The Science Behind Irrigation Water Management

By Tom Del Conte

WATER DISTRICTS ACROSS the country agree that landscapes are overwatered by 30 percent to 60 percent on average. The negative impacts result in soil erosion from excess water runoff, poor health of the landscapes, a tremendous waste of water to suburban properties, and the enormous waste of electrical power used to pump the water from its source and deliver it to us.

There are a myriad of reasons behind this travesty in conservation practices. In most irrigation intense regions of the country, the stewards of the irrigation are the landscapers. Unfortunately, the landscaper is typically only gauged by how green the landscape is at any given time. The landscape will be green by accurate watering, but it also will be green by overwatering 10 percent, 50 percent, 200 percent and so on. The grossly overwatered lawn will definitely die, but so slowly over a season or two that the decline in the lawn's condition will not be noticeable to the customer. Yet, if under-watering by only 10 percent, brown spots will occur and the landscaper's contract will be in jeopardy. Combine this with the fact that water expenses are not usually shared with landscapers, nor are there any objective water budgets established, and you have a recipe for serious overwatering. What incentive does a landscaper have to employ sharp water management strategies? If it is not something the customer places sincere value on, then why would a contractor invest in building a serious water management program or hire personnel with such advanced skill sets? To hire people with these advanced skill sets would raise the cost, and thereby the pricing, above the minimalist competitor.

Further, for many common interest developments, water is one of the Top 5 expenses. Yet it is a line item typically accepted "as is." The irrigation comes on at night and all of the over watering that runs down the gutter disappears by sunrise, and along with it goes an enormous amount of association money. There are some very good irrigation managers serving the landscape industry. However, while almost all gardeners profess to have good irrigation management skills, few have found the absolute need to hone this skill. The reason is the marketplace; managers and HOA boards have yet to consider this a serious value. Real water management requires a serious skill set! Usually the low-cost service provider has not acquired the skills, or hired those who have the skills and talent to use this science of proper landscape water application. One landscaper has said, "I have been waiting 25 years for the price of water to go up, so my skill set will have more value to the market!" From a good contractor, there is much more potential than just mowing lawns, trimming shrubs and removing weeds. The truth is a good water manager can have a cost saving for property development that is multiple times the price difference of a contractor without water management talent. The cost savings will not only be in water savings, which can be huge, but in asphalt life span, plant life and improved curb appeal leading to increased property values. The largest benefit of proper water management is staving off the very gradual decline to a landscape that occurs over a season or two, when plants are regularly subjected to the unfriendly environment of excessive water.

Advancing a landscape properly is an integrated horticultural program that requires, among other things, creating the proper environment for the plants we select to thrive. Water management is without a doubt the most critical aspect in creating this plant-satisfying horticultural environment.

Most people think irrigation management is a simple matter of giving the plants "a drink of water." However, there is indeed a science and an objective process with which to properly manage irrigation water and a method to determining an accurate budget for water costs. This begs the adage, "If you can count it, you can manage it." To count it, there are two basic pieces to the equation. The first question to ask is, "How much water is leaving the landscape? This is a concept known as "evapotranspiration." The second question to ask is, "How is the replacement water applied to the landscape?" This is commonly referred to as the "precipitation rate." While these are closely related, it is important to keep these two concepts separate in one's mind.

A fine water management program will have rewards well beyond the obvious. If you can count it, you can manage it.

Evapotranspiration is the measurement of water that leaves the landscape as a result of 1) soil evaporation and 2) plant tissue transpiration (transpiration is the plant equivalent to human perspiration)." The sum total of both of these drying components is referred to as evapotranspiration, or "ET," and is the total amount of water lost from the landscape. ET is measured in inches of water lost over a time period. These amounts vary by region according to climate and hours of sunlight. The ET numbers also change throughout the season. There are plenty of sources to get real-time ET values in every region for each day. However, daily monitoring becomes too burdensome and impractical unless automated. The most practical ET values to use for landscape irrigation systems are 20-year historical averages of each month's ET for your region. For instance, the 20-year historical average ET for an East Bay Area of the San Francisco region is 3.8 inches of ET in April, 5.2 inches for the entire month of May and 6.4 inches for June, and so forth. For the time period over the entire year, this same area has a cumulative ET of 32.4 inches of lost water from the landscape.

There is one more very important component to the ET concept. That is a factor for the type of plants. We all realize that some plants transpire more water while others transpire less water. Therefore, we need to apply a factor to the ET value for plant types. ET is provided from a host of government agencies, mostly associated with agriculture. So that we can all count

on a consistent ET number as provided to us, the ET provided by agencies is a standardized value always based upon a certain crop type, pasture grass. The standardized number is labeled as ETo. Since the number is always for a certain crop type, we need to factor the ETo for our type of plant material in our suburban landscapes. While there are differing opinions of the various factors that could be considered, the factors of ET for landscaping generally range as follows: Cool-season turf 75 percent of standard ET (ETo), warm-season turf 60 percent of ETo, typical shrub beds is 40 percent of ETo, and plants native to the area are 20 percent of ETo. Therefore, if ETo for June is 6.4 then the ET for warm-season grass in June should be 6.4 inches x 75 percent = 4.8 inches of ET required for this grass in June in the San Francisco East Bay Area.

Now, understanding that ET is simply a number of inches of water that the landscape requires, you can calculate a water budget for the area of your landscape. For instance, if your annual ETo is 36 inches of water and you have 10,000 square feet of landscaping, then you would require 30,000 cubic feet of water annually. That 30,000 cubic feet of water equals 300 units of water as characterized on most agencies' water bills. You might ask why the budget does not consider the plant type factor. Most professionals recognize the industry is not advanced enough yet and watering systems lack efficiencies, so most water agencies and professionals are recommending water budgets based upon the full standard base ETo, without applying crop factors.[1] (The author's opinion is that it is acceptable to use the base ETo to create the water budget for your development.) The water budget is a baseline to set as a target with legitimate numeric basis. You will use the water budget number to compare the actual water use from your water bills and you will know the amount of water that should be attainable if there is a reasonably efficient irrigation system and a good water manager. The budget sets a line to measure. If your water steward can manage to this volume of water, a little or a lot under, you can be confident that you are inside of a calculated amount, and no longer guessing if you are using too much water.

Precipitation Rate can be thought of as the opposite of ET. As we have learned, ET is the measurement of how much water is lost and now required. Precipitation rate is the amount of inches of water applied by our irrigation systems and measured as precipitation per hour. ET is to determine how much water we need as determined by nature – and that is rather simple. Precipitation is using the watering irrigation systems we have built to deliver the water at a rate that hopefully matches ET. Each type of sprinkler head has a precipitation rate at which it applies water. Some sprinkler heads apply water at a rate of 2 inches per hour, while others put the water down at half an inch per hour.[2]

By knowing the inches of water our sprinkler system will apply in an hour – the "precipitation rate" – we can use the number of minutes of watering run times to try to apply the amount of effective precipitation to match the required evapotranspiration rate. So irrigation systems that water at a higher precipitation rate, such as most spray-type sprinklers, which average 2 inches per hour, do apply water faster and, hence, should run fewer minutes. Irrigation that waters slower, such as rotor sprinkler heads, which average a half an inch per hour, will need to water a longer amount of time to get the same amount of water applied in order to accommodate ET.

We know that ET changes throughout the season.[1] The most practical way to set your timers is to adjust the run times to match the ET for each month. While we can access the ET values daily, resetting the timers more often than monthly is not practical or cost effective. After we know the precipitation rate for the various types of sprinklers, and we set them for the proper amount of minutes to match the ET, the next step is to insure we are watering in accordance with the monthly ET requirements.

If we set the irrigation system only once per year and leave it on the same setting all year, we will indeed be significantly overwatering, as we would be watering all year for the month with the highest ET of the year. Unfortunately, this practice is commonly done and results in large amounts of wasted water during the months of the year that have significantly lower ET water requirements.

The irrigation manager should expect to make slight modifications over a period of a season or two to fine tune the relative watering to accommodate the imperfections of the irrigation system and the unique property site conditions. These unique adjustments will require a fair amount of tweaking and monitoring of the effects of the landscaping as fine-tuning adjustments are made over the course of time.

There is a program on the market for $5.99 per year at www.sprinklertimes.com that performs all of these calculations to set the watering schedules on a monthly basis for each climate zone in the United States. Sprinkler Times is an easy-to-use online program and app that calculates monthly run times for each zone. Most importantly, the program has an adjustment feature to manage and fine-tune the system over time. The instructional videos walk through the concepts in a very simple and concise manner.

WHY HAVING A WATER BUDGET MATTERS

Proper water management begins with counting it to manage it. Create a landscape irrigation water budget for the site by using ETo to calculate the depth of water, in inches, required over the square footage of the property. The water budget can and should be broken down for each month of the season and should represent the amount of water that should be used for the landscape each month of the season. Next, understand the precipitation rates[2] (and the distribution uniformity) of each sprinkler zone. Factor the inches of ET for the various plant types that are being watered to determine the inches of water required for the plant type in each irrigation zone. Use the minutes of irrigation run time to match, as nearly as possible, the effective precipitation for each irrigation watering zone to the monthly ET requirement of each zone. While the sprinkler type will get you close, fine-tuning will be essential for effective water management. The landscape lawn and plant material itself will show you how close you are to a good schedule. Watch the plants and soil and make the adjustments on a zone-by-zone basis. The Sprinkler Times program will manage this process, but do not print all monthly schedules as that will discourage the fine-tuning adjustment function. (The fine-tuning adjustment video in the Sprinkler Times program describes this excellently.)

Lastly, review your water bills against your water budgets to see how much water you saved. Be proud that you are using green and professional water management practices, are conserving as much water as your system will support and are using tools to save money on one of your largest budget line items. Some landscape companies have built the capacity to create such budgets from water meters. Also, many water districts are beginning to calculate the water budgets for the property and send them to their water customers.

Yes, there is a science available to manage irrigation management. A fine water management program will have rewards well beyond the obvious. ***If you can count it, you can manage it.*** Some associations adopt a strategy to hire higher levels of talent and save on their overall cost while improving overall performance. Beyond the money saved from accurate water applications, there is avoidance of asphalt damage, soil erosion, disease infestation and the absence of plant replacement over the years. But the largest value comes from curb appeal, as an integrated landscape management program that includes the invaluable component of water management will actually reverse a declining landscape and promote a healthy horticultural environment required to actually advance the landscape and create a curb appeal of pride. ■

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1 This assumes the sprinkler controllers are conventional irrigation timers without outside sensors and without the ability to make automatic adjustments to watering regimes based on outside weather inputs. Timers that do have an ability to communicate with outside sensors and make daily automatic watering adjustments are Smart Timers, which are available.

2 It should be noted that the precipitation rates of irrigation systems are never uniform, and the irrigation manager should understand the effective irrigation precipitation rate, which is factored for distribution uniformity (DU).