



**Residential Landscape
Irrigation Study
using
Aqua ET Controllers
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**Denver Water, Denver, CO
City of Sonoma, CA
Valley of the Moon Water District, CA**

Residential Landscape Irrigation Study Using Aqua Conserve ET Controllers

Residential landscape irrigation studies, using Aqua ET Controllers, were established with Denver Water in Denver, Colorado, and two adjacent water districts in Northern California, the City of Sonoma and the Valley of the Moon Water District , during 2001. The data collected from these studies indicated that participants had a total outdoor water savings of 21%, 23% and 28% for Denver Water, City of Sonoma and Valley of the Moon Water District, respectively.

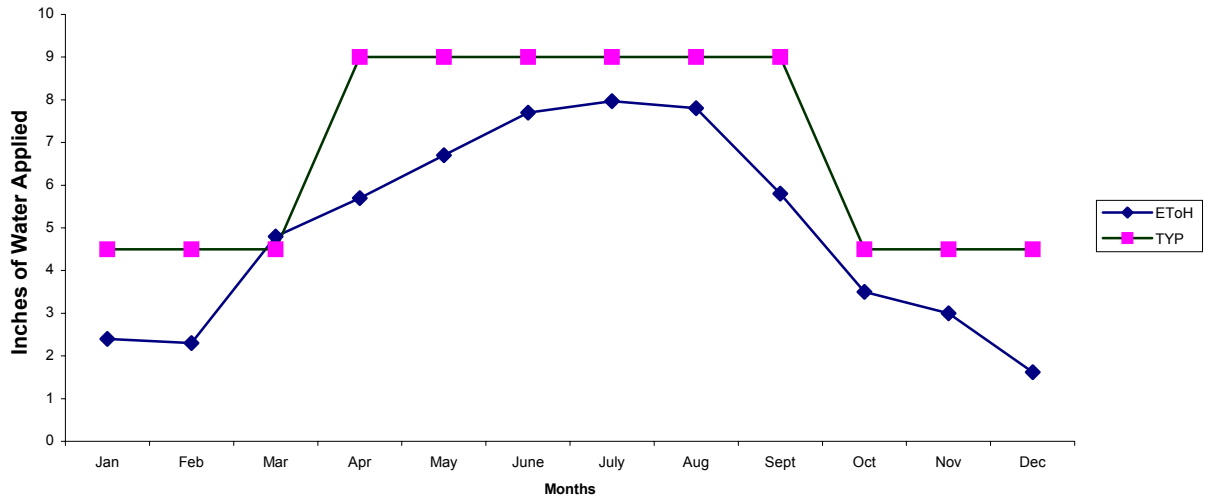
Introduction

In arid areas of the world water is becoming one of the most precious natural resources. Meeting future water needs in these arid areas will require aggressive conservation measures. This requires irrigation systems that apply water to the landscape based on the water requirements of the plants. This will provide water savings and will also reduce water runoff that frequently results in the pollution of our water resources including our lakes, rivers and streams.

Many irrigation controllers have been developed for automatically controlling application of water to landscapes. Known irrigation controllers range from simple devices that control watering times based upon fixed schedules, to sophisticated devices that vary the watering schedules according to local geographic and climatic conditions.

With respect to the simpler types of irrigation controllers, a homeowner typically sets a watering schedule that involves specific run-times and days for each of a plurality of stations, and the controller executes the same schedule regardless of the season or weather conditions. From time to time the homeowner may manually adjust the watering schedule. According to a survey of 2500 residential water users around the United States, more than one-half of the water users either made no changes to their watering schedule during the year or only changed their scheduled watering run-times twice in a twelve-month period. One change is frequently made in the late Spring when a portion of the yard becomes brown due to a lack of water. Another change is often made in the late Fall when the homeowner assumes that the vegetation does not require as much watering. These changes, to the watering schedule, are generally insufficient to achieve efficient watering. See the following figure of the water applied by a typical irrigation user that makes changes in the spring and fall compared to the water that would have been applied, if irrigations were based on evapotranspiration (ET_o) data.

Comparison Between Water Applied by Typical Residential Irrigation Users and Water that would have been Applied if the Irrigations were Based on Eto for the Year 2000 in Riverside, CA



Evapotranspiration is the result of water being removed from the soil by evaporation and by transpiration from the plant surface. Potential evapotranspiration (ETo) is calculated from meteorological data (temperature, solar radiation, humidity and wind). ETo calculations are closely correlated to the water requirements of plants. Controllers that base irrigation applications on ETo data automatically reduce the run-times of the irrigation stations in the spring and fall, when there is less evapotranspiration. Most ETo based irrigation controllers have irrigation run-time settings initially set for the peak water requirements of the plants or run-time settings that would be used for the summer irrigations. As the season changes from summer to fall, the weather turns cooler reducing evapotranspiration and the ET controller automatically reduces the irrigation run-times. In the spring, the irrigation run-times will still be reduced and as the seasons progress a warming trend will occur and evapotranspiration will increase. As the evapotranspiration increases, the ET controller will automatically increase the irrigation run-times.

Method

The study with Denver Water was established prior to the 2001 irrigation season. Jim Reed, Conservation Specialist with Denver Water, provided a list of potential participants. Thirty seven Aqua ET Controllers were installed with participants from throughout the Denver metropolitan area. Twenty of the Aqua ET Controllers applied irrigations based on historical data and seventeen Aqua ET Controllers had temperature sensors installed in them and irrigations were based on the daily changes in temperature. The Aqua ET Controllers collect data from the temperature sensors and a mathematical algorithm relates the temperature to evapotranspiration rates (Patent Pending). Jim Reed collected data on water usage by the participants during 2001 and compared this to the participants historical water usage during a previous five year period. The water used by participants was corrected using water usage data from a control group of 800+ residential non-participant irrigation users. Jim Reed compared the water used by the control group during 2001 to their historical water usage and any change in water usage, either positive or negative, was used to correct the water used by the participants in the study. This factored out the effect the 2001 weather might have had on water use when compared to water use during the previous five year historical period.

The two sites in California were both established in May and June 2001. Hal McCutchan of the Sonoma County Water Agency was instrumental in initiating the study and represented the City of Sonoma. Robert Freeland represented the Valley of the Moon Water District. In both studies, Aqua Conserve was provided a list of high volume water users interested in the study project. From the lists and other sources, including neighborhood contracts, Aqua Conserve personnel installed controllers at 27 residential sites in the City of Sonoma and at 10 residential sites in the Valley of the Moon Water District. All of the controllers involved were equipped with temperature sensors. Water usage during the 2001 irrigation season, following controller installation was compared to pre-installation historic use. The historic period for the City of Sonoma was the average of the previous two years and for the Valley of the Moon Water District it was the average of the previous five years.

As mentioned earlier, the primary reason for the reduction in water usage, with controllers that vary irrigation applications based on ETo data, is due to the frequent changes the controllers make to the application rate based on seasonal weather changes. Additionally, in these studies, it was found that some of the reduction in water usage was because of the lowering of the peak water run-times during the summer months. The Aqua ET Controllers have a feature that allows the user to add an additional complete scheduled irrigation by just pressing a button. Aqua Conserve personnel and Aqua Conserve literature stress the importance to set the peak summer minutes as low as possible and yet maintain a quality lawn. Then, if any excessive wilting of the grass or brown spots begin to appear in the lawn the user need only press a button and add an additional scheduled watering.

Results

Jim Reed, Conservation Specialist with Denver Water, analyzed the data from the Denver Water study. He reported that the total reduction in outdoor water usage was 1,424,000 gallons (4.37 acre-feet) or a reduction of 21% compared to historic water usage. The average outdoor water savings per participant was 21.47%. In a letter to Aqua Conserve, Mr. Reed stated, “Your ET controller has performed very well.”

Aqua Conserve analyzed the City of Sonoma data, which was accepted by the City of Sonoma personnel. The total reduction in outdoor water usage was 647,000 gallons (1.99 acre-feet) or a reduction of 23% compared to historic water usage. The average outdoor water savings per participant was 7.37%. In a letter to Aqua Conserve, Mr. McCutchan stated, “the City of Sonoma is very appreciative of the workmanship of the Aqua’s performance in relationship to the Residential Evapotranspiration Controller Demonstration Project. The verbal feedback from the participants has been positive and your rapport with the participants was outstanding”.

Valley of the Moon Water District personnel analyzed their data and reported a total reduction in outdoor water usage of 419,000 gallons (1.29 acre-feet) or a reduction of 28% compared to historic water usage. The average outdoor water savings per participant was 25.1%.

There was substantial variation in the results, some participants had extremely high water savings, some no water savings and even a few had an increase in water usage compared to historic water usage. Some of the variability could be explained, for example, due to abnormally high water use when a participant added sprinklers, improper controller settings, etc. However, not all of the variability could be explained and rather than arbitrarily leaving out some data, the data from all the participants was included in the final result calculations. Additional years of data would likely help remove some of the variability, especially in the northern California studies where the controllers were installed after the irrigation season had started. However, as the above results indicate, when averaged across all data, the Aqua ET Controllers did provide substantial water savings.

Based on the results from these studies, homeowners who install an Aqua ET Controller can expect an average water savings of from 7% to 25%, with two of the three studies indicating 21% to 25% average water savings. Additionally, Water Districts whose customers install Aqua ET Controllers can expect a significant reduction in water demand. Combining all three studies, 74 users saved 2,490,000 gallons (7.64 acre feet) of water in one irrigation season. This averages out to 0.10 acre foot savings per customer or 1 acre foot annual savings for every 10 customers who used the Aqua ET Controller. In the Denver Water study, just 37 customers provided a 4.37 acre-foot reduction in water usage. During 2002, with the severe drought conditions that occurred in the Denver, Colorado area, if all the Denver Water customers had installed ET Controllers the water shortage would likely have been far less severe.