How Much Water Does A Garden Need? Workbook

emwd

G3

CLIMATE READY
LANDSCAPE ACADEMY

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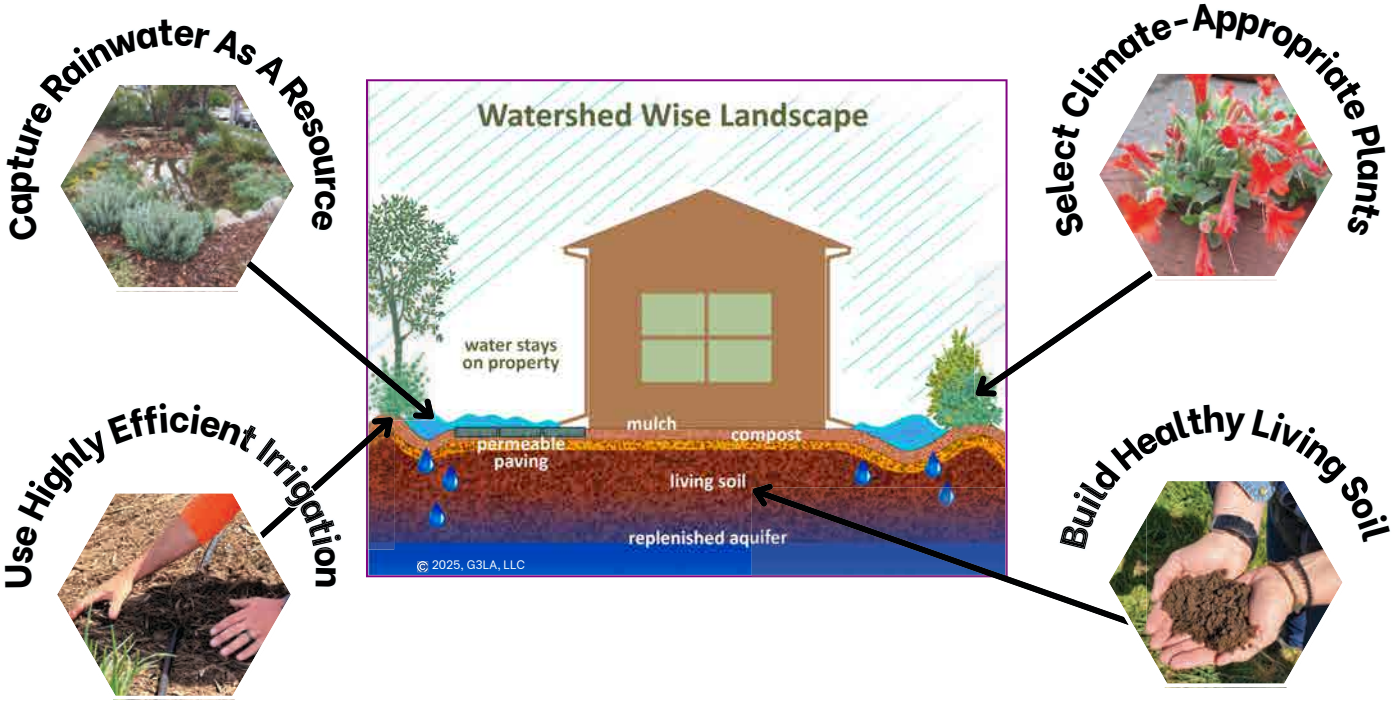
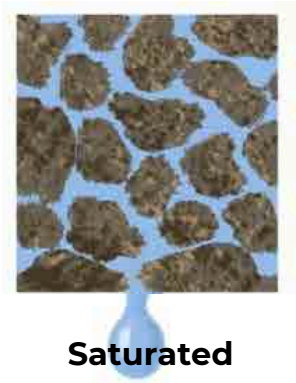
Concepts Covered

All Plants Need Some Water to Thrive

Watershed Wise Approach:
Irrigation is Meant to Supplement Rainfall

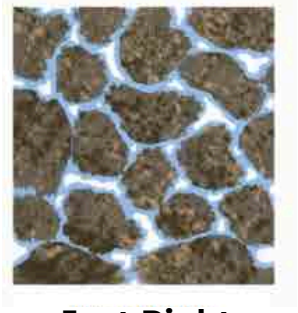


Irrigation Maintains the Balance of Oxygen & Water in Soil For Optimal Plant Growth



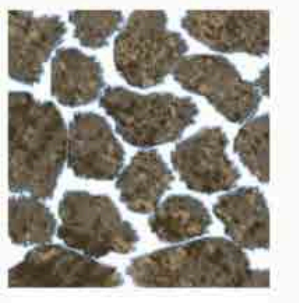
Saturated

No Oxygen.
Too Much Water.
Anaerobic
(Pathogenic) Life.



Just Right
(Field Capacity)

Balanced Oxygen.
Balanced Water.
Aerobic Life.



Too Dry
(Wilting Point)

Lots of Oxygen.
No Water.
No Life.

Four Factors Determine a Plant's Water Need

Macro/Micro Climate

Plant Type/Form

Soil Type/Health

Equipment

1A Climate: Macro Climate - Generalized Conditions that Affect Weather

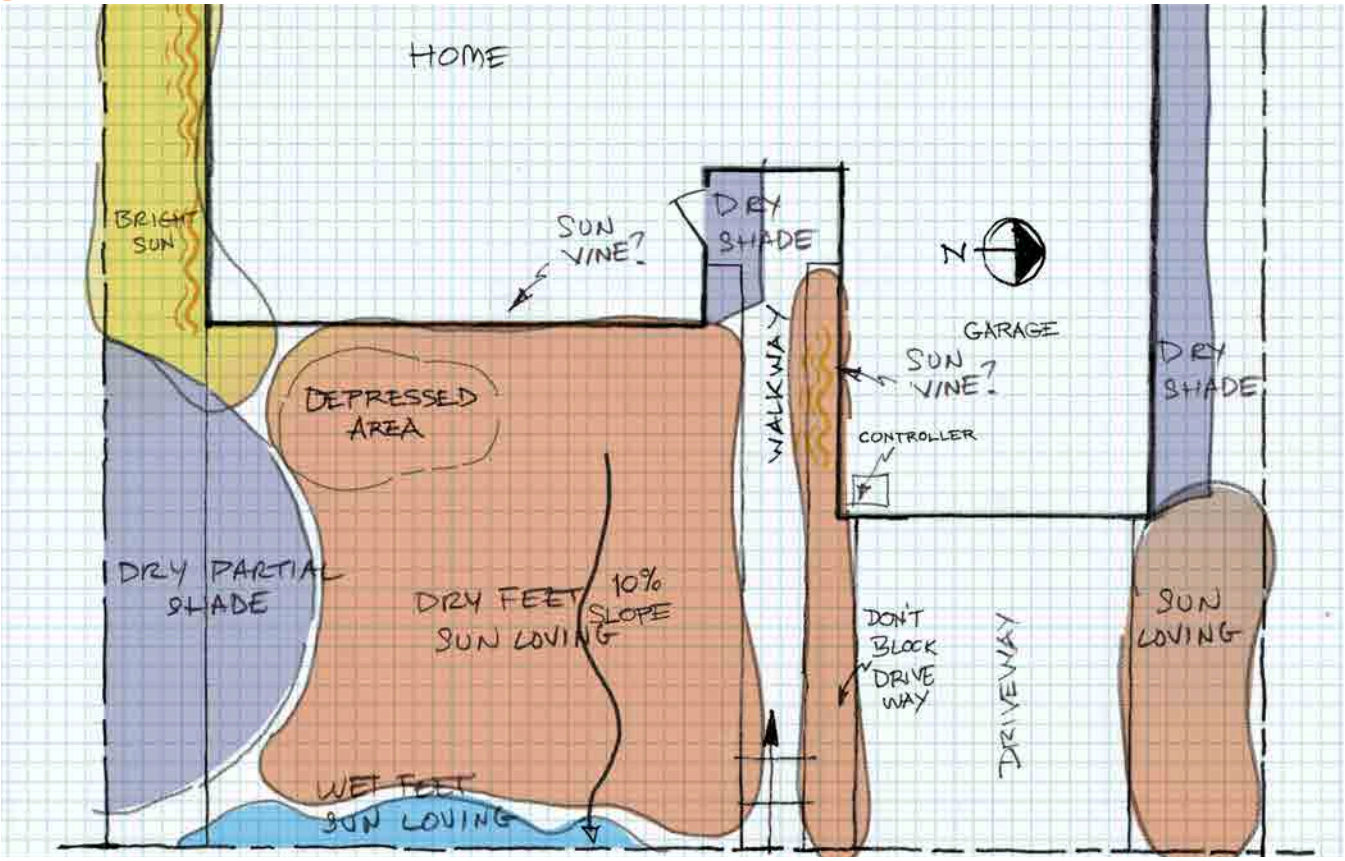
GEOGRAPHY.

LAND USE.

The macro-climate is the climate of a particular region, not specifically within your landscape. Here are some other examples of determinants of weather:

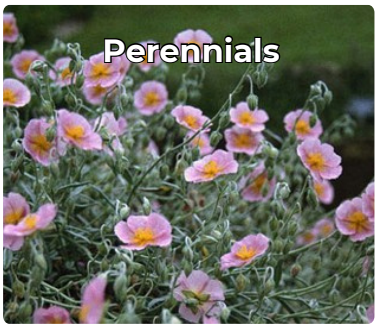
- Rainfall
- Snowfall
- Wind
- Fog/Humidity
- Solar radiation/intensity
- Altitude
- Number of sunny days
- Seasonal length of days
- Average temperatures
- Annual temperature variations
- Timing of precipitation

1B Climate: Micro Climate - Specific Conditions in YOUR Garden



- Sun/Shade
- Slope
- Wet/Dry
- Tree roots
- Narrow spaces
- Land contour
- Radiant heat
- Wind tunnel

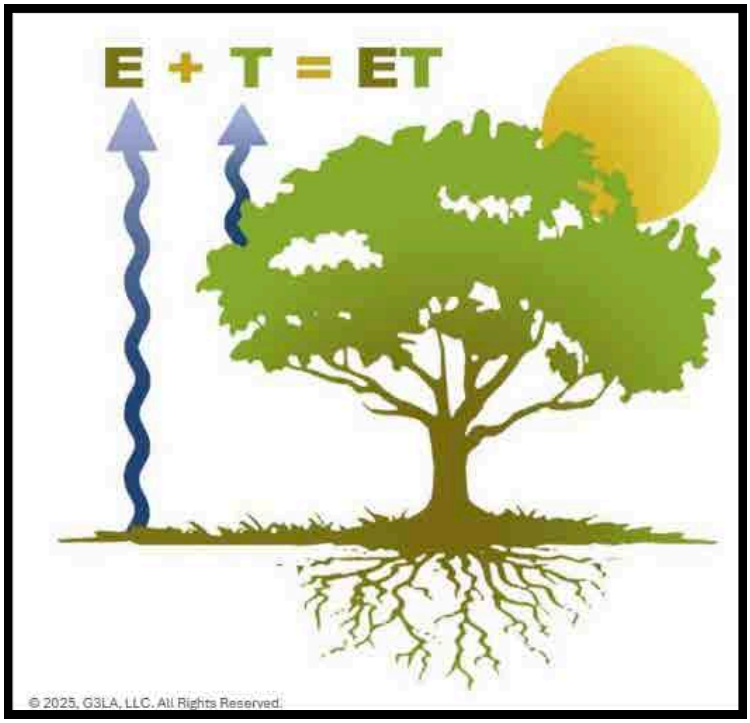
Plant Types and Forms



Don't Forget Seasonality (Time of Year)

- Spring
- Summer
- Fall
- Winter

2 The Plant Water Need is Measured as ET (Evapotranspiration)



The amount of water lost from an uncovered soil surface and transferred to the atmosphere **(EVAPORATION)**

+

The amount of water plants take from the soil through their roots and cycle to the atmosphere through their leaves (**TRANSPIRATION)**

ET is expressed in INCHES of water per time period (Daily, Weekly, Monthly, Annually)

Plant Adaptations Help Limit Their Water Need

Plants are very efficient at cycling water in their environment. Some have developed **adaptations** that allow them to **limit their water need and still thrive** in a particular place. These adaptations should be considered along with the site's microclimates and other design considerations that the gardener can influence:

- Annual/Perennial
- Sun/Shade requirements
- Fast/Slow growing
- Height/Width
- Epigenetics (adaptations to place)
- Grouping by hydrozone (water needs)
- Grouped by plant community
- Highly diverse planting plan
- Density of planting
- Soil health

3 Soil Type/Structure

HOW MUCH Water is Available in the Soil Water "Bank" Account

Sand

- Acts like Iced Coffee
- Can't hold water
- Fast infiltration
- Easily extracted

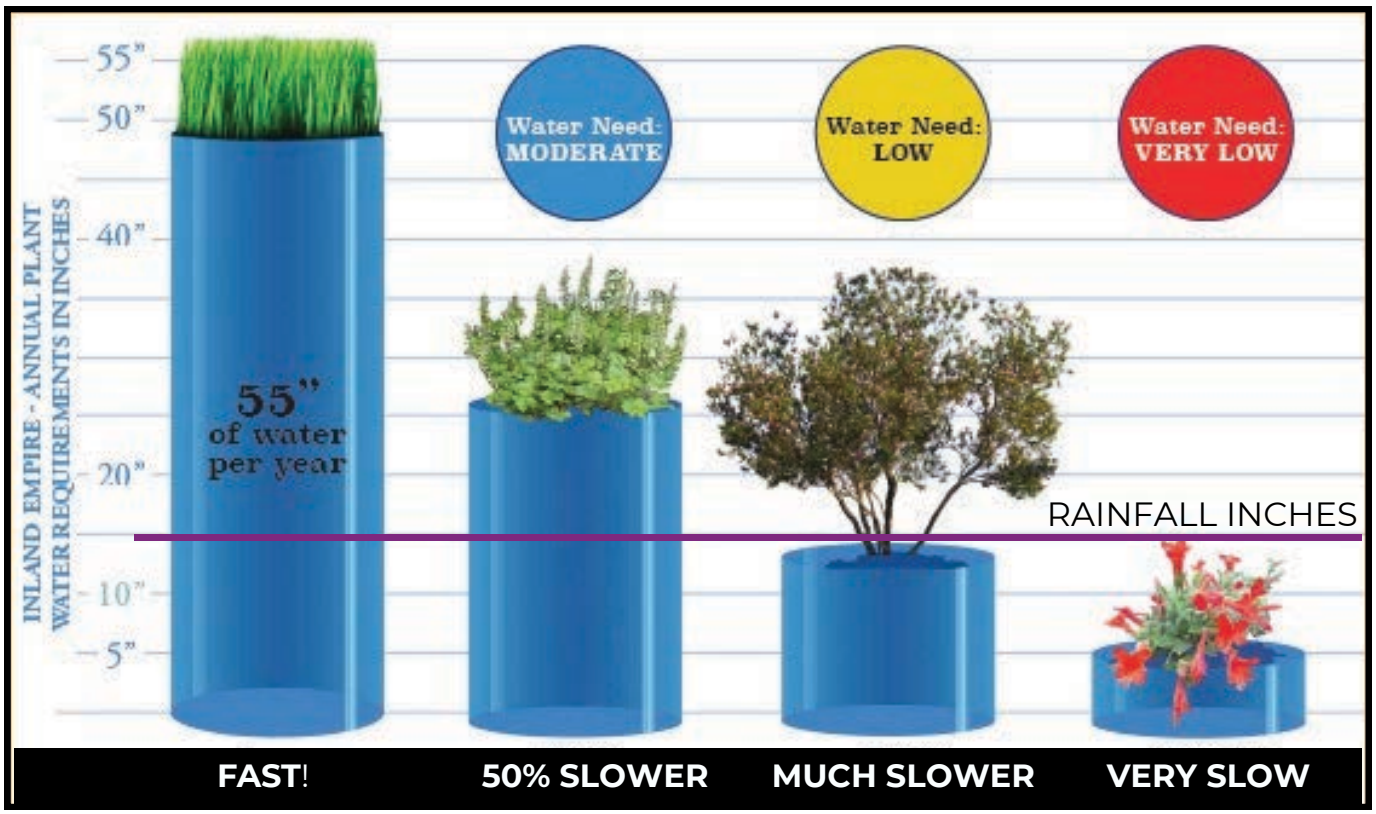
Clay

- Acts like Blended Coffee
- Holds a lot of water
- Slow infiltration
- Difficult to extract

Healthy Soil

- Acts like a Sponge
- Holds water when dry
- Releases water when wet
- Infiltrates quickly
- Easily extracted

How Quickly Plants Remove Water from the Soil Water "Bank" Account Determines WHEN Plants Need to be Watered



4 Irrigation Equipment

HOW QUICKLY Water Fills the Soil Water "Bank" Account

EMITTER TYPES.

Low Flow Spray Nozzles:

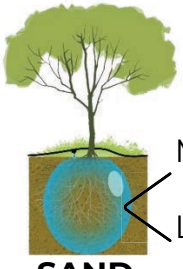
- Better than conventional spray
- Applies water evenly when installed properly
- Fast emission of water
- **Each Emitter = 0.75 - 1.0 Gallons Per Minute**

Drip Emitters:

- Applies water directly to roots
- Slow emission of water
- **Each Emitter = 0.50 - 2.0 Gallons Per Hour**
- In-line- Emitters at regular intervals along the tube
- Point-Source - Emitters added to blank tubing

Soil Type affects how quickly water can be applied to the root zone of the plants without creating runoff or going below the root zone.

SOIL TYPE.



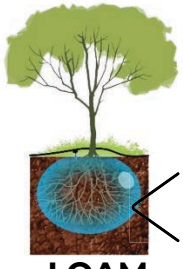
More Frequent

Longer Cycles

SAND

Needs Slow Application

- Water flows quickly out of root zone.
- Doesn't spread out horizontally .



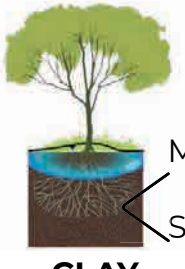
Less Frequent

Longer Cycles

LOAM

Best Spray Condition

- Ok with faster application if well managed.



More Frequent

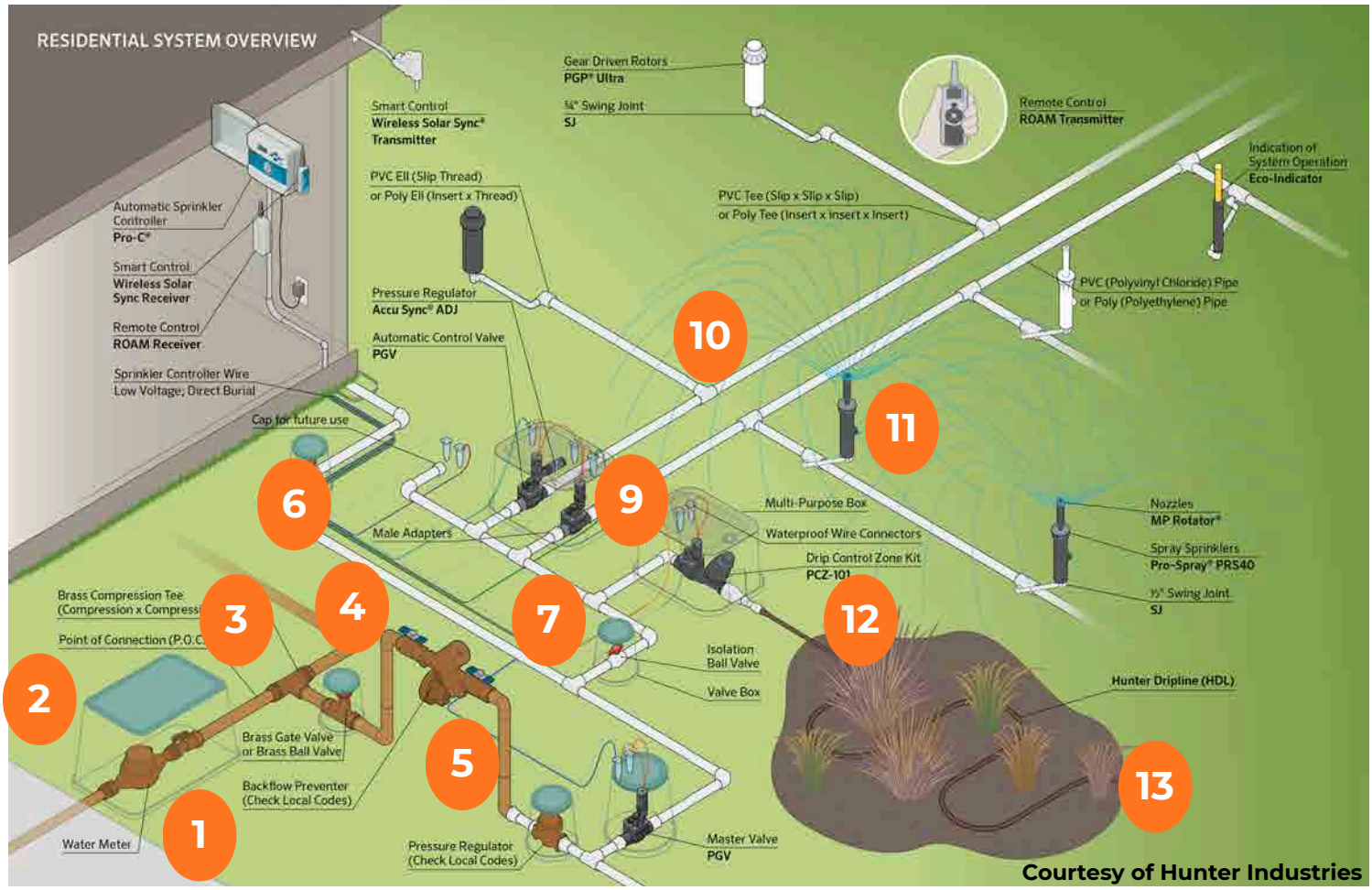
Shorter Cycles

CLAY

Needs Slow Application

- Roots easily become water-logged.
- Spreads out horizontally and stays too shallow.

Typical Residential Irrigation System Layout

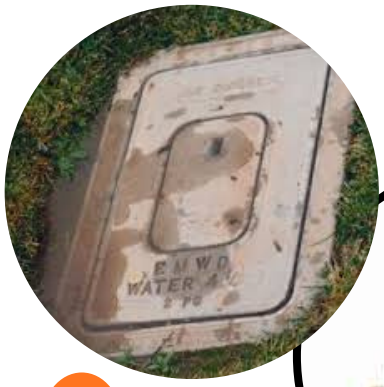


Courtesy of Hunter Industries

1. Meter Box/ Water Meter
2. Remote Water Monitor
3. Copper Mainline (under constant pressure)
4. Gate/Ball Valve (mainline shut off)
5. Backflow Prevention
6. PVC Irrigation Mainline
7. Master Pressure Regulator
8. Anti-Siphon Valves (don't need backflow prevention)
9. Globe Valves (do need backflow prevention
10. PVC Lateral Lines (only under pressure when valve open - distribute water into the landscape)
11. Spray Emitters (pop-up when under pressure)
12. Point of Connection to Drip Tubing
13. Tattle-tale (pops up when drip turns on)
14. Manual Flush Valve (allows clean-out of drip line)

Where is your Irrigation Controller? Download the manual from online sources and place a map of your irrigation zones inside the box.

Other Components of an Irrigation System



1 Meter Box

Water Meter

Ball/Gate Shut off Valves

Mainline Shut off Valve 4

5 Pressure Vacuum Breaker

8 Anti-siphon Valve

Backflow prevention like a Pressure Vacuum Breaker keeps water that has passed through the meter into your landscape from being siphoned back into the municipal water supply or into your home. **Anti-siphon Valves** also provide backflow prevention and **must be installed 6 Inches ABOVE the highest point in the zone.**

If valves are in the ground, at the bottom of a hill, or lower than 6" from grade, master backflow prevention is needed. These control valves are called **Globe Valves.**

9 Globe Valve

Other Components of an Irrigation System

Points of Connection occur where an irrigation system taps into a water source (e.g. municipal water meter) to receive water or to transition from one form of pipe to another (e.g. mainline to anti-siphon valve to PVC lateral lines). **The Drip Point of Connection is where the PVC lateral lines transition to drip irrigation tubing.**

12 Drip Point of Connection

Irrigation Controller

the Irrigation Controller or Timer is the brains of the irrigation system, as it sends electrical signals to the irrigation valves to open or close in response to a watering program. When valves are told to open, pressurized water can flow through from the mainline to the PVC lateral lines, charging the emitters to pop-up or emit water from drip tubing. When valves are told to close, the water in the PVC lateral line is no longer under pressure and emitters shut down.

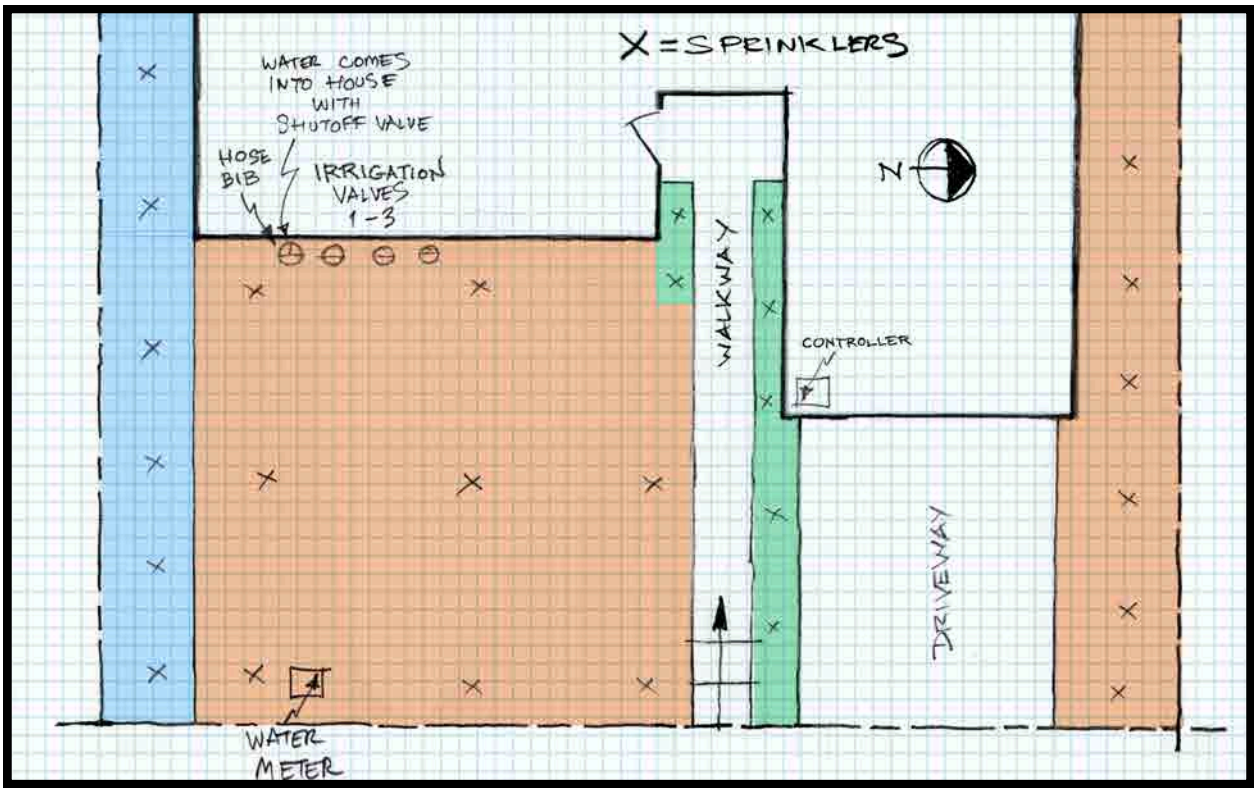
Smart irrigation controllers are Weather-based and set programs according to local weather conditions.

7 Pressure Regulator

11 Pop-up Spray Sprinkler Body

11 Spray Nozzle

Get to Know Your Irrigation System



1. Where is the Water Meter?
   a. Is there a Shut-off Valve?

2. Where is the Irrigation Controller?
   a. What kind is it?

3. Where are the Valves?
   a. What kind are they?
   b. What Areas do they control in the landscape?

4. Turn on each zone using the controller and map the location of the zone coverage.
   a. What kind of emitters (sprinklers or drip) are in the zone?
   b. How many sprinklers does the zone have?
   c. Locate the sprinkler head closest to the valve. This will be converted to drip.

5. Where are the Hose Bibs?

Use the next page to layout YOUR Irrigation System.

Take one part of the yard at a time.

Start with the Front Yard as you see above.

Ask these questions to make sure you gather all the information you need to identify the elements of your irrigation system or troubleshoot leaks.

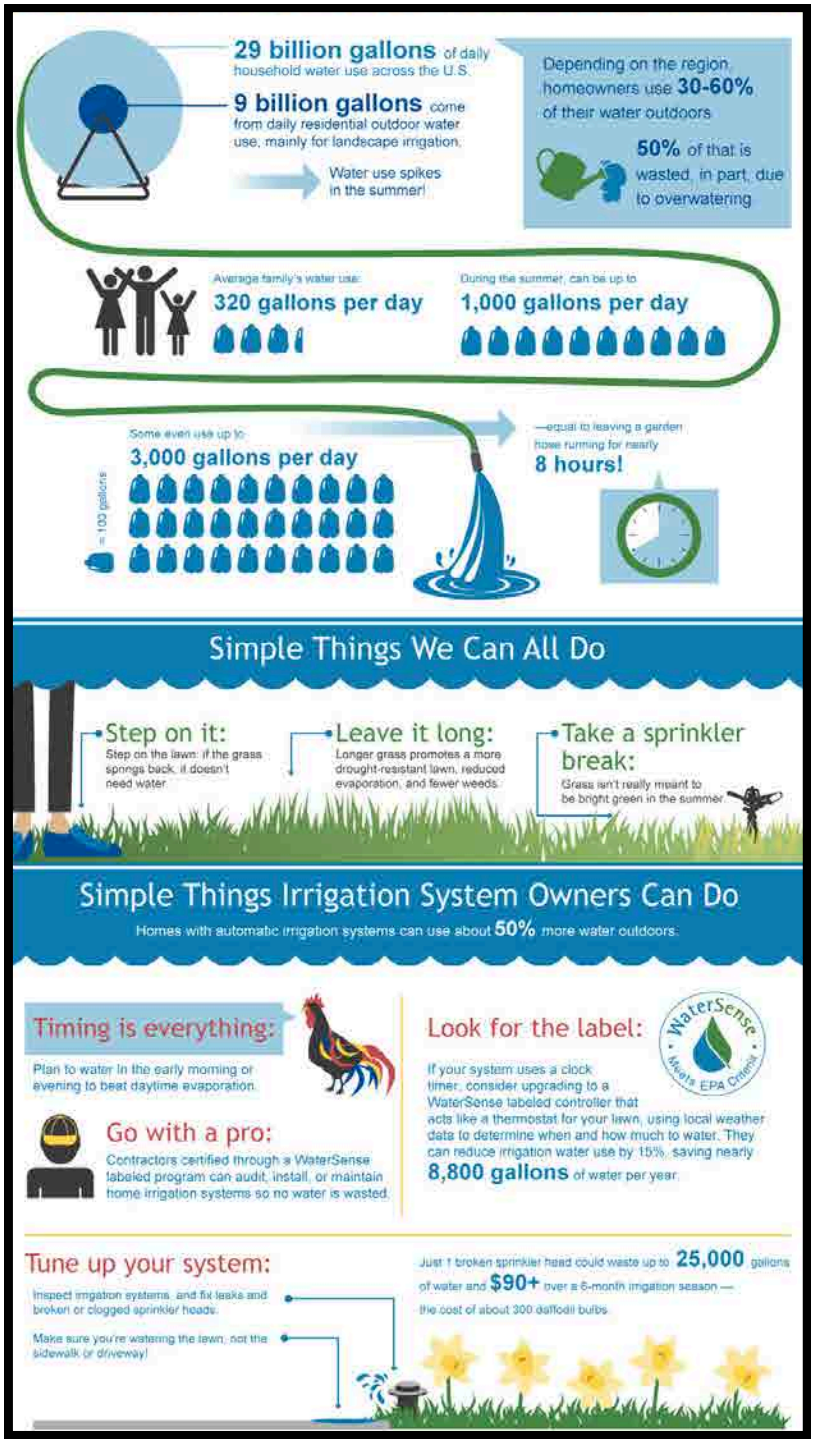
Also, all of the data from **pages 4 - 8** will be needed to program your irrigation controller. Gather that now.

Is there other information you could add?

Sketch Your Existing Valve Zones and Label the Key Elements

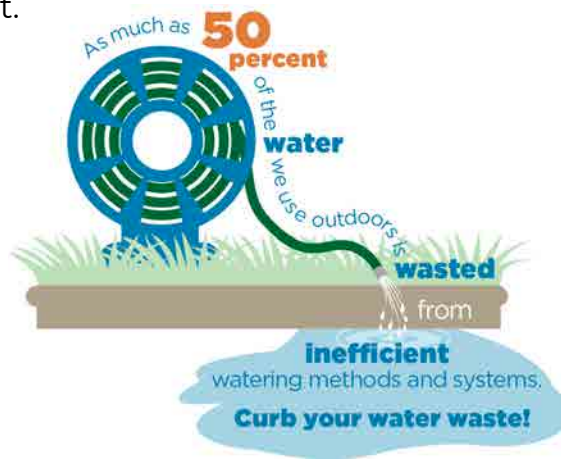
Where is your Irrigation Controller? Download the manual from online sources and place a map of your irrigation zones inside the box.

What Could Go Wrong?



Keys to Irrigation Success: Equipment Selection, System Design and Installation and Ongoing Water Management, Leak Detection and Repair

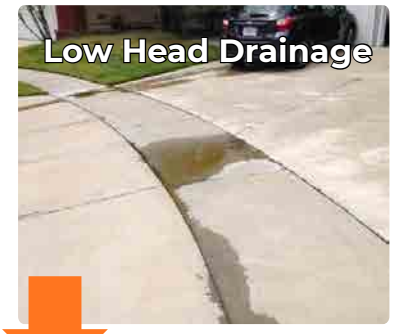
Irrigation systems are not simple. They have many points of connection where pipes are fit together, emitters are attached or inserted into tubing, and valves or meters are conected to pipe. Pressure changes abruptly in the pipes, creating stress. PVC pipes are exposed to sunlight. People step or drive on the emitters and components, damaging them. The irrigation controller programming remains a mystery to the vast majority of people, and water management appears to be a magical art.

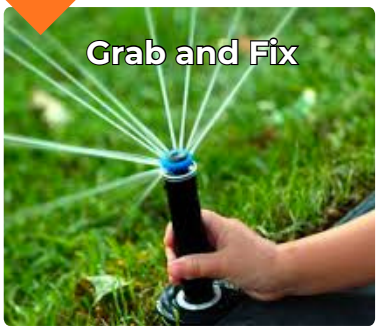


WaterSense, a partnership program by the U.S. environmental Protection Agency, seeks to protect the future of our nation's water supply. For more tips on reducing water use, visit ***www.EPA.gov/WaterSense/Outdoor***. Always look for the WaterSense Logo when purchasing irrigation equipment including nozzles and timers.

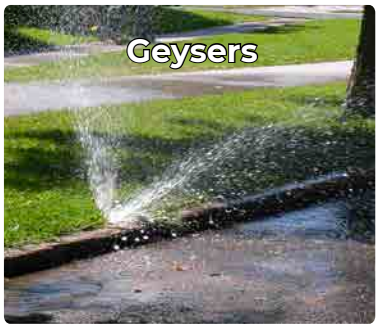
look for WaterSense Meets EPA Criteria

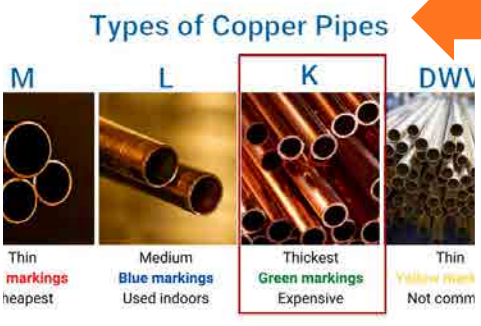
Easily fixed issues that instantly will save water.





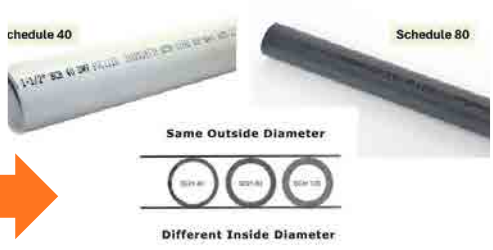
If you see these, you will have to track down the leak.





Pressurized line (Mainline) should be Schedule K Copper Pipe buried 12" - 18" deep or at least 6" below frost penetration zone.

Lateral line should be Schedule 40 PVC Pipe, properly glued (chemically welded) and buried 6" - 12" below grade as sunlight degrades it.



Schedule 80 (black pipe) should be used above grade as it does not degrade in sunlight like Schedule 40. **That means all anti-siphon valves should have black pipe above grade.**

Track Down the Leaks

Use the Low Flow Indicator on a Water Meter

Locate Your Water Meter and Identify the Low Flow Indicator
When you shut off various parts of the plumbing in your house or landscape, this indicator will help you determine if there is a leak, so keep your eye on it.

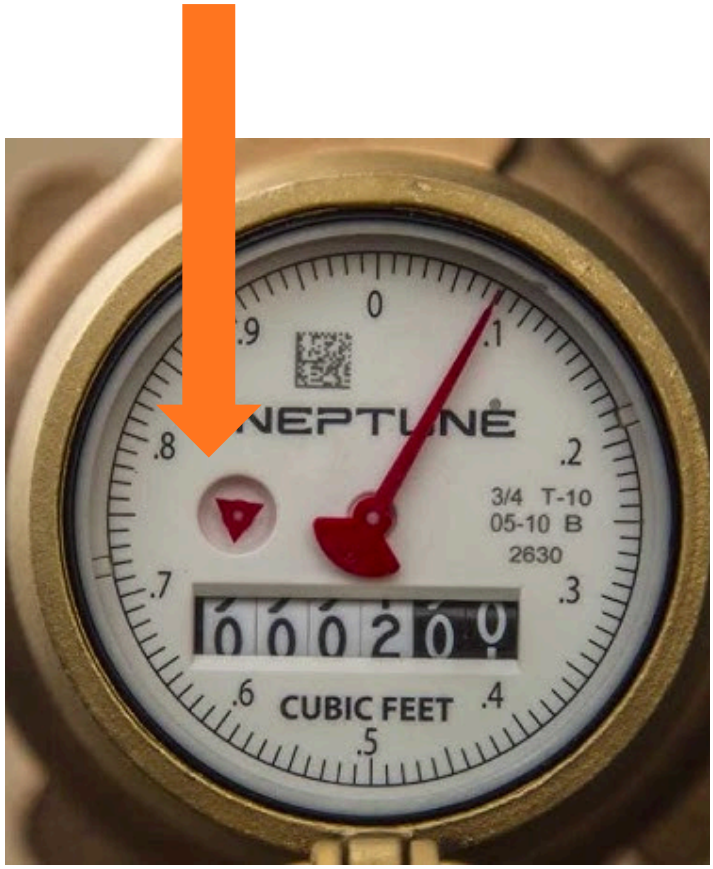
Is there a Mainline Break?

1. Shut off BOTH the house and landscape water lines
2. Wait 10 minutes
3. If the meter is running or the Indicator is moving, there is a leak in the mainline from the water meter.
4. If the meter is not moving, there is no leak in the mainline.

Mainline leaks occur more often than you would think. **The mainline should be thicker Schedule K Copper pipe buried at least 12-18" below the grade OR at least 6" below the frost penetration line in cold climates.**

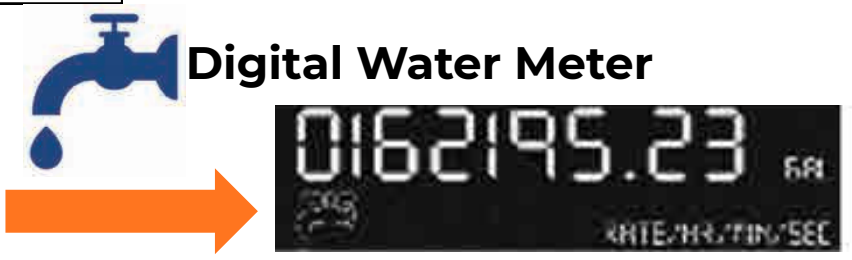
Analog Water Meter

Low Flow (LEAK) Indicator is used to find the leaks in the landscape. If this indicator is moving when the water is shut off, there is a leak somewhere in the system.



Digital Water Meter

Flashing Faucet Icon is for leak detection of intermittent leaks. The Icon stays on if there is a continuous leak.



Where is the Leak?

Is Leak in the House?

1. Shut off landscape mainline.
2. Wait 10 minutes.
3. If Indicator is turning, leak is in the house. If no meter running, leak in the landscape.

Is Leak in the Landscape?

1. Shut off house mainline.
2. Wait 10 minutes.
3. If Indicator is turning, leak is definitely in the landscape.
4. Start sleuthing!

When handle is in line with the pipe, the water is flowing through the pipe. When it is perpendicular to the pipe, the water is shut off.

Check Backflow and Pressure Regulator

Shutoff Valve Seal Damaged/Debris

Valve Piping Cracked or Damaged?

Islolate Irrigation Zones with Controller

Broken Heads

Spray and Drip Points of Connection

Check and Clean Filters

Lateral Line/Drip Line Break

Converting to Drip Irrigation

Drip Irrigation is an excellent choice for watering your garden.

- Targets water to the roots of the plants.
- Minimizes evaporation.
- Minimizes overspray.
- Generally fewer weeds (layout matters).
- Applies water slower (Gallons per Hour) so limits runoff.
- Requires a low flow irrigation valve.
- Requires pressure regulation and filtration.
- Must be kept covered with mulch.

Try to not have more than 100 GPH on any single drip Point of Connection.

Point-Source Drip Emitters are best for a larger garden without much groundcover. Use this type of emitter for **Random Pattern Layouts.**

In-line Emitters are best for smaller gardens and areas with uniform planting or groundcover. Use this type of emitter for **Grid Pattern Layouts.**

Changing Out Spray Emitters for Drip Irrigation

When you change your irrigation from spray to drip, think about two parts of the system:

1. A **Low Flow Drip Valve** should replace your old spray valve. These valves are designed to sense very low flows of water and will not get stuck in the OPEN position when the irrigation controller signals the drip zone to close. These valves also have **Pressure Regulation** and a **Filter** to reduce clogging of the lines. Drip irrigation pressure should be around 25 - 40 psi,

2. **Using a Drip Converter Kit,** the first spray body located after the valve can be converted to drip irrigation tubing.

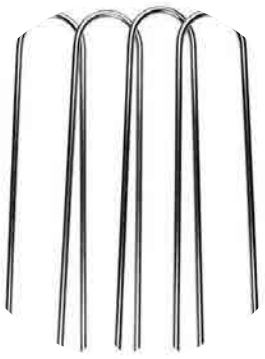
This image is for illustration purposes. The finished conversion is at grade.

Finished drip conversion installation using a spray sprinkler body. this is ready to be covered with mulch.

Remember These When Converting to Drip

Pressure Regulation

Filtration



Round-top Staples

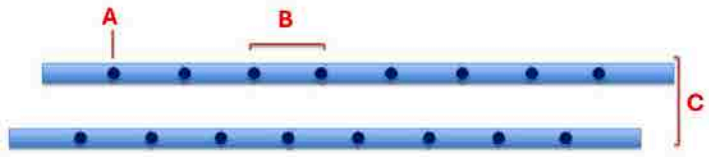
Keep Covered in Mulch

Which Drip Irrigation Layout is Best for YOU?

In-line drip irrigation has embedded emitters at regular intervals, so use in a grid as below.

Point-source drip irrigation has emitters punched into blank tubing around each plant in the zone.

Grid Spacing and Line Spacing

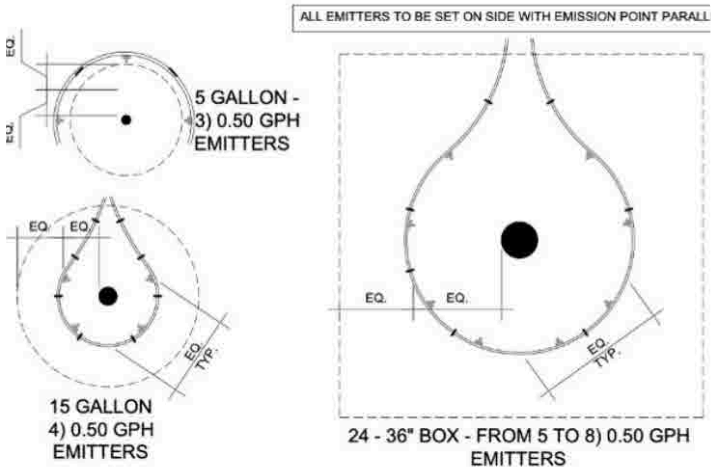


A – Emitter Flow Rate depends upon soil type
(1.0 gph for sandy soil and 0.50 gph for clay soil)

B – Emitter Spacing (typically 12” or 18”)

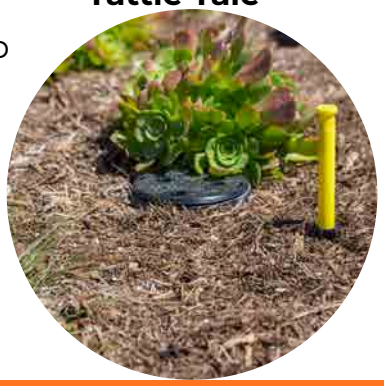
C – Line Spacing depends upon soil type
(12” for sandy soil and 18” for clay soil)

How Many Emitters Per Plant?



Two key components are placed at the end of each of the drip tubing zones. The **Tattle Tale** pops up when the drip zone valveis opened so you know the zone is pressurized and operating correctly. The **Manual Flush Valve** allows you regularly to clean out the drip tubing.

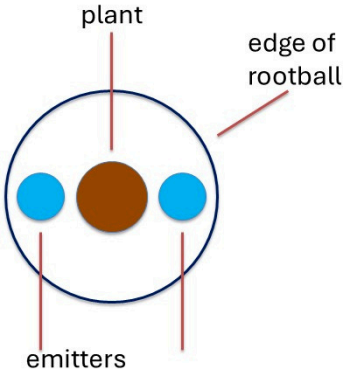
Tattle Tale



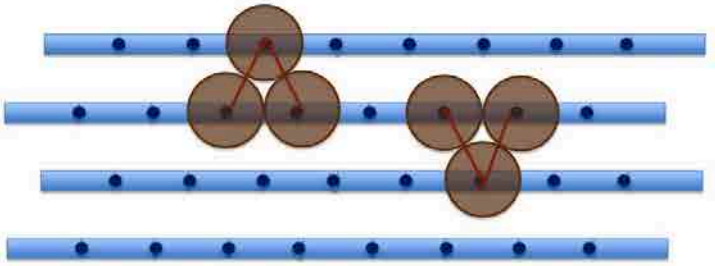
Manual Flush Valve

Emitters Need to be in the Right Place!

Proper Emitter Placement Reduces Water Need



Overlap Emitters in Grid Layout



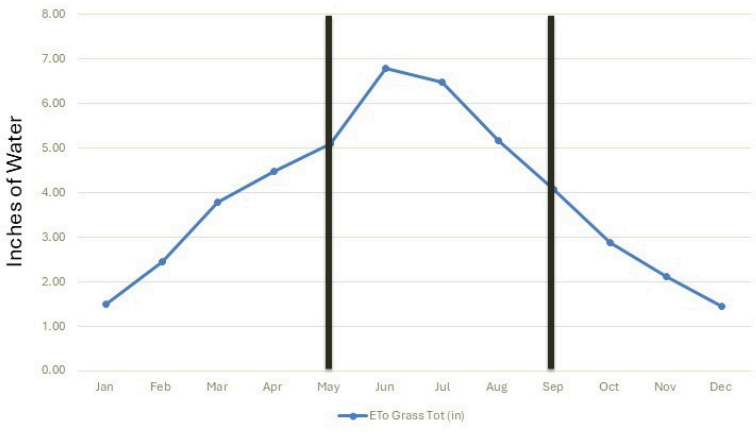
Drip irrigation emitters are usually 0.50 Gallons Per Hour (GPH) to 2.0 GPH.

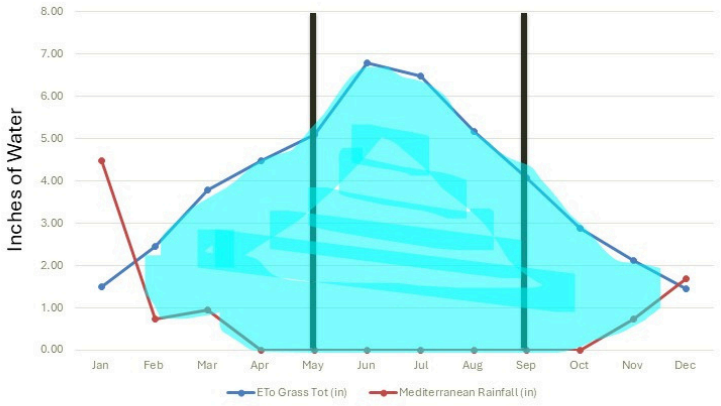
Bubblers and soaker hoses are not low flow drip irrigation. These can emit water up to 4.0 GPH per foot of hose.

Save the 3/4" “Spaghetti” tubing for use in containers or raised beds. There are too many points of connection to fail, and anyone walking through the garden is likely to snag one and create a leak.

Water Efficiently

Plants Need Different Amounts of Water Seasonally





Evapotranspiration Curve vs Rainfall in a Mediterranean Climate (winter rain)

The Evapotranspiration Curve (Plant Water Need) peaks in summer, so plants require more water during the "growing season" of May-September. A growing season is defined as the time between the last frost of spring and the first frost of fall. It corresponds with the longest days of the year when Evapotranspiration is the highest.

Irrigation is required to supplement rainfall. The **difference between Rainfall and Evapotranspiration is called the Irrigation Requirement. It is how much water must be applied to your garden to keep the plants happy** and thriving during the growing season.

Reduce the Irrigation Requirement

- Build healthy spongey soil.
- Capture and hold rainwater on site to fill the soil water "bank" account.
- Select plants that require less water and plant densely.
- Many Mediterranean plants go dormant in summer to reduce water need.
- Cover bare soil with plants or mulch.
- Adjust/repair irrigation systems and minimize leaks.

More Ideas to Reduce Water Need

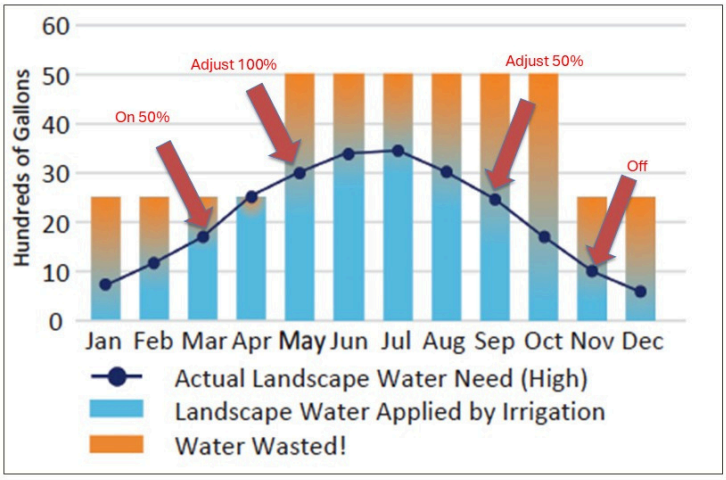
- Hydrozone properly and use multiple irrigation valves to maximize control.
- Use a weather-based "smart" irrigation timer.
- Hand-water whenever possible.

Invest in a soil probe to determine actual watering depth.

Water Efficiently

Seasonally Adjust Your Irrigation Controller

Summer should not last all year. If plants need summer water, then try to follow the Evapotranspiration Curve as closely as possible or select a "smart" timer. Reduce irrigation when the days get shorter in fall through spring.



Install a dedicated water monitoring device to spot leaks and track water usage.

Controller Setting	Zone 1 schedule in minutes (total runtime of 15 minutes)	Zone 2 schedule in minutes (total runtime of 30 minutes)
Irrigation on	5	10
Soak (Irrigation off)	30	30
Irrigation on	5	10
Soak (Irrigation off)	30	30
Irrigation on	5	10
Cycle Complete	✔	✔

Cycle and Soak during a watering event to reduce runoff. Compacted or clayey soils cannot accept rapid applications of water, so divide the needed run time into several shorter irrigation events with a 30-60 minute rest in between to allow the water to soak into soil. Cycle and soak is a good idea for sandy soils too, as it helps keep water in the rootzone of the plants and not run below.

Install a Smart irrigation timer ("weather-based" irrigation timer) and allow the algorithm to calculate the days of the week irrigation should happen as well as the run times based on the data about the garden you input. These have rain shut-offs too.

Live or historical weather information is provided via an app on your phone/computer or sometimes a weather station is installed in the garden to monitor local conditions.

Smart Timer

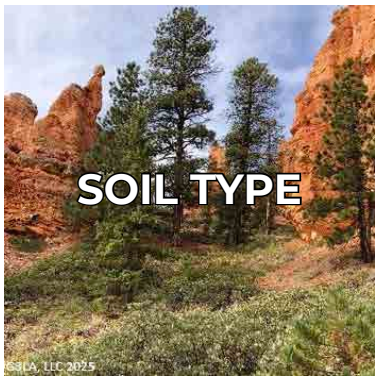
Rain Shut-off

Group Plants by Hydrozone to Irrigate More Efficiently

Group plants into communities according to their similar growing characteristics and water needs. Each grouping by water need is called a **Hydrozone** and is used by "smart" irrigation timers to calculate the actual amount of water required by a portion of the landscape. Hydrozones take into account (1) which plants are selected and (2) the type of irrigation used in each planted area of the landscape.

When irrigated with different irrigation valves, these groups of hydrozoned plants are also called **Valve Zones**. Each valve zone will then have a different irrigation schedule that can be applied to the whole area.

Nature groups plants into naturally hydrozoned communities by:



In this landscape, each hydrozone has it's own valve, and the irrigation timer creates a unique schedule [days and run time] for each zone. No plants get overwatered!

Consider separating zones by:

- Sun from Shade
- Natives from Edibles
- High from Low Evapotranspiration
- Mature from Newly Planted Areas
- Trees & Large Shrubs from Groundcovers

Use Your Water Meter to Measure Your Water Use

Irrigation and rainwater is calculated in inches, so most landscape measurements are in inches or, if a volume, Cubic Feet.

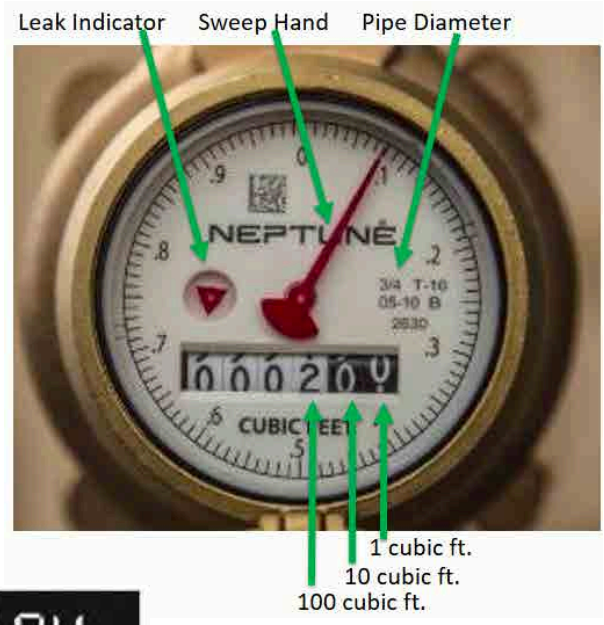
1 Cubic Ft. of Water = 7.48 Gallons
100 Cu. Ft. of Water = 748 Gallons= HCF or CCF or Unit

Analog – Cubic Feet
Reads like an odometer

Analog – Gallons

Water meters are devices used to measure the volume of water used by a particular property (commercial or residential). They are utilized by water utilities to generate water bills based on actual use and to detect leaks on the property.

This meter reads 200 Cubic Feet or 1,496 Gallons



Digital-Gallons

- Read left to right, including all zeros.
- Measures water usage by 100 gallon increments.
- Digits to right of decimal indicate usage less than 1 gallon.

- Screen flashes between current reading and flow rate in Gallons Per Minute.
- If no water is flowing, reading is 0.0.

Reading a Water Bill

The water bill tracks ACTUAL water use. Depending upon where you are located and whether you have a dedicated landscape meter, you will have to estimate how much of the total water bill applies to the landscape. In summer-dry areas, compare summer bills to winter bills and see that irrigation probably accounts for the difference. The water bill provides a summary of the water meter readings, which usually provide information in Cubic Feet of water. The bill is stated in Units and Hundred Cubic Feet (HCF) of water.

To figure out how many gallons of water have been used during the time period, convert the Units to Gallons by multiying by 748 Gallons/Unit.

Meter Size	**ELEV. Band**	**Meter Readings**		**Units**	**Consumption Information**		
⅝ Inch	2	Current 2,132 2017	Previous 2,097 USAGE	**35** 65	Gallons 26,180 48,620	Days 62 62	Gal/Day 422 784

35 Units = 35 x 748 = 26,180 gallons used this period.

Last year during the same period, this customer used 65 Units. The customer successfully **reduced their actual water usage from the previous year by 30 units, or 22,440 gallons.**

Take Notes Here

emwd

CLIMATE READY
LANDSCAPE ACADEMY

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