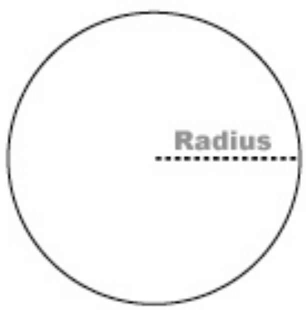
CHEAT SHEET FOR CALCUATING SQUARE FOOTAGE (AREA)

Break an area into manageable pieces and calculate the square footage of each piece. Then add up the pieces.

Area of a Circle

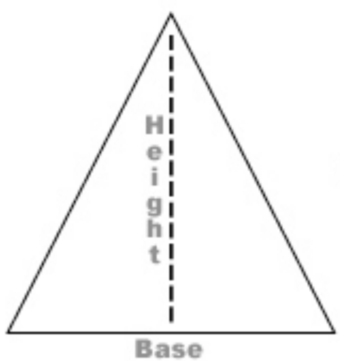


Area = 3.14 x (radius)^2

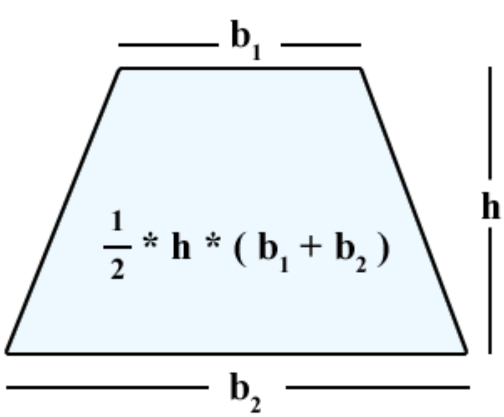
Area of a Rectangle

Area = (base) x (height)

Area of a Triangle



Area = (base) x (height) / 2



www.greengardensgroup.com

MINI WATERSHED SITE EVALUATION:
DATA CRUNCH AND CONCLUSIONS

1) Determine Water Budget

How much ***annual water*** in gallons does turf grass need to stay healthy in this area?

ETo x 80% x .62 = Cool season turf grass

ETo x 60% x .62 = Warm season turf grass

How much ***annual water*** does the EXISTING landscape need (in gallons)?
Sq. ft. x ETo x (PLANT FACTOR %) x .62 gallons/inch =

2) Determine Actual Water Use

Total GPM x Minutes/zone x Days /week x 52 weeks/year =

3) Determine Rain Retention – First Flush is 3/4" – 1" of rain

a. First Flush formula is:
Sq. ft. of roof surface x 1" x .62 gallons/inch =

b. Total annual rainfall to be retained by your garden is:
Sq. ft. of roof surface x Inches of rainfall per year x .62 gal./inch =

c. Is there a rainy season in your area?
   i. Are there gaps between rainstorms in which water can absorb?
   ii. What is a really large storm event?

   iii. Where in the landscape would you hold the water? How large is the area in Square Feet?

4) <u>Determine Where To Place The Rain</u>

a. Determine the Volume of First Flush:

First Flush Gallons ÷ 7.48 = Cubic Feet of Water

b. Determine the Volume of Total Rainfall:

Total Annual Rainfall ÷ 7.48 = Cubic Feet of Water

c. Determine Depth of The Sponge Garden:
   i. Remember the square footage of the area to put the water?
   ii. Be aware of any setbacks from buildings (9' – 15' minimum) and from neighbors' properties (10' minimum) and from sidewalks (3' minimum)
   iii. Are there other setback requirements or impediments like tree roots?

Cubic Feet of Water ÷ Square Ft. of Storage Space = Depth of Garden Feet (To convert to Inches, multiply by 12 Inches/Ft.)

<u>Watershed Wise Landscape Plan of Action:</u>

<u>Conservation -</u> Our target for water use is a 50% reduction from the amount currently needed by the garden. How do we best achieve this reduction?

G3, the Green Gardens Group: Watershed Site Assessment HOW
Page 3

1) Does changing irrigation reduce water consumption?

2) Should we remove any turf?

3) Could we select plants that get us to this reduction? Which plants?

Permeability – Is the garden a brick or a sponge?

1) What kind of soil do we have? How do we plan on bringing oxygen, water and life into this soil?

2) Where is the hardscape in this garden? Do we want more or less?

3) Which areas need radical amendment and which can be amended with less intensive intervention?

Retention - Do we have any runoff (dry or wet weather)? What can we do about that?

1) Where can we re-direct the downspouts? What would we have to do to capture that rainwater?

2) How much water can we realistically capture on this property – where does it all go? Do we have the space?

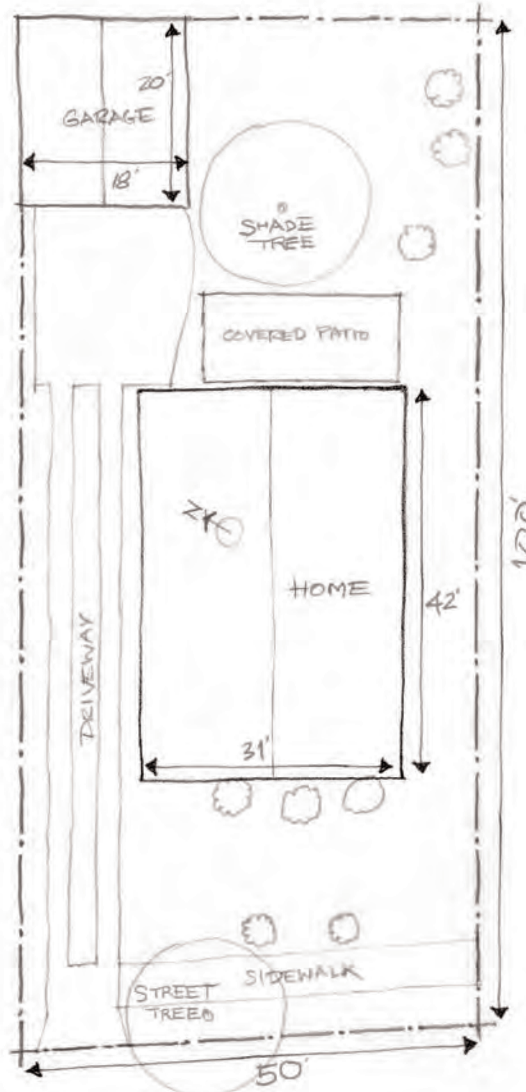
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

PLAN YOUR GARDEN PROJECT

1. Make a site plan

Start by measuring your property. Measure your house and other buildings. Draw it out on graph paper or use a computer. Make several copies.

Think about how you and your family want to use the space, and how the sun and rain affect your garden.



INCLUDE THESE ITEMS ON YOUR SITE PLAN:
- Dimensions of the site (round up to the nearest foot or 6 inches)
- Orientation — North arrow (or mark East and West)
- Buildings (house, garage, neighbor's houses if nearby)
- Other structures (carport, porch, arbor, shed)
- Large landscape features (ponds, streams, swimming pools, driveways, patios)
- Large trees or shrubs

Walk around your garden with a copy of your site plan, and mark any of these that are relevant:
- Hillsides, slopes, or other major grade changes
- Areas of erosion or obvious soil compaction
- Low areas that are commonly wet
- Exposed rock
- Shallow soils
- Areas where the soil abruptly changes texture or structure

Later, you can note your soil type and places where you conduct your soil and compaction tests. You also will be making notes for irrigation.

site your home on your property:

BingMaps (bing.com/maps) gives you a good birdseye view of your roof for calculating square footage.

LOOK at Google Maps (maps.google.com) for help placing buildings and trees on your property. Just type in your address, zoom in, and use the Satellite view.

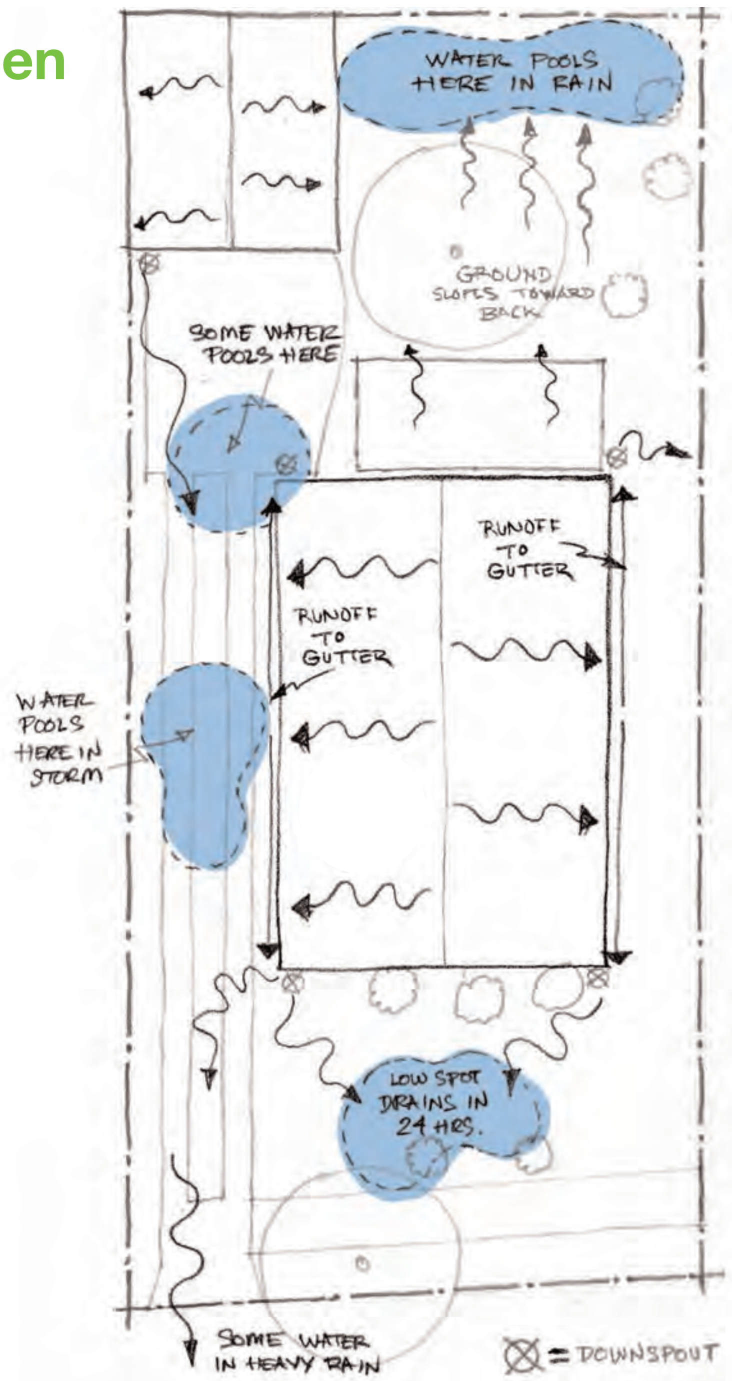
PLAN YOUR GARDEN PROJECT

2. Water in your garden

It's important to know where water flows into your garden, how it moves around, where it stays, and how it leaves your garden. Walk around your garden with another copy of your site plan, and note this information:

INCLUDE THESE ITEMS ON YOUR SITE PLAN:

- If you don't have roof gutters and downspout, then mark the edges of your roof where water sheets down to the landscape.
- Mark your roof gutter downspout, if you have them, and follow the path of the water in them out to the street.
- Identify which part of the roof drains into each downspout, and estimate the dimensions of that portion of roof.
- Draw arrows to indicate the direction water moves through your garden.
- Note areas where water pools when it rains.
- Locate where rainwater runoff is concentrated and eventually leaves your garden (i.e. driveways, drainage pipes, storm gutters etc).
- Mark which areas are impervious surfaces, where water can't get into the ground (i.e. driveways, solid patios, areas covered by a roof, etc).



photos: Pamela Berstler

Excerpted from The Drought Tolerant Garden: Los Angeles County Handbook, © 2012, Los Angeles County

PLAN YOUR GARDEN PROJECT

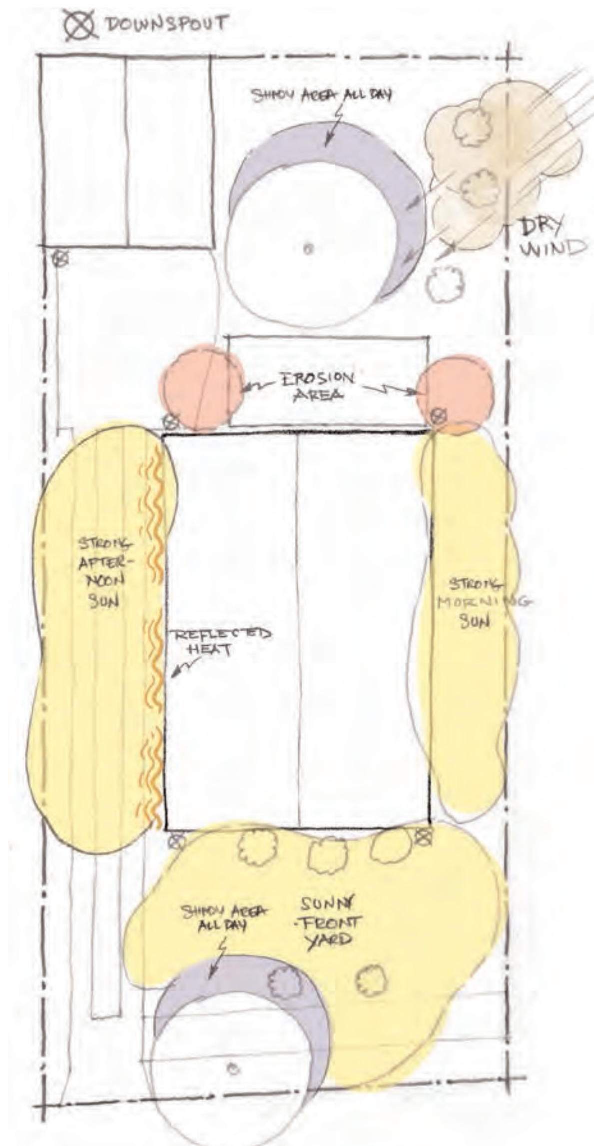
3. Plants and sunlight

On a copy of your site plan, locate large trees, shrubs, lawn and other significant vegetation. Outline the canopy area of each plant and note with the name, general size and health of the plant. If you don't know what the plant (or tree) is, take pictures (or samples) of its leaves, fruit and bark to your local nursery for help with identification.

Every garden has areas where plants will grow well and others will die. Structures, walls, fences, and other plants all can affect the amount of sun and shade in a garden. And every garden is completely different. There will be hills and hollows in your garden that may collect cold air or, because your property is sloped, you don't get frost when neighbors do. These climate factors that are particular to your garden are called microclimate, and they may differ significantly from the general climate of an area. Note on your site map any microclimate you think your garden might have.

Outline the sun and shade patterns of the site. Mark areas that receive sun all day and areas that are shaded all day. Also note which areas receive only partial sun, maybe just a few hours of direct sun in the morning, mid-day or in late afternoon. When you choose your plants make sure to select those that are appropriate to the sunlight pattern in your garden. Plants marked as “full sun” will not be happy in full shade.

Look closely at the plants you have, and note which are dry climate appropriate and which aren't. Many plants can be dry climate appropriate if they're well established, with deep healthy roots (old rose bushes, for example). Decide which plants will work well in your new garden and which you should plan to remove.



dry climate appropriate characteristics of plants

There are four characteristics shared by many dry climate appropriate plants that will allow you to find them in a crowded nursery. Sometimes you will find plants with three or four of these adaptations at one time - they're really drought tolerant!

STIFF, LEATHERY LEAVES These leaves hold on to water, and represent many of our evergreen native plants.

SILVERY OR HAIRY LEAVES Light colored leaves reflect sunlight, cooling the plant. Hairy back sides of leaves hold moisture longer which cools the leaf.

TINY LITTLE LEAVES Like the solar panels they mimic, it is easier to keep small surfaces cool than it is to cool down one large hot surface.

SOLAR TRACKING LEAVES In the middle of the day these leaves will appear to be standing at attention, straight up and down. As the day progresses, or if you see the same plant in the early morning, you will find that the leaves are more horizontally oriented. This plant is moving its solar panels throughout the day to minimize exposure during the hottest part of the day (smart, huh?). Many of the native manzanitas utilize this adaptation.

PLAN YOUR GARDEN PROJECT

4. Check your irrigation

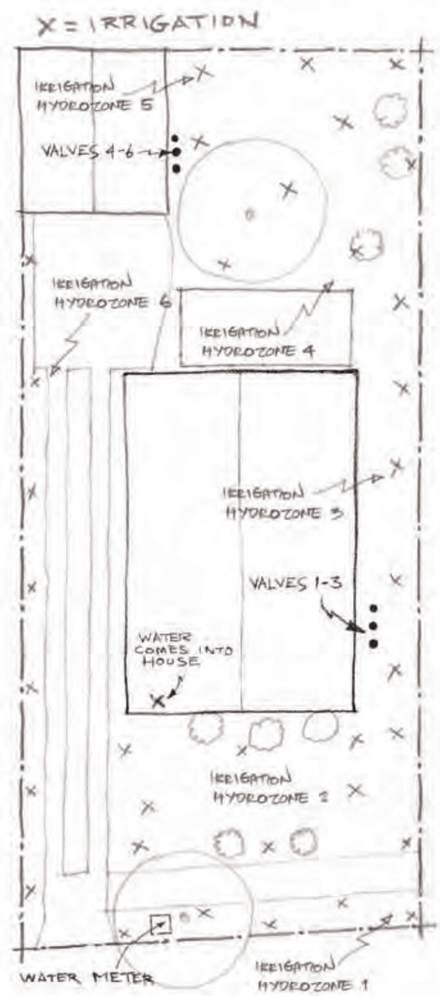
If you have an irrigation system installed, chances are that it is a spray emitter system with an automatic irrigation controller. Locate all of the sprinkler heads on your property and mark their location on a copy of your site plan. Note the location of your controller, where the water comes on to your property from the street (the main line), and the location of every valve that controls the various irrigation zones.

RUN YOUR IRRIGATION SYSTEM & OBSERVE WHAT'S HAPPENING — TEST ONE VALVE AT A TIME

- Does water spray on the hard surfaces surrounding the garden?
- How quickly does water run off the landscape?
- Are there any broken or missing heads?
- Make notes of all of the things you observe when you turn on your irrigation.

CHECK YOUR CONTROLLER

- How many days does each zone run each week?
- How many minutes per run for each zone?



sprinkler data chart

Head Type	# Heads or Emitters	Pressure at Hose Bib	Approx. Gallons Per Minute (GPM)	Total GPM or GPH(# Heads x GPM or GPH)
1/4			0.50 - 0.65	
1/2			0.90 – 1.30	
Full			1.80 – 2.60	
3/4			1.35 – 1.95	
Side (4' x 30')			0.89 – 1.21	
Bubblers			2.00 – 5.00	
Impact Spray/Rotors			2.00 – 3.00	
Drip On-Line			0.50 – 2.00 GPH	
TOTALS				

Fill in chart: Range is based on Pressure in Pounds Per Square Inch (PSI) at Hose Bib:
Low = 15 PSI, High = 30 PSI; Values are for spray heads spaced 12' apart unless otherwise noted.

Calculate Spray Heads Annual Water Use For The Zone =
TOTAL GPM x Minutes/Zone x Days/Week x 52 Weeks/Year =

Calculate Drip Emitters Annual Water Use For The Zone =
TOTAL GPH ÷ 60 x Minutes/Zone x Days/Week x 52 Weeks/Year =

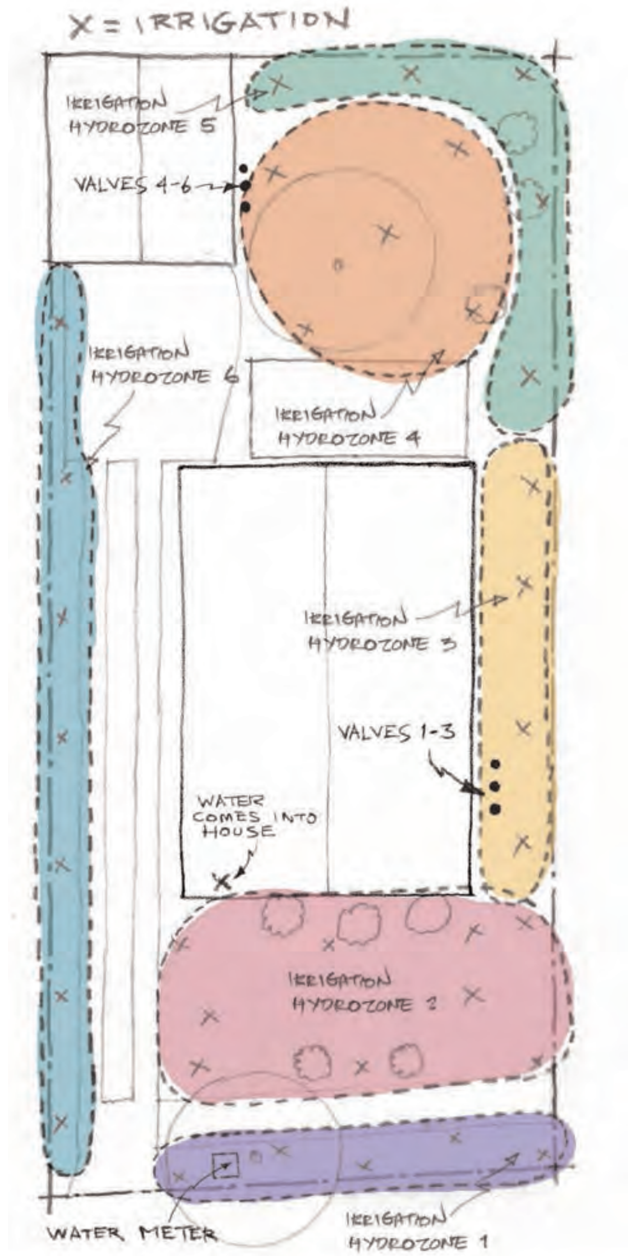
PLAN YOUR GARDEN PROJECT

5. Group plants into hydrozones

Once you've reviewed your irrigation, make a note of which sprinkler heads go on at the same time. Color code the groupings of sprinklers on your site plan.

Now compare the colored zones with your microclimates (see p.3). Are sun and shade areas combined on the same valve? Are lawn and planter beds combined on the same valve? If so, the irrigation zones will have to be altered to correlate with plants that need similar things. Groupings of plants by water need are called hydrozones.

Remember that you want plants that require the same amount of irrigation to be grouped together; otherwise, your garden will not thrive and thirsty plants will dehydrate or dry plants will drown. The colors on our site plan indicate different hydrozones.



sprinkler test

Ingredients:

CUPS, BOWLS OR JARS, STOPWATCH, RULER, PEN AND PAPER

① Collect your containers (they all need to be the same size).
② Spread them around so they are spaced about 5' apart.
③ Get your stopwatch ready and start it as you turn on your sprinklers.
④ At 2 minutes, turn the sprinklers off. Hold ruler upright and note how deep the water is in inches.
⑤ Get ready and start again, for 3 more minutes this time, and record your results.
⑥ One more time, this time for 5 more minutes.
Note: Measure at 5, 10, and 15 minutes for drip systems.

- **Different depths of water in different containers means your sprinklers are not watering evenly. Get new heads that emit the same amount of water at once (matched flow rate). Note that each head has a different spray pattern; full circle, half, quarter or adjustable.**
- **See how much water your section emits at 2 minutes, 5 minutes (2+3), 8 minutes (5+3), and 10 minutes (5+5) for drip then at 5, 10, 15, 30 and 45 minutes.**
- **Next, look at www.bewaterwise.com and determine how many inches of water your garden needs each week or month.**
- **Now you can give your plants just the water they need.**

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

bewaterwise.com

how to make a rain garden

simple rain garden recipe

Your soil says "It's Swale!"

G3LA LLC. © 2012

Ingredients:

- YOUR SITE PLAN
- SHOVELS & RAKES
- COMPOST, WORM CASTINGS
- LIVING WOODCHIP MULCH
- HOSE WITH SPRAY NOZZLE
- SWALE PLANTS (see #7 below)

Call DIG ALERT (811) at least two days before digging to locate underground utilities!

① Get to know your rain. Make your site plan and note where rain falls, and how it flows. Look for an open, mostly flat low spot to direct water towards in the front yard, or anywhere with the center at least 10' away from the foundation of the house and 3' away from the sidewalk. Calculate the best size of your rain garden (*see p. 2*).

② Lay out your rain garden. Spread out a garden hose to outline the shape. The area must be basically flat or slightly bowl-like, and not sloping back toward the house. Be careful around trees. Don't put your rain garden under a mature tree or disturb any big roots. Remove all plants (including grass) from the area and start digging.

③ Test how fast your soil drains. If you have compaction, try to break through it with a shovel or a pitchfork.

④ Dig a basin that is between 6" and 12" deep at the center. Slope the sides gently to make a sloping bowl, not a cylinder. Mound extra soil around the bowl to increase capacity. Put down at least an inch of compost or worm castings to activate your soil.

⑤ Direct downspouts into the basin area, moving the rainwater through gravel lined ditches or above-ground drainage pipes. Also, make an overflow path so extra water has a direct channel to the street and not back towards your house.

⑥ Plant swale plants in compost on the bottom. On the mounded sides, choose plants that like their feet drier. When it rains, the basin will fill up, creating a temporary pond until the water soaks into your soil. All the water should be gone in 24 hours. Make sure to mulch (2-3" deep) around your plants.

⑦ SWALE plants are special. They can be completely submerged in rain water and still survive our hot dry summers without extra water. They're sort of plant Super Heroes that way!

Excerpted from The Drought Tolerant Garden: Los Angeles County Handbook, © 2012, Los Angeles County

rainwater capture basic math

If you want to figure out how large your rain garden should be, use this basic calculation.

Gallons of Water ÷ 7.48 = Square Feet of Rain Garden (at 12" deep)

For example, to capture 620 Gallons, how big should you dig?

620 Gallons ÷ 7.48 = 83 Sq. Ft. area (at 12" deep)

620 Gallons ÷ 7.48 = 166 Sq. Ft. area (at 6" deep)

If your rain garden (aka swale) is 10' wide and 8-1/2' long, its area (10' x 8.5') is 85 square feet. So at 12" deep, it will hold about 620 gallons of rainwater. If you dig it down just 6" deep, your rain garden will hold only half of that, or just 310 gallons of water. With shallower swales, you may want more, or wider rain gardens. If you make your swale deeper, you can capture more water in a smaller footprint.

HOW MUCH WATER RUNS OFF THE ROOF?

The shape of your roof doesn't matter. A pitched roof and a flat roof have the same footprint and the same amount of rain falls on the area no matter its shape. Just measure the outside edges and calculate the area.

Area = length of side a x length of side b

For complicated roofs, divide into squares then add up the area of each square.

Rainfall (in inches) x Square Feet x .62 = Gallons of Rain Water

If your roof is 1,000 square feet here's how much water runs off it:

1" (rainfall) x 1,000 (sq. ft.) x .62 = 620 gallons

5" (a big storm) x 1,000 x .62 = 3,100 gallons

15" (one year's total rainfall) x 1,000 x .62 = 9,300 gallons

It adds up quickly, even in dry areas. Try to save as much as you can in your garden!

HOW MUCH WATER COMES OUT OF ONE DOWNSPOUT?

Imagine the water from your roof splits into two downspouts.

Your Roof Area is 20' x 40' = 800 sq. ft.

If half of the water goes into each downspout, then the roof size for one downspout is:

800 sq. ft. ÷ 2 = 400 sq. ft.

Now calculate how much water that is in gallons.

400 sq. ft. x 1" x .62 = 248 gallons (of water, per inch of rain, from each downspout).

You can use these calculations to determine how much water comes off of any hard surface (patio, driveway, roof, sidewalk, etc.).

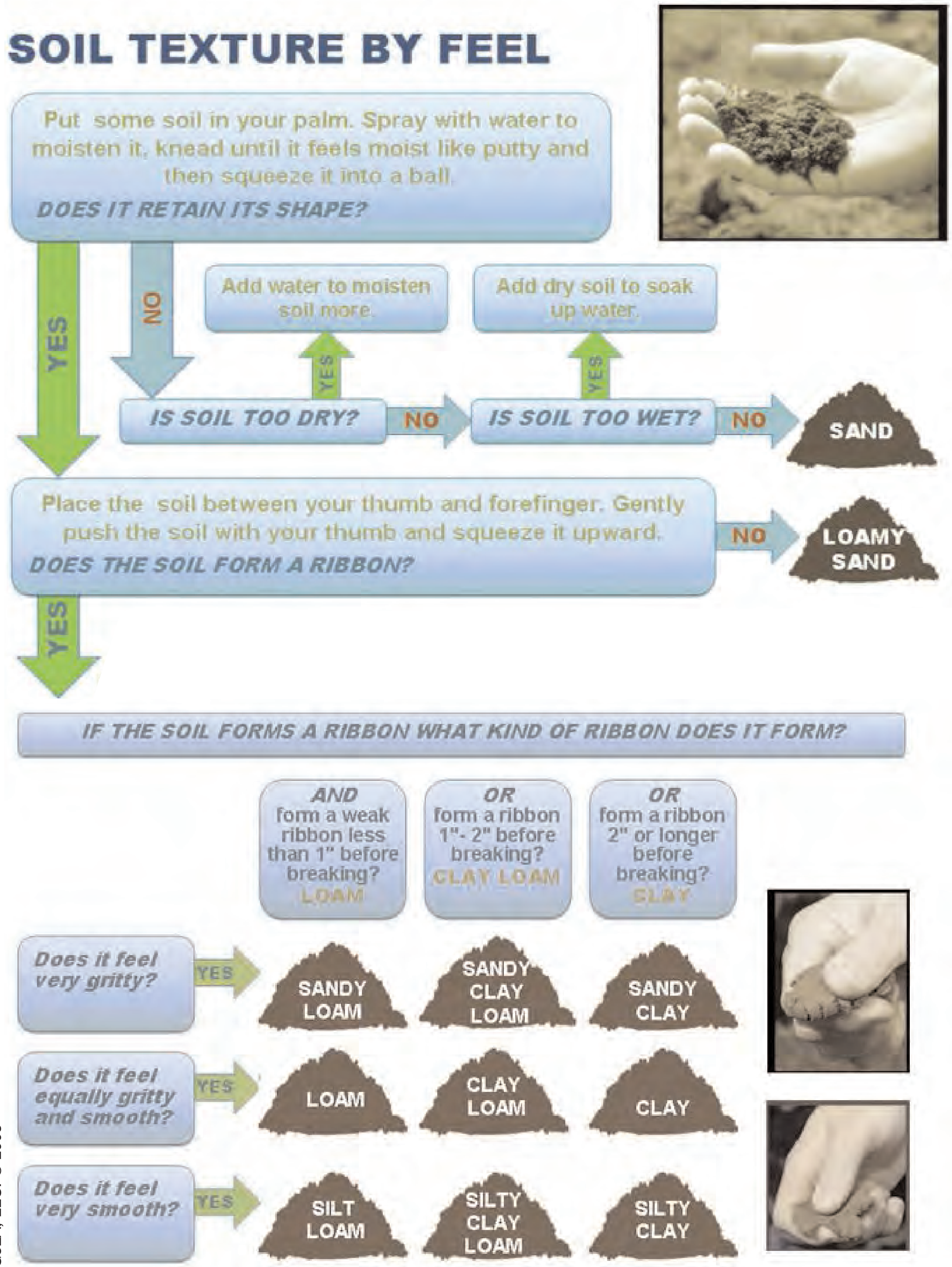
photo: Pamela Berstler

how to capture the rain

how to test your soil

check your soil type

(an easy way to figure out your soil type)



G3LA, LLC. © 2009

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how to build healthy soil

making the sponge

So how do I change a BRICK into a SPONGE? Living soil remediation is the answer. It's not fertilizer, but it is food for the soil. When that food is digested by the organisms, it becomes food for the plants!

LIVING SOIL REMEDIATION

① ADD OXYGEN by opening up the soil. Once the spongy soil structure has been created, you will not want to break up the soil again. But to get things started, you must beak a few eggs --- or break a little soil. You can rototill it, auger it, or dig it up with a shovel (or jackhammer!). Sometimes all it takes is a pitchfork plunged into the ground and pulled back and forth.

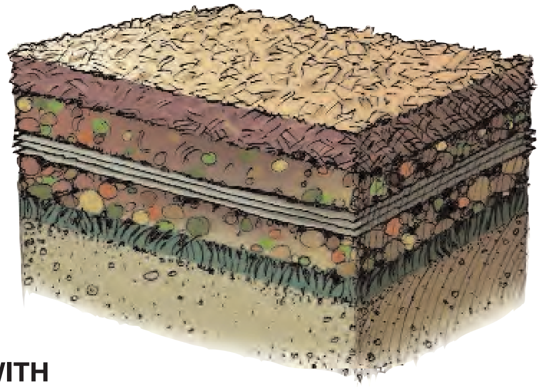
② ADD WATER and LIFE. You can add good compost, worm castings, and/or compost tea. All of these are full of the living microbes that will do the hard work of bringing your soil back to life. Spread them on, give them some water, and then...

③ FEED YOUR SOIL ORGANISMS (not your plants)! They like to eat organic matter, so give them a nice thick blanket of mulch (3" at least). Add water as needed, and your soil will be healthy and happy in no time, ready for your plants!

join the soil party! **Living soil is alive. A teaspoon of good garden soil contains billions of invisible bacteria, several yards of equally invisible fungal hyphae, several thousand protozoa and a few dozen beneficial nematodes.**

“soil lasagna” recipe

(aka Sheet Mulching to Remove Turf)



• SHOVELS & RAKES
• BINS FOR REMOVED GRASS AND SOIL (WARM SEASON TURF GRASS ONLY)
• LANDSCAPE FLAGS
• COMPOST OR WORM CASTINGS
• MULCH (FRESHLY SHREDDED TREE TRIMMINGS WITH LEAVES ARE BEST)
• PAINTERS PAPER OR BIG SHEETS OF CARDBOARD (IT SHOULD BE CLEAN)
• HOSE WITH SPRAY NOZZLE
• WATER (LOTS!)

① **Deal with the turf grass you have. If it's cool season turf grass (stays green all year), say goodbye, give it a good soaking of water and go to Step 3.**

② **If it's the other kind of turfgrass (any mixture that turns brownish in the winter) remove and dispose of soil at least 8” deep, but preferably 10” or more to be sure it’s all gone. If you can’t hand remove, rent a sod cutter.**

③ **Dig back 12” - 24” from any hard surfaces and building foundations to a depth of 8” - 10.”**

④ **Flag all your sprinkler heads so you can find and adjust or remove them later.**

⑤ **Add LIFE! Spread out a 1” deep blanket of compost or worm castings.**

⑥ **Water the soil so the paper will stick to it.**

⑦ **Roll out paper or cardboard. Be sure to overlap all edges by at least 6” - don't leave any bare soil! If necessary, to prevent tearing and gaps, use two layers of paper.**

⑧ **Water well - really soak the paper/cardboard.**

⑨ **While the paper/cardboard is wet, gently rake out a thick blanket of mulch (4” to 6”) over everything. Keep watering while you do this - you want the mulch to be really wet at first.**

⑩ **Admire your work.**

That's it! Now the LIFE you added will get to work, turning it all into delicious, healthy living soil. When you're ready to plant, just dig a hole right into it, cutting through the paper/cardboard (if it's still there) and plant right into the yummy soil.

how to build healthy soil

Excerpted from The Drought Tolerant Garden: Los Angeles County Handbook, © 2012, Los Angeles County

right plant right place

NOW THAT YOUR SOIL IS HAPPY you are ready to plant! It's almost as easy as digging a hole, but a little extra love will help. By following these simple steps, you will get your plants' roots growing properly, quickly spreading into the living soil and making friends with the other drought tolerant plants. Strong roots make strong plants, and this is especially important in dry environments.

successful planting recipe

Ingredients:

- **TOOLS: shovel, hand trowel, hose**
- **PLANTS • COMPOST • MULCH**

Feeling Adventurous? Try the more advanced planting approach in ⑤ and add these to your list: ***MYCORRHIZAE*** *(not for grasses)* ***FISH EMULSION*** *or* ***WATER SOLUBLE HUMATES***

① **Dig a hole! Don't dig it any deeper than the rootball of the plant. Do dig at least a little bit wider than the plant to loosen the surrounding soil. If you accidentally dig too deep, be sure to put the soil back in and tamp it down firmly before moving on, to give your plant a solid base.**

② **Throw in some compost or worm castings no more than 1" deep - along the bottom of the hole. Never put mulch in a hole!**

③ **Fill the hole with water TWICE, and allow it to drain completely each time. This will take a long time, unless your soil is really sandy. Start digging the next hole, or take a break.**

④ **Submerge the rootball in a bucket of water until air bubbles stop bubbling up. It's probably easier to keep the plant in its container but ok if you take it out - just be careful with the delicate roots.**

⑤ ***Add fish emulsion or soluble humate to the water (follow label directions). Dust the rootball with a mycorrhizae inoculant (only if the plants are woody, so don't bother with the grasses).***

⑥ **Place plant in hole, make sure the root collar (that's where the roots join the stem or trunk) is a bit (1/2" - 1") higher than the surrounding soil/existing grade. This is super important because we don't want the plant to get choked by the surrounding soil.**

⑦ **Fill the hole with water one more time (this time with the plant in it) and let it drain completely.**

⑧ **Now fill the hole with the soil you dug out (not with fancy potting soil!), making sure the soil slopes away from the root collar. Tamp the soil down (use your feet, but be gentle) so the plant doesn't move around.**

⑨ **Don't create a bowl around the plant. Really! Your plant doesn't need it and it might make a moat that would drown your drought tolerant plant.**

⑩ **Water the soil all around the plant one more time, and deeply. And have a drink yourself!**

What's with all the water at planting time?
There are three reasons:

DRAINAGE If the water does not drain within an hour or so, it's probably not a good place to plant a drought tolerant plant until you fix the compaction.

SOIL PARTY By watering so thoroughly, you are waking up any microbes that might be in the surrounding soil.

PLANT SHOCK The major reason plants suffer from planting shock is that the dry soil around the new plants wicks water away from their rootball, sending the plant into shock from which they never recover. By watering the surrounding soil, you reduce the probability of plant shock.

"Hey, where's the fertilizer?" you may ask. Dry climate gardens don't want nutrient rich (i.e. fertilized) soil. It could make them grow too fast, use too much water, or just make them weak and sickly. By following our living soil remediation instructions you've made healthy, living soil for your plants - just add rainwater and that's all these plant need! Really. Let the soil microbes do all the work to keep your plants strong, healthy, and continuously drought tolerant.

IRRIGATION QUICK GUIDE

Following the Flow….

A properly designed system distributes water to the plants as directly and effectively as possible. It takes into consideration the site's water pressure and water flow, and sizes the materials so that the velocity stays within safe limits.

Delivery Methods:

Overhead via sprinklers: used for groundcover, grasses and turf. Measures water in gallons per minute
Drip – at surface or subsurface: typically used for groundcover, shrubs, trees. Measures water in gallons per hour

Typical Irrigation Equipment Set Up (there are many variables that can affect a system – these are the more common components)

Water Main – at the street
Service Line
Water Meter
Main Line
Shut Off Valve
Wye Strainer
Backflow Prevention Device(s) – prevents reverse flow and back siphoning. See manufacturer's specifications and local plumbing codes for proper installation.
    Pressure Vacuum Breaker - must be 12" above highest head (or per code)
    Reduced Pressure Backflow Preventer – can be placed anywhere on site
    Double Check Valves - not that common – often installed in vaults
Pressure Regulator
Shut Off Valve
Quick Coupler
Flow Meter (new)
Main Line
Controller – Manual (obsolete) or Weather Based
    Historic data
    Live data

Satellite
On Site
Rain Sensors (optional)

Up to this point, the set up is essentially identical for both sprinklers and drip.

Sprinklers:
Control Valves, either remote control or manual
Globe Valves / Angle Valves – below grade
Remote Control Valve – above ground (anti-siphon valve). must be at least 6” above highest head (or per code) **
Shut Off Valve
Lateral Lines
Distribution Method – Sprinklers
Spray (pop up or fixed)
Rotary Nozzles (aka rotators)
Rotors

** If anti-siphon valves will work on the site, there is no need for a master backflow prevention system.

Drip:
Control Valves, either remote control or manual
Low Flow Globe Valves / Angle Valves – located below grade
Low Flow Remote Control Valve – above ground (aka anti-siphon valve). Installed at least 6” above highest head (or per code)
Filter
Pressure Regulator
Shut Off Valve
Lateral Lines
Distribution Method – Drip
½” In-line (emitters built in)
½”On-line (emitters punched in)
3/8” EZ Drip Pipe (6” o.c.)
Tattle Tale – one per zone
Flush Valve – min. one per zone

** If anti-siphon valves will work on the site, there is no need for a master backflow prevention system.

At the hose bib – new code requires a Hose Connection Vacuum Breaker – mini backflow prevention.

Some Irrigation Terms / Definitions:

Anti-Siphon Valve – This valve is a manual or automatic control valve with a built-in atmospheric vacuum breaker. It must be installed a minimum of 6 inches higher than the highest sprinkler head or drip emitter outlet. (or per code). One valve is needed for each zone.

Backflow Prevention – This is a must! A device that prevents contaminated water from being sucked back into the water source should a reverse flow situation occur. All preventers except the anti-siphon valves must be inspected once per year (or per code).

Back siphoning / back pressure - When water pressure in a potable water main line is lost for any reason, the fluids in all of the potable and non-potable service lines connected to the main line will be effectively pulled or back-siphoned out of those lines and back into the main line, unless effective backflow preventive measures have been taken on those lines. Back-pressure backflow occurs whenever the water pressure in a service line is higher than that of the main line. The fluid in the service line will be forced back, or back-pressured, back into the line.

Control Valves - generally used to deliver pressurized water to either sprinklers or drip throughout the system. These can be automatic (regulated by the controller) or they can be controlled manually.

Flow – Flow rate is defined as the volume of water per unit of time flowing past a point in the system. Commonly used units for flow rate are gallons per minute (gal/min or gpm), gallons per hour (gal/hr) and acre-inches per hour (ac-in/hr).

Can be checked with either a flow meter or turning on a faucet and measuring how quickly a 5 gallon bucket gets filled.

Container size in gallons / Seconds to fill container X 60 = GPM
Example: Using a 5 gallon container it takes 20 seconds to fill the container.
5 / 20 X 60 = 15 GPM.
(5 divided by 20, then multiplied 60, equals 15 GPM.)
This is the total water available per zone per minute.

In a properly designed system, the total gallons per minute required per zone cannot exceed the safe flow available to the system (75% of flow).

Globe Valve / Angle Valve – Remote control valves that can be installed below grade. Requires a master backflow prevention system.

Head to Head Coverage - each sprinkler throws water ALL the way to the next sprinkler in each direction.

Lateral Line – PVC pipe from control valves out to distribution system (sprinklers or drip)

Main Line – line from Meter to point of connection (POC) or from POC to control valves.

Manifold – a group of valves

Pressure – describes the flow strength of water through plumbing pipes, measured in pounds per square inch (psi).

Dynamic – water is moving in the pipes
Static – water is not moving in the pipes

As water moves thru an irrigation system it will either lose or gain pressure. Potential sources of pressure changes: elevation, equipment and irrigation lines. Need to make sure that the pressure at the final distribution point is within the correct range for system to function properly.

Test at source and at last head (or drip line) on the most distant circuit with the highest pressure requirement, using a pitot tube and pressure gauge.

Too much pressure can cause misting, or even damage to the system. Too little pressure can result in sprinklers not operating at optimal capacity.

Pressure Vacuum Breaker - An option for a master backflow prevention system. It must be installed above ground and it must be 6 inches higher than the highest sprinkler head or drip emitter controlled by any of the valves. (or per local code)

Reduced Pressure Backflow Preventer – An option for a master backflow prevention system. The reduced pressure backflow preventer is the king of the backflow preventers, made for high-hazard uses. It is the standard for commercial irrigation installations. The Unit must be installed 12 inches above ground, but it does **not** have to be higher than any of the sprinklers.

Service Line – Water line from street to water meter

Shut Off Valves – Shut off valves are used to temporarily turn off water throughout the entire sprinkler system or sections of the sprinkler system. Can be either ball valves or gate valves.

Velocity - The velocity of flow is a calculation of the speed of water moving in a closed pipe system. More than 5 feet per second (FPS) in PVC can cause water hammer and damage irrigation systems. Needs to be considered when sizing pipe.

Water Meter - an instrument for recording the quantity of water passing through a particular outlet. Typically measure in gallons or cubic feet: 7.48 gallons = 1cf. **HCF** – Hundred Cubic Feet or 748 gallons

Some Irrigation Rules of Thumb / Tips

Proper Drip Installation Recommendations and Tips

- Place emitters uphill of plants.
- If using in-line, follow contours of slope.
- If using more than one emitter per plant, place emitters on either side of plants.
- Compression fittings vs. external barbed fittings - For 1/2" tubing, compression fittings are preferred over barbed fittings. Barbed fittings fit inside the tubing and on a hot day the connection can blow apart due to the fact that the tubing gets soft in the heat. Compression fittings where the tubing fits inside the fitting solve this problem.
- No more than 200 linear feet of tubing and a maximum of 240 gallons per hour.
- In-line can be used either on the surface or subsurface. On-line or point source should be used only on the surface.
- Staples – Use 'U' shaped every 4 – 6' to hold tubing in place.
- Install tattle tale for each zone.
- Stay away from spaghetti tubing.

Do not exceed a 10% psi drop from pressure read at the meter
Do not exceed 75% of maximum flow on any one zone

Great resources for additional information:

www.Irrigationtutorials.com

http://www.smgov.net/Departments/OSE/Categories/Landscape/Landscape_Plans.aspx

Review Of Basic Plant Data

Exposure:
- Sun
- Part-Sun or Part Shade
- Shade
- All

Growth:
- Max Height
- Max Spread-Width

Water Needs (ET):
- High
- Medium
- Moderate
- Low
- Very Low
- No Supplemental Water

Habit:
- Evergreen
- Deciduous (By season)
- Partially Deciduous

Form:
- Tree (Most wood, harder the longer it lives)
- Shrub (Some wood, lives years)
- Perennial (Lives more than 2 yrs)
- Succulents
- Bulbs
- Bi-Annual (Finished cycle in 2 years)
- Annual (Finished cycle in 1 yr)

REGULATIONS, CODES & RESOURCES

OSHA – Occupational Safety and Health Administration

Purpose:

To help employers and employees reduce on the job injuries, illnesses and deaths:

- Maintain conditions and/or adopt practices necessary and appropriate to protect workers on the job.
- Be familiar with and comply with standards applicable to their establishments.
- Ensure that employees have and use personal protective equipment when required for safety and health.

OSHA Standards for landscape and horticultural services encompass a wide range of services. Included in this category are companies engaged in landscape design and architecture; soil preparation and grading; irrigation systems; tree, shrub and lawn planting; hardscape construction including: retaining walls, pathways and patios; lawn care and landscape maintenance; arborist services including tree trimming and line clearance.

Landscaping and horticulture hazards are addressed in specific standards for the *general industry* if work is considered maintenance activity and the *construction industry* if work is considered building activity.

The OSHA website includes, among other things, OSHA regulations, enforcement procedures and how to get OSHA training:

https://www.osha.gov/SLTC/landscaping/

Electrical & Plumbing Codes

The purpose of building codes are to provide minimum standards for safety, health, and general welfare including structural integrity, mechanical integrity (including sanitation, water supply, light, and ventilation), means of egress, fire prevention and control, and energy conservation

In the USA the main codes are the International Commercial or Residential Code [ICC/IRC], electrical codes and plumbing, mechanical codes. Fifty states and the District of Columbia have adopted the I-Codes at the state or jurisdictional level.

Not every location is the same – each has their 'sense of place' that affect building codes (including landscaping). States and even local municipalities may decide to create more stringent requirements.

State Codes:

Title 24 – Title 24 of the California Code of Regulations, known as the California Building Standards Code or just "Title 24," contains the regulations that govern the construction of buildings in California. There are 12 parts; Electrical (part 3), Plumbing (part 5) and Green Building (part 11) which can pertain to irrigation.

http://www.bsc.ca.gov/Home/Current2013Codes.aspx

Local Codes:

Most municipalities will follow the State regulations as a minimum. Some will exceed requirements.
When beginning a project, be sure to check with:
- Local Building and Safety Departments
- Review municipal codes for the site
- Check on local implementation of AB 1881, Model Water Efficient Landscape Ordinance

Recent Innovations and Technological Developments,

Research and development are on-going for irrigation and better water efficiency products. Sometimes they are successful and move into the marketplace. Sometimes they are a dud.

Where to go for the best information?

Check with Trade Associations to stay current on legislation and technology relating to irrigation:

Irrigation Association http://www.irrigation.org/
California Landscape Contractors Association http://www.clca.org/
Association of Professional Landscape Designers http://www.apld.com/
American Society of Landscape Architects http://www.asla.org/default.aspx

WaterSense

WaterSense is a partnership program sponsored by EPA that is designed to protect the future of our nation’s water supply by promoting and enhancing the market for water-efficient products, new homes, and professional certification programs (hereafter referred to as “programs”).

WaterSense aims to help consumers and businesses use water resources more efficiently to preserve them for future generations and to reduce water and wastewater infrastructure costs by decreasing unnecessary water consumption. Through this program, EPA provides reliable information on water-efficient, high-performing products, homes, and practices; raises awareness about the importance of water efficiency; ensures water-efficient product performance; helps consumers and businesses identify products and services that use less water; promotes innovation in product development; and supports state and local water efficiency efforts.

WaterSense labeled products are backed by independent, third–party testing and certification, and meet EPA’s specifications for water efficiency and performance.

Currently these include weather based irrigation controllers. In the pipeline are irrigation sprinklers, soil moisture-based control technologies.

Check the WaterSense site to learn more about their role and for the most up to date approved products:
http://www.epa.gov/WaterSense/products/
http://www.epa.gov/watersense/docs/programguidelines.pdf

G3 green gardens group

www.greengardensgroup.com

Core Concepts Workshop

Completed Exercises

Exercise #1
Calculate "Drive-By" Landscape Water Requirements

The lawn in your client's Escondido home covers 1,000 sq. ft.

QUESTIONS:

How many inches of water are needed for this lawn in the month of July?

SF x ETo x PF = Inches of Water Required

1,000 sq. ft. x 7.34" x 100% = 7,340 Inches

How Big is the landscape area?

1,000 Sq. Ft.

Where Are We (hint: place and time of year)?

Escondido in July = July ETo = 7.34"

What's There in the landscape and what would be the Plant Factor we'd apply?

Lawn – the simplest "drive by" Plant Factor would be 100%, but you could apply 80% or 90% if you're into the math.

How many gallons of water are needed for this lawn in the month of July?

SF x ETo x PF x .62 = Gallons

1,000 sq. ft. x 7.34" x 100% x .62 = 4,551 Gallons

How many gallons of water are needed for this lawn annually?

Escondido Annual ETo = 56.96"

SF x ETo x PF x .62 = 1,000 sq. ft. x 56.96" x 100% x .62 = 35,315 gallons of water annually are Required for maintaining the health and aesthetics of a 1,000 sq. ft. lawn in Escondido.

PLANT FACTOR WORKSHEET

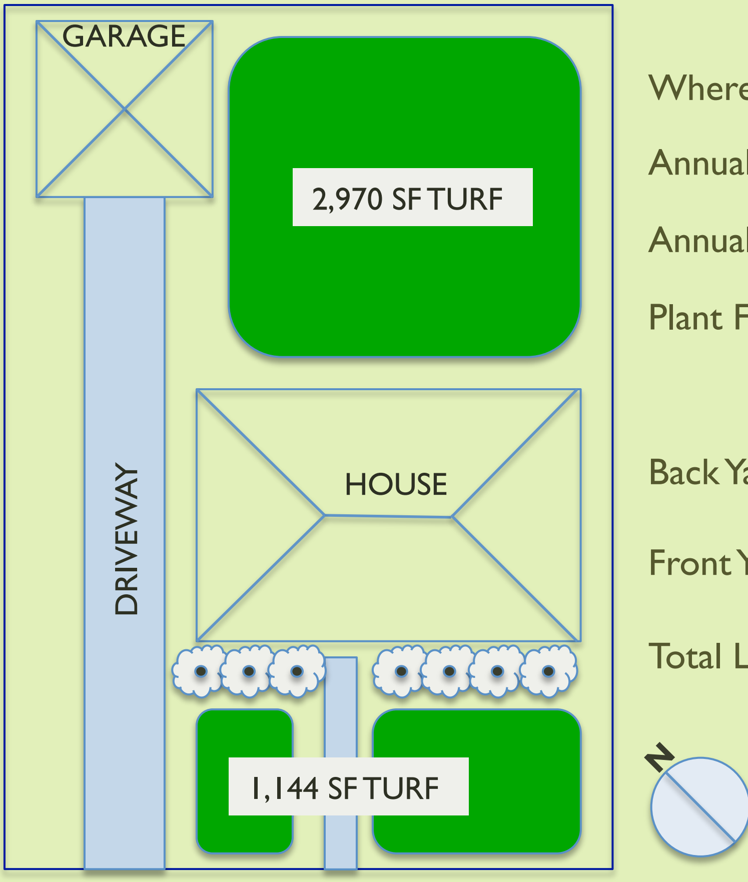
Using the WUCOLS IV 2014 reference information attached to this worksheet, determine the Plant Factor and Plant Water Requirement by region for the three plants listed below:

Santa Monica	Annual ETo=	44.22”	Borrego Springs	Annual ETo=	75.39”

Picture	Botanical Name	Common Name	Santa Monica WUCOLS Water Need	% PF (Kc)	Santa Monica PWR	Borrego Springs WUCOLS Water Need	%PF (Kc)	Borrego Springs PWR
	Justicia carnea	Brazilian plume flower	High	80%	44.22” x .80 = 35.37” per year	High	80%	75.39” x .80 = 60.31” per year
	Kniphofia uvaria	Red hot poker	Low	20%	44.22” x .20 = 8.84” per year	Medium	50%	75.39” x .50 = 37.70” per year
	Laurus nobilis	Sweet bay	Low – maybe adjust because a tree form?	20% - 30%	44.33” x .30 = 13.27” per year	Medium – adjust because it’s a tree?	60%	75.39” x .60 = 45.23” per year

If Plant Factor is listed as unknown (?) then use data from growers of the plant

Exercise #3
Annual Water Requirement for TURF-Centric Landscape



Where are we? = California

Annual ETo for Region = 50"

Annual Rainfall for Region = <12"

Plant Factor–Cool Season Turf (PF) = 1.0

Back Yard Turf SF: 2,970

Front Yard Turf SF: 1,144

Total Landscape Area (TLA): 4,144

Annual Water Requirement in Inches = TLA x Eto x Plant Factor

Annual Water Requirement in Gallons = TLA x Eto x Plant Factor x 0.62

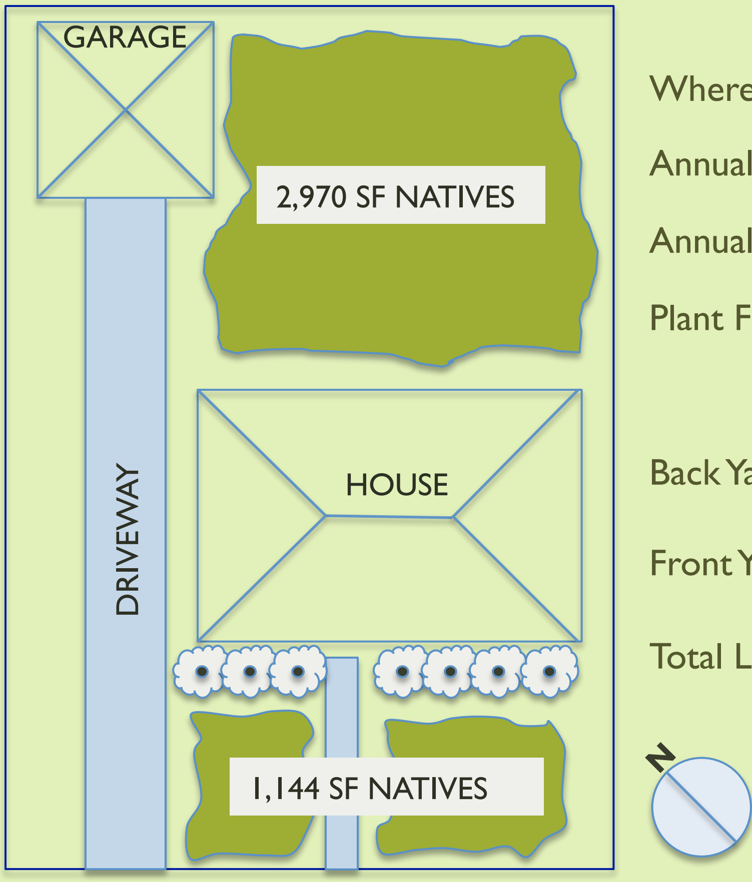
Plant Factor Inches per SF: (ETo x PF) — 50 x 1.0 = 50"

Plant Factor Gallons per SF: (ETo x PF x 0.62) — 50 x 1.0 x 0.62 = 31 gal

Total Gallons Per Year: (TLA x ETo x PF x 0.62) — 4,144 x 50 x 1.0 x 0.62 = 127,534

What does this number mean? — This turf-centric landscape requires 127,534 gal. per year in California to remain healthy.

Exercise #4
Annual Water Requirement for NATIVE -Centric Landscape



Where are we? = California

Annual ETo for Region = 50"

Annual Rainfall for Region = <12"

Plant Factor–Cool Season Turf (PF) = 0.20

Back Yard Turf SF: 2,970

Front Yard Turf SF: 1,144

Total Landscape Area (TLA): 4,144

Annual Water Requirement in Inches = TLA x Eto x Plant Factor

Annual Water Requirement in Gallons = TLA x Eto x Plant Factor x 0.62

Plant Factor Inches per SF: (ETo x PF) — 50 x 0.2 = 10"

Plant Factor Gallons per SF: (ETo x PF x 0.62) — 50 x 0.2 x 0.62 = 6.2 gal

Total Gallons Per Year: (TLA x ETo x PF x 0.62) — 4,144 x 50 x 0.2 x 0.62 = 25,507

What does this number mean? — This Native centric landscape requires 25,507 gal. per year in California to remain healthy.

Exercise #5
Calculating Annual Designed Landscape Water Requirement

What is the Total Landscape Area?

TLA includes everything that needs water, so all is included in the calculation.

5,000 sf Lawn + 2,000 sf Mixed Bed + 1,000 Native Border + 2,000 sf Pond =

10,000 sq. ft. of Total Landscape Area

What is the appropriate ETo for this project?

The annual ETo = 60” per year

What would be the Annual Landscape Water Requirement of this property assuming the entire Total Landscape Area is covered in Lawn that is Cool Season Turf with a Plant Factor (Kc) of 100% and IE of 55%?

TLA = 10,000 Sq. Ft.

Landscape Water Requirement IN INCHES = Sq. Ft. x ETo x PF ÷ IE = 10,000 sf x 60” x .85 ÷ .55 = 927,273 INCHES of water per year

Convert Inches to Gallons x .62 = 927,273” x .62 = 574,909 GALLONS per year

If the Annual Water Budget for this property is set at 60% of ETo, what is the Annual Water Budget in gallons for this property?

Annual Water Budget = TLA x ETo x 60% x .62 = 10,000 sf x 60” x .60 x .62 =

223,200 Gallons of water per year

What are the Hydrozones of the property?

Lawn 5,000 sq. ft.
Mixed Bed 2,000 sq. ft.
Native Plant Border 1,000 sq. ft.
Pond 2,000 sq. ft.

What are the Hydrozone Water Requirements?

Cool Season Lawn is assigned a Plant Factor of 80%.

Designed Landscape Water Requirement
Page 2

The Mixed Border is the trickiest Hydrozone with Low and Medium plants. The higher Plant Factor must be selected, so use Medium or 50% Plant Factor for that hydrozone.

The Native Plant Border is Low and therefore 10% - 30%. We used 20%.

The Pond evaporates at 100%, so it has an Adjustment Factor of 100%.

What is the Designed Water Plan or Designed Landscape Water Requirement for this property?

From the chart, we find the Designed Water Plan is 394,545 gallons per year.

How does the Water Budget compare to the Designed Water Plan?

Water Budget = 223,200 Gallons
Designed Water Plan = 394,545 Gallons

Water Budget < Designed Water Plan

Our Plan would be rejected and needs to be re-designed to be less than the Water Budget.

Exercise #6
Calculate Precipitation Rate and Lower-Quarter Distribution Uniformity From Observed Data

DATA:

Wind speed = 3.5 MPH
Irrigation run time = 10 minutes
Meter reading at Start = 66956 Gal. Meter reading at End = 67540 Gal.
Irrigated area Square Footage = 8,250 sq. ft.
Observed water from cans in milliliters:

CAN #	ML OBSERVED	CAN #	ML OBSERVED
1	55	9	30
2	50	10	35
3	45	11	30
4	37	12	25
5	55	13	10
6	4	14	8
7	25	15	55
8	10	16	4
TOTAL	281 ml	TOTAL	197 ml

QUESTIONS:

What is the Average Total ML Observed?

Total ml In Sample	÷ Number of Samples	Avg. Total
281 + 197 = 478 ml	**16**	**29.875 ml**

What is the Flow Rate or Gallons Per Minute (GPM)? [(Meter read End – Meter read Start) ÷ Run Time]

[[67540 gal. – 66956 gal.) ÷ 10 min.] = 584 ÷ 10 = 58.4 GPM

What is the Application Rate we have observed (Inches/Hr.)? [(96.25 x GPM) ÷ SF Irrigated Area]

[(96.25 x 58.4 GPM) ÷ 8,250 SF] = 5,621 ÷ 8,250 = .68 In/Hr.

Arrange the results in ascending order of magnitude in this chart:

DATA #	ML OBSERVED
1	4
2	4
3	8
4	10
5	10
6	25
7	25
8	30
9	30
10	35
11	37
12	45
13	50
14	55
15	55
16	55
TOTAL	478 ml

What is the Average of the Lower Quarter? (hint: #1-4)

Total ml In Lower Qtr.	÷ Number of Samples	Avg. Lower Quarter
10+8+4+4 = 26 ml	**4**	**6.5 ml**

What is the Average of the Lower Half? (hint: #1-8)

Total ml In Lower Half	÷ Number of Samples	Avg. Lower Half
30+25+25+10+26= 116 ml	**8**	**14.5 ml**

What is the Distribution Uniformity of the Lower Quarter if DU_{LQ} = (Average of Lower Quarter ÷ Average of Total)?

DU_{LQ} = (6.5 ml ÷ 29.875 ml) = .22

What is the Distribution Uniformity of the Lower Half if DU_{LH} = (Average of Lower Half ÷ Average of Total)?

DU_{LH} = (14.5 ml ÷ 29.875 ml) = .49

In order to correctly evaluate our irrigation system, what other information should we gather when we are on site?

Slope	**pattern of layout**
head-to-head coverage	**root zone depth**
nozzle/emitter types	**broken sprinklers**

Exercise #7
Calculate Plant Available Water (PAW) For This Landscape Scenario

DATA:
Plant = 24” Koelreuteria paniculata
Landscape Maturity = Planted 1 year ago
Root Depth = 24”
Soil Type = Sandy Loam

QUESTIONS:

What form does this plant take in the garden? How will you determine this?

Looking on the WUCOLS sheet, we see that it is a Tree form.

How do you determine the Root Depth of the plant, if it were not provided?

Soil probe on site or look up grower literature.

What is the Soil Available Water Holding Capacity (AWHC)?

Soil type is Sandy Loam, the chart indicates that there is a range 1.25 – 1.75”/Foot of Soil. We chose the middle 1.50”/Ft. This equals .125”/” of soil.

Using the Root Depth above to complete this question, what is the Plant Available Water (PAW)?

PAW = Root Depth” x AWHC “/” = 24” x .125”/” = 3” of Water/24” of Soil

Exercise #8
Calculate Allowable Depletion and Irrigation Intervals For This Landscape Scenario

DATA:

Neverywhere Annual ETo = 50″
Square Footage of Area = 500 Sq. Ft.
Plant Type = Medium Low Shrub Type
Root Depth = 20″
Soil Type = Clay Loam
MAD = 50%
Distribution Uniformity = 70%

QUESTIONS:

What is the Plant Water Requirement (PWR)?

PWR = ETo″ x PF = 50″ x .40 (because it is MEDIUM LOW) = 20″ Annually

This is the tricky part. For use in AD calculations you have to determine the **PWR DAILY** so: Annual 20″ ÷ 365 Days/year = **.055″/Day**

Note: It would be preferable to use a monthly ETo for determining Daily PWR, if it is available; but if not, make sure you use what data you are given.

What is the Soil Available Water Holding Capacity (AWHC)?

AWHC Clay Loam soil is 1.90″/Ft. of soil or **.158″/″** (to get this, divide 1.90″/ft. by 12″/ft.)

What is the Plant Available Water (PAW)?

PAW = Root Depth″ x AWHC″/″ = 20″ x .158″/″ = **3.16″** of water in 20″ of Root Depth

What is the Allowable Depletion?

AD = MAD% x PAW = .50 x 3.16″ = **1.58″**

How many days between irrigation events (irrigation Interval)?

Irrigation Interval = AD ÷ Daily PWR = 1.58″ ÷ .055″ = 28.72 Days or **29 Days**

Exercise #9
Determine Total Irrigation Run Time For This Landscape Scenario

DATA:
Anywhere Annual ETo = 50″
Daily Plant Water Requirement = 0.055 inches / day
Irrigation Interval = 29 days
Precipitation Rate = 0.52 inches per hour
Soil intake rate = 0.48
IE = 70%

Irrigation Interval x DPWR ÷ IE = Irrigation Water Requirement (IWR)
(IWR x 60) ÷ Precipitation Rate (PR) = Total Irrigation Run Time

How much water will be applied in irrigation event?

Applied Water = Irrigation Interval x PWR = 29 Days x PWR = 29 x .055″ = **1.6″ of Water needs to be applied. But DU = 70%, so 1.6″/.70 = 2.28″ must be applied to get 1.6″ on the garden.**

Given your Precipitation Rate, how long do you need to run the irrigation to achieve total irrigation water requirement?

Total Irrigation Run Time = (IWR x 60) ÷ Precipitation Rate (PR)
(2.28″ x 60) ÷ 0.52 = 263 Minutes. Every 29 days you would need to irrigation for a total of 263 minutes.

If your soil intake rate is lower than the precipitation rate, and you see run off after one hour, how many cycles would you need to avoid run-off?

Soil intake rate is: 0.48 inches per hour. Precipitation rate is: 0.52 inches per hour. Run off occurs after 60 minutes.

263 Minutes ÷ 60 minutes = 4.38 (round up to 5).

It would take 4 cycles of 60 minutes and 1 cycle of 23 minutes every 29 days to efficiently irrigation this hydrozone without any runoff!

Exercise #10
Calculate Amount of Rainfall From Each Impermeable Surface

Catchment Area	Sq. Ft.	x First Flush “	x Runoff Coefficient	x .62	= First Flush Gallons	x Annual Rainfall “	= Total Annual Gallons
Flat Composite Roof	3,200	1	.85	.62	1,686.40	10	16,864
Flat Steel Roof	800	1	.95	.62	471.20	10	4,712
Sidewalk	500	1	.95	.62	294.50	10	2,945
				TOTA L	2,452	TOTAL	24,521

Exercise #11
Calculate Runoff Available To Be Harvested From Each Hard Surface In This Landscape Scenario And Size BMPs For Capture

INSTRUCTIONS & DATA:

Use the Sq. Footage and Surface information on the first page Image for calculating the runoff that will be generated by each surface. Assume all runoff generated is harvestable.

First Flush = 1”
100 Year Storm Event = 4”
Average Annual Rainfall = 10”

Capture constraints: 15’ setback from buildings; 3’ setback from sidewalks, 10’ setback from neighbors’ properties and no runoff on to neighbors’ property.

QUESTIONS:

Calculate Square Footage of each Impermeable Surface.

Flat Composite Roof = 40’ x 80’ = 3,200 SF

Flat Steel Roof = 40’ x 20’ = 800 SF

Sidewalk = 5’ x 100’ = 500 SF

Calculate First Flush Runoff in Gallons from each Impermeable Surface. What are the Runoff Coefficients For Each Surface?

Flat Composite Roof = .85

Flat Steel Roof = .95

Sidewalk = .95

From Chart: **2,452 Gallons** Total From 1” First Flush

Calculate Total 100 Year Storm Event in Gallons.

100 Year Storm Event = 4”

2,452 Gallons Total From 1” x 4 = **9,808 Gallons**

Calculate Total Annual Avg. Runoff in Gallons.

Avg. Annual Rainfall = 10’

2,452 Gallons Total From 1” x 10 = **24,521 Gallons**

What is the Maximum Length and Maximum Width (and how much square footage) available for capture given the constraints outlined above. What is the Total SF for BMPs?

Hardscape Setback 15’ from building + 3’ from sidewalk = 18’ Total Setback
50’ Width of Landscaped Area – 18’ Setback = **32’ W** Total Available

Neighbor Setback 10’ Total
85’ Length of Landscaped Area – 10’ Setback = **75’ L** Total Available

32’W x 75’L = **2,400 SF available for capture**.

What is the Minimum Depth required of the BMP to capture First Flush if the entire BMP square footage is available for use?

First Flush Total Gallons = 2,452 Gallons
Convert Gallons to Cubic Feet = Gallons ÷ 7.48 Gal/Cu. Ft. =
2,452 Gallons ÷ 7.48 Gal/Cu. Ft. = **328 Cu. Ft.**

2,400 Sq. Ft. available.

328 Cu. Ft. ÷ 2,400 SF = .136’ Depth x 12”/’ = 1.6 Inches

What is the Minimum Depth required of the BMP to capture A 100 Year Storm Event if the entire BMP square footage is available for use?

100 Year Storm Event Total Gallons = 9,808 Gallons
Convert Gallons to Cubic Feet = Gallons ÷ 7.48 Gal/Cu. Ft. =
9,808 Gallons ÷ 7.48 Gal/Cu. Ft. = **1,311 Cu. Ft.**

2,400 Sq. Ft. available.

1,311 Cu. Ft. ÷ 2,400 SF = .55’ Depth x 12”/’ = 6.5 or 7 Inches

What is the Minimum Depth required of the BMP to capture First Flush if only 100 sq. ft. is available for use?

328 Cu. Ft. ÷ 100 SF = 3.28’ Depth x 12”/” = 39 Inches

What is the Minimum Depth required of the BMP to capture Annual Average Precipitation if only 100 sq. ft. is available for use?

1,311 Cu. Ft. ÷ 100 SF = 13’ Depth

G3 FORMULA & CONVERSION SHEET 2014

TLA = Total Landscaped Area
(Distribution Uniformity is an approximation for Irrigation Efficiency, therefore IE = DU))
Plant Water Requirement = PWR = ETo x PF or ETo x Kc (PF = Kc)
Annual Landscape Water Requirement In Inches = SF x ETo x Plant Factor ÷ IE
Annual Landscape Water Requirement In Gallons = SF x ETo x Plant Factor ÷ IE x .62
Annual Designed Water Use Plan = SUM: [(Hydrozone1 SF x ETo x (PF ÷ IE) x .62) +
    (Hydrozone2 SF x ETo x (PF ÷ IE) x .62)…]
Annual Water Budget in Gallons (MAWA) = TLA x ETo x Budget Adjustment Factor x .62
Annual EPPTA Gallons = TLA x Avg. Annual Rainfall x .25 x .62
Annual G3 Water Budget = MAWA – EPPTA

Plant Available Water = PAW = AWHC by Soil Type x Root Depth Inches
Managed Allowed Depletion = 50% in most cases, but adjusted for site conditions
Allowable Depletion = AD = MAD x PAW
Irrigation Interval = AD ÷ Daily PWR
Irrigation Water Requirement = IWR = (Irrigation Interval Days x Daily PWR) ÷ IE
    Alternative IWR Estimate = AD ÷ IE
Total Irrigation Run Time = TIRT = (IWR x 60) ÷ PR

First Flush Gallons = Catchment Area SF x .75 Inches x Runoff Coefficient x .62
Annual Total Runoff Gallons = Catchment Area SF x Total Inches of Rainfall x Runoff Coefficient x .62

Application Rate = Precipitation Rate = PR Inches/Hour
PR_{DGRID} = (231.1 x Emitter Flow Rate) ÷ (Emitter Spacing Inches x Row Spacing Inches)
$PR_{DRANDOM}$ = (96.25 x Total Zone GPM) ÷ Total Zone Area SF
$PR_{SPRAY/BUBBLER}$ = (96.25 x Total Zone GPM) ÷ Total Zone Area SF
GPM = (Start Meter Reading – End Meter Reading) ÷ Minutes Test Run

Lower Quarter Distribution Uniformity = DU_{LQ} = Avg. Lower Quarter Catch Observed ÷ Avg. Total Catch Observed

Convert Inches of Water to Gallons of Water = Inches x .62
Convert Gallons to Cubic Feet = Gallons ÷ 7.48
Convert Cubic Feet to Cubic Yards = Cu. Ft. ÷ 27

Plant Type	% of ETo (Kc)	Irrigation Type	Irrigation Efficiency
Warm Season Turf	70	Classic Spray	.55
CA Native Shrubs/VERY LOW/LOW	20	PGP/Rot Nozzle	.70
MEDIUM	50	Micro-spray	.70
HIGH (Water Feature or Edibles @ 100)	80 – 100	Drip Irrigation	.90