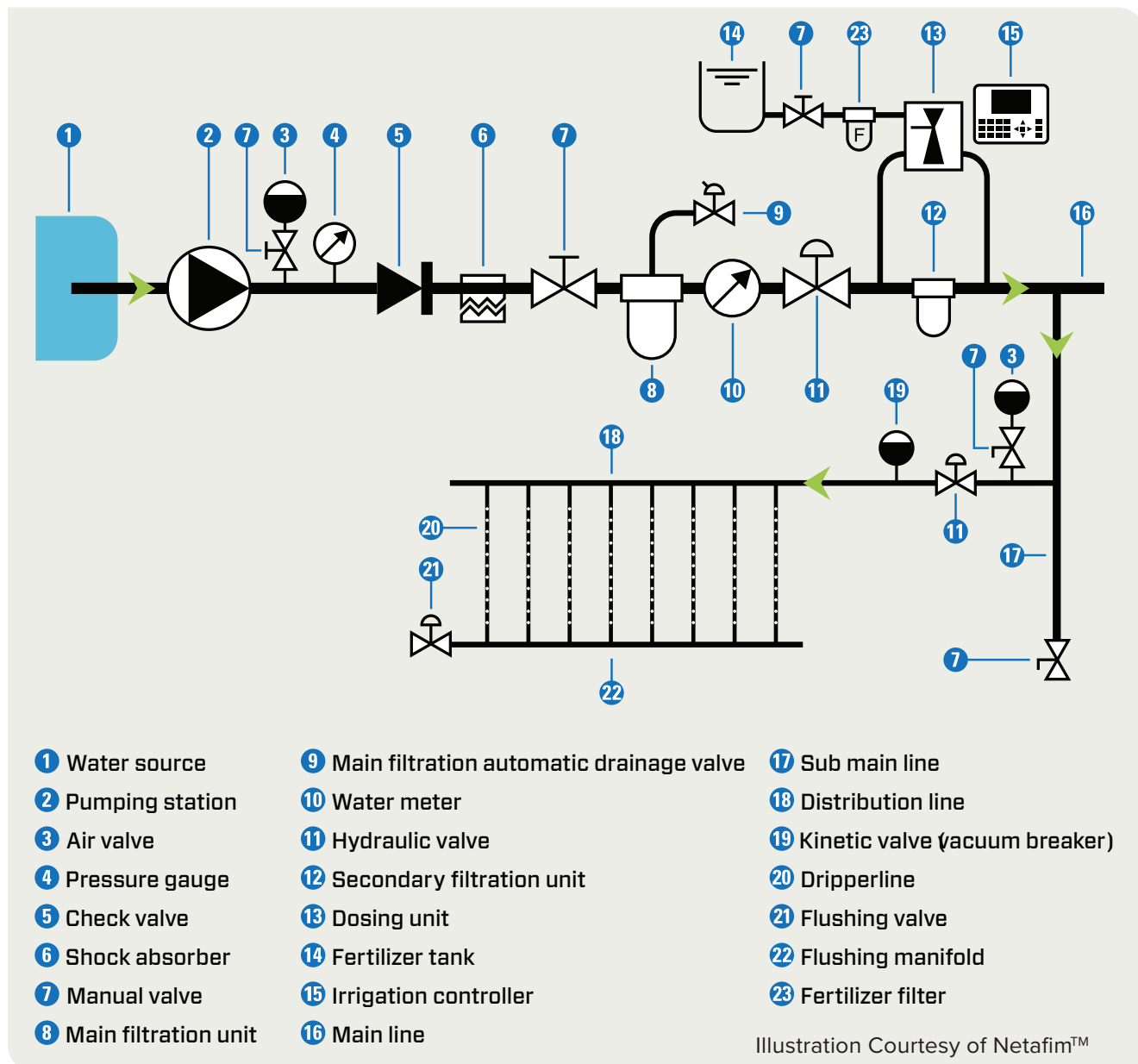
## GETTING STARTED: A COMMERCIAL SYSTEM OVERVIEW

First, let's look at the overview of a pressure-compensated drip system, commonly used in commercial facilities. One way to think of irrigation systems is like the circulatory system within a human body.



Both have a “pump” that moves fluid through tubes of progressively smaller sizes. This fluid contains vital nutrients and elements essential to its recipient. And both systems are complicated, requiring 24 volt AC controllers to operate correctly. (Just making sure you're still with us!)

Below you'll see a schematic diagram of a generic drip irrigation system. Schematics can seem complicated, but our goal is to guide you through how to use them, so they become a useful and productive companion.



“Yeah that’s it, I’m just watering by hand”

Each component is relatively simple when viewed individually, and together, create a complex, fully functional and effective irrigation system. A lot goes into the planning of a commercial system like this, because a lot can go wrong if not handled correctly. Expert planning and support to help ensure proper installation is a key benefit of working with Hawthorne experts, for any aspect of crop production.



## **STEP 1: START AT THE PLANT—AND WITH A PLAN**

When designing, evaluating, or troubleshooting a drip irrigation system, rule No. 1 is to start at the plant. Plants are what we're all here for, after all. A well-designed drip irrigation design also takes into account:

- : 1. A cultivator's growing style/preferences
- : 2. Container size
- : 3. Plant size
- : 4. Number of plants
- : 5. Growing media

Growers intuitively understand that these factors and others within their environment can affect one another. It's why most growers consistently, even obsessively, monitor every bit of information available to them—temperature, nutrient pH and EC, humidity, light levels, photoperiod, moisture content, etc. Growers know all these factors play into how plants not only grow, but thrive.

Great design takes this understanding a step further, by analyzing the specific effects conditions in *your* grow have on *your* results, rather than relying on generalities for all drip irrigation systems to make planning decisions.

## **STEP 2: CHOOSE DRIPPERS AND DRIP EMITTERS**

### **WHY DRIP IRRIGATION VS. HAND WATERING**

With drip irrigation, gone are the days of trailing huge, kinking garden hoses and counting the seconds you water each plant, dousing each in water while fighting an unwieldy wand.

Thanks to drip irrigation, there's no need to dump a ton of water onto a plant all at once, because there's no rush when you have a *fully automated* system.



### **WHAT IS A DRIP EMITTER?**

**Drip emitters** control the flow of the nutrient solution. By restricting the flow rate (common flow rates are 0.5-6+ gallons per hour, see below for more details) this allows long, relatively thin stretches of tubing to supply hundreds of drippers all from one tube. This means hundreds of plants can all be evenly watered from one tube with a smaller diameter than a garden hose!

### **CONSIDER YOUR MEDIA**

Designing with a plant-first mentality means starting at the roots, and the media they're in. You'll want to choose your equipment based on how quickly water and nutrients can move throughout your chosen substrate.

MEDIA	DRAINAGE RATE	IDEAL FLOW LEVEL
Stonewool or Rockwool™ cubes	Very Fast	Low
Coco coir	Moderate	Medium
Peat-based	Slow	High

## UNDERSTANDING FLOW RATES

Consider this next metaphor: Do you want to eat one giant meal each day, or would you rather have 3 meals, plus snacks, some sort of protein smoothie, and maybe a dessert? Most people would prefer the latter. Same goes for plants and water/nutrients! “**Irrigation Essentials: Basics, Biology and Best Practices**” for a deeper look at this concept (and metaphors about cars!)

### FLOW RATE:

the **volume** of solution, per **unit of** time, that is moving through a pipe, emitter, tube, or similar

### COMMON UNITS:

- Gallons per Minute (**GPM**)
- Gallons per Hour (**GPH**)
- Liters per Minute (**LPM**)
- Liters per Hour (**LPH**)

This is why emitters are rated at such a low flow compared to hand watering. This also gives us two of the most important qualities of a drip irrigation system: accuracy and efficiency.

## HOW DRIP IRRIGATION CAN HELP ENSURE ACCURATE AND EFFICIENT NUTRIENT DELIVERY

Let’s say you have a new irrigation technician who accidentally hand-waters each plant for 15 seconds instead of 5. This small mistake can result in gallons of additional nutrient solution being fed to the crop, which will be wasted, running straight down the drain. However, with the low flow of precision irrigation, a few extra seconds of irrigating will result in a much smaller volume of water (and nutrients) from being consumed.

### EXAMPLE

Let’s say we have two growers: **Grower A** and **Grower B**.

**Grower A** hand waters, and just hired Technician A to water for him.

Technician A waters for 3 seconds instead of 2 seconds per plant, resulting in an additional 0.16 gallons of water per plant. In his 500 plant grow, Grower A is now flushing 83 gallons of water (and nutrients!) down the drain—at every watering event (assuming a watering wand with standard 10 gallons per minute flow).

**Grower B**, on the other hand, installed an irrigation system.  
She hires Technician B to fiddle with the irrigation system. This tech decides to add 1 minute to each irrigation event. They have 6 irrigation events per day. This means they now irrigate for an additional 6 minutes per day, per plant. Assuming a 1.0 GPH flow, they will only have an additional 50 gallons being delivered to the crop (and flushed down the drain).

Even with a simple example like this, it’s clear to see drip irrigation is more precise, with a wider margin of error when it comes to timing than hand watering.

## CHOOSING THE RIGHT FLOW RATE

When it comes to drip irrigation, “low and slow” is the mantra we need to learn and repeat.

MEDIA	RECOMMENDED FLOW	RECOMMENDED EMITTER GPHA
Stonewool or Rockwool™ cubes	Low	0.3 or 0.5 Ex: <b>Grodan</b>
Coco coir	Medium	0.5-2.0 (or higher in some cases)
Peat-based	High	1.0-6.6 (or higher!)

### NOTE:

You can choose to go with a lower flow than recommended. However, a flow that’s too high can increase the risk of an effect called “channeling,” or when water pushes its way through the media without being absorbed. If this happens, your valuable nutrients are going straight down the drain. Bad for your plants, and your budget.

## NUMBER OF EMITTERS

Knowing your pot size is important to determining how many drip emitters you’ll need. Drip emitters have a limit to how wide their wetting pattern is (10-20 cm diameter). The larger the pot, the more drippers required.



## 🌱 STEP 3: SELECT SPAGHETTI TUBING AND STAKES

A spaghetti tube, as the name implies, is a thin, flexible, often polyethylene tube that is thicker than lateral or drip lines. Lateral/drip tubes are also often made of polyethylene but have a thicker wall than spaghetti tubing.

Spaghetti tubing is also called ¼" tubing, because the outside diameter (OD) is often, you guessed it, ¼". Other common diameters are measured in millimeters (3 mm inner diameter (ID) and 5 mm OD). Always make sure your ID matches your dripper and stake.

Always match your tubing size to your stake and emitter size! Need help? Our Technical Experts are here for you. Explore options [here](#).

The spaghetti tube is the link between the drip emitter and the stake. The stake is the last stop before nutrients hit the growing media. Stakes are generally simple, designed to direct nutrient solution to the media by allowing solution to cling to the stake before gently gliding down to the eagerly waiting root zone of the plant.

### CONSIDER PREMADE ASSEMBLY

Drip emitters, drippers, tubing and stakes can be purchased in premade bundles. This saves valuable time when building a system. Explore options available from Hawthorne [here](#).

## 🌱 STEP 4: FACTOR IN PRESSURE COMPENSATION

A critical question in drip irrigation is how to ensure the first plant on a table gets the same amount of water and nutrients as those at the end of the table. This is where pressure compensation comes in.

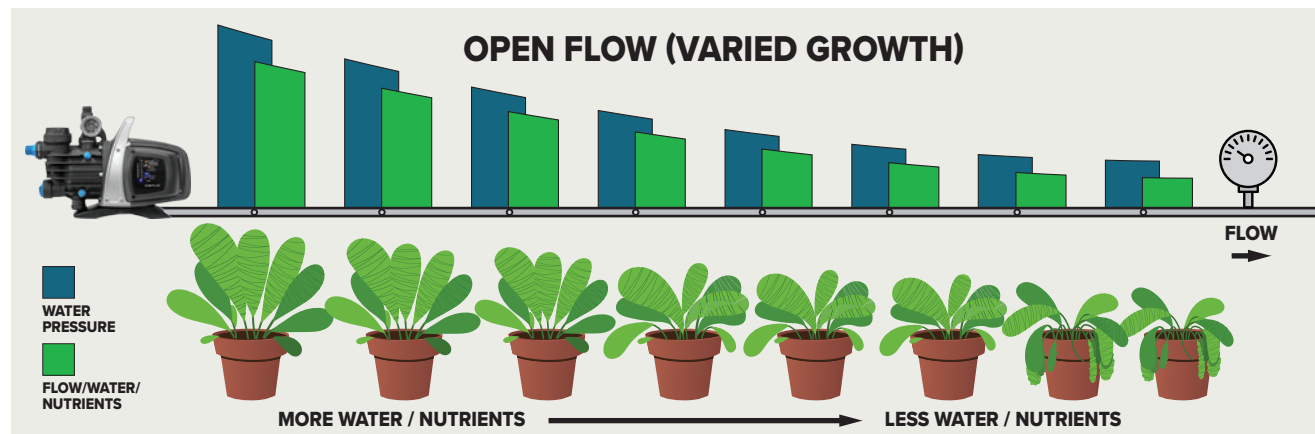
As liquid moves through a pipe, it gradually loses energy to friction. Friction is the resistance to motion of one object moving relative to another. For example, when you slide across a tiled floor in new socks, friction is the force that brings you to a stop. When pressurized liquid is forced through a tube in a drip irrigation system, friction is constantly opposing the movement of the liquid.

It's not exactly the same as sliding across the tile, because the liquid is not *slowed* down by friction when it is pressurized in a tube/pipe (for reasons we won't get into here). This energy loss has to go somewhere, and that somewhere is the *pressure*!

### EXAMPLE

Let's say you have a 500 foot long section of perfectly straight ¾" schedule 40 PVC pipe and you want to push 8 gallons per minute (GPM) through it. You install an **Eco Plus Elite 3/4HP Electronic Multistage Pump** to the system and turn it on. The built-in pressure gauge on the pump's electronic controller reads 51 PSI of pressure.

At the other end of that pipe you install a pressure gauge, and it reads 25.4 PSI of pressure.



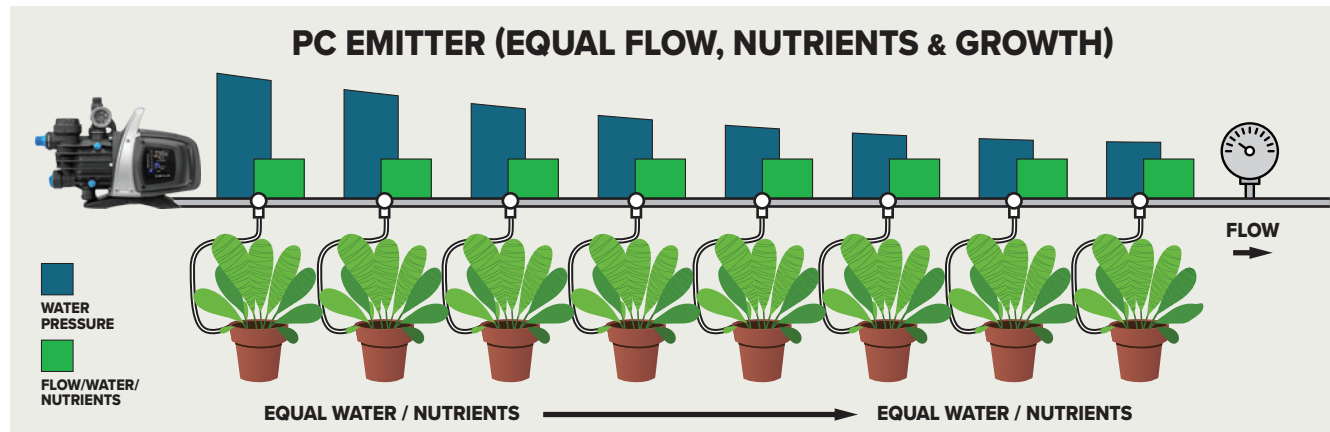
In an open flow system, less pressure means less water and nutrients

Why the difference? Pressure loss. This is another reason thoughtful irrigation design is so important. If you use the wrong size pipe, pressure loss increases *exponentially*. Using 1" PVC instead of ¾" PVC could mean the difference between a functioning and non-functioning system.

## WHY PRESSURE LOSS MATTERS

Liquid in a pipe will have a pressure gradient form along the length of it. This is not ideal when we want to evenly distribute water (and nutrients) to a crop, because without the benefits of pressure *compensation*, pressure will directly affect the flow at a given point.

Continuing the example above, if we punched a small hole in PVC where the pressure in the pipe was 50 PSI, more water would leak than if we punched the same sized hole in the pipe at 30 PSI. This is a problem when we are growing crops, because that pressure gradient will mean more water (and nutrients) will end up in the pots closest to the pump, while plants at the other end of your grow room are at a high risk of **drought stress**.



With pressure compensation, each plant receives the same water and nutrients

Pressure compensation (PC) can help. Emitters with this technology will provide the exact same *flow* so long as the pipe is within a certain pressure range. No more misfed plants, only even growth and uniform canopies.

This is why we use PC emitters for commercial applications. You can get away with open flow if you have a few plants close together, because there will be little or no pressure (and therefore flow) difference between them. But for large commercial grows, uniformity from pressure compensation is critical to helping cultivators grow consistent, profitable crops.

### SPECIAL NOTE ON SPRAY VS. DRIP STAKES:

When growing with large pots, either because of cultivation style or preference, drippers might not be recommended. Depending on the pot size, each pot might require upwards of six drippers for even watering.

For those situations, we recommend spray stakes instead of drip stakes, like those from top-selling Netafim™. These feature pressure compensating emitters so you get the benefits of drip irrigation, with the coverage of a sprayer.

## A WELL-DESIGNED DRIP IRRIGATION SYSTEM:

- Features the ability to alter the frequency and duration of irrigation events
- Delivers uniform flow rate and total amount of water and nutrients to each individual plant
- Includes the ability to provide targeted water programs for each plant growth- or crop-stage
- Provides adequate water supply or storage to maintain consistent irrigation
- Can help minimize costly wastewater removal or treatment
- Can help minimize humidity load for indoor growing operations, thus helping to reduce dehumidification load

The primary goal of any irrigation system is to deliver water and nutrients to your plants in a consistent, uniform fashion. This can help maximize total crop yield, and reduce the risk of pest and disease pressure in soilless media. The design and management of your irrigation system is integral to maximizing crop output.

## STAY TUNED FOR PART 2

This concludes part 1 our exploration into drip irrigation. Be sure to follow us on social media and check our website to be among the first to know when we release part 2.



## THE HAWTHORNE DIFFERENCE

Our team of technical experts can help not only with the specifics on setting up a drip irrigation system, but also with the holistic, complex interplay between irrigation and other areas of your grow, including nutrients, growing media, HVAC and lights. Our goal is to provide growers the information they need to make the right decisions for their facilities, the first time.

### THE PRODUCTS AND ADVICE TO KEEP YOU IN THE GAME

- Hawthorne Gardening Company, in partnership with the largest irrigation equipment manufacturers in the world, is here to help you maximize your crops' potential with the best irrigation management strategies and information available today.
- Our dedicated team can assist you in every step of the way to ensure that your system will work exactly how it is supposed to from day one.

For more information, call Hawthorne at 888-808-4826 or visit our website at [hawthornegc.com](http://hawthornegc.com)





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