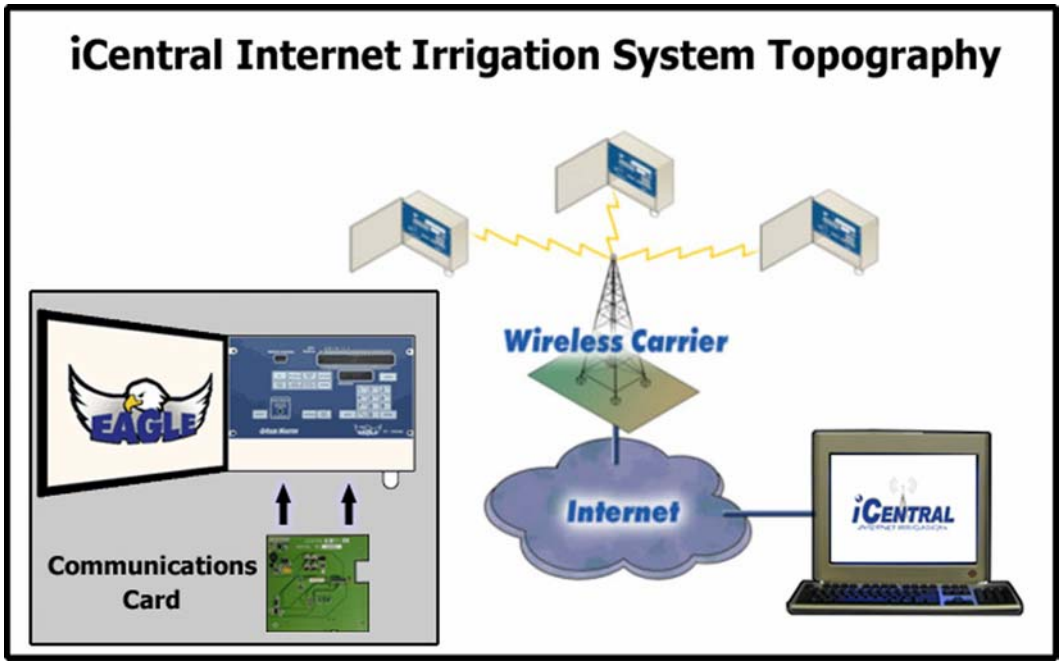
WHY SMART WATER APPLICATION TECHNOLGY MAKES SENSE!



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ABSTRACT

Today more than ever it is important that we all do are part to conserve our planets most precious natural resource… water. This white paper presents the case for water conservation using modern smart water application technology (S.W.A.T). It describes the types of modern technologies available to achieve the goals of reducing water use and discusses the associated benefits. The white paper also includes case studies of homeowner's associations, municipalities, school districts and parks departments who are currently utilizing these tools to document the benefits of using intelligent irrigation controllers.

A new era in landscape irrigation has arrived. The decreasing cost of technology including the adoption of the Internet and wireless communication technology will significantly accelerated the advancement of irrigation management water conservation and labor savings. The management tools discussed include: central control systems, Evapotranspiration (ET) based irrigation scheduling, flow sensing and two-way radio and/or wireless connectivity devices.

INTRODUCTION

Water conservation is an increasingly important world issue; the key benefits of which are environmental, financial and societal. As an issue, water conservation is prevalent in the Sunbelt states, where both water supply and costs are particularly important. As such, progressive cities in Sunbelt areas have begun implementing policies and installing equipment to encourage water conservation. While various studies forecast some type of dwindling of water resources in the years ahead if conservation measures are not set in place right now, regulations arising from regional droughts are driving landscape water users to more targeted, efficient systems both in residential and commercial applications where usage is nearly equally divided. Environmentally conscious landscape architects, designers and contractors must increasingly take water conservation into consideration for environmental and cost saving reasons.

City and state governments are increasingly turning to legislative measures and mandates to preserve supply and prevent over-watering. According to Dave Zoldoske, Director of the Center for Irrigation Technology at California State University, Fresno, "There is tremendous interest by water purveyors to save water and improve control systems."

In the Sunbelt states, e.g., Texas, California, and particularly those states with large agricultural communities like the San Joaquin Valley, water is one of the most precious resources available. While agriculture is a major user, large volumes of water are also funneled to large metropolitan areas such as Los Angeles, CA.

Advances in irrigation technology and efficiency together with increasing costs and legislation are answering the growing consumer need for both water and labor saving systems. Indeed, costs and regulations are the two forces rapidly changing the irrigation of landscapes. While the price of water varies from community-to-community and

region-to-region, the price is not falling, particularly in the Southwest where water is scarce. For example, pending legislation in California may require non-potable water be used for landscape irrigation.

The biggest advances in irrigation technology are emerging within irrigation system controllers – the brain of the system. Controllers have evolved from motorized, master hydraulic valves that powered a series of pressurized valves to electromechanical clocks and, most recently, to microcomputer-based clocks. Although experts have suggested the controller market is still in its infancy, the coming of age of today's modern irrigation controllers appears to be near arrival with increasingly more affordable, centrally controlled, remote-controlled systems and weather-based scheduling through two-way communications.

It is inevitable that central control will increase in popularity as irrigation contractors look for more accurate and timely ways for clients to supply their landscapes with water. Indeed, even if a controller is locked in a client's storage shed or garage, the contractor will be able to remotely access the controller from anywhere, using any type of access device. And remote access will provide the contractor with the same opportunity to perform any number of tasks: troubleshooting, winter system blowout, spring start-up or other types of general maintenance.

As the concept of on-site remote control evolves, the use of GPS satellite, fiber optics or modem, and new system control models that can connect any wireless or Internet-enabled device to the brain of the irrigation system are emerging. In this way, contractors could use a computer in their office to run, test and troubleshoot hundreds of different sites. Not only that, similar to systems already in use on golf courses, centralized controllers can be connected to a weather station to monitor natural precipitation, ET rates, temperature and wind in order to make adjustments to the irrigation programs at individual sites.

A state-of-the-art irrigation system can deliver these benefits:

1. Calculate the evapotranspiration loss, which occurs since the last irrigation cycle;
2. Control each sprinkler head relative to the quantity of water applied and the duration of the application, to replace the lost water;
3. Apply water at a rate that will prevent runoff;
4. Regulate pressure at each head to get maximum uniformity of water distribution;
5. Allow the field staff to make site adjustments to compensate for shade, slope, sun exposure (relief), etc.

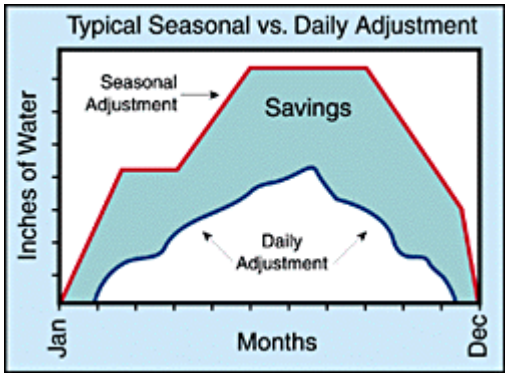
Today's landscaping project can include any of the following irrigation components to create a state-of-the art irrigation system capable of applying water where it is needed and in the amount desired:

1. On-site weather station;
2. Central control irrigation system;

3. Field control satellites;
4. Valve–in-head sprinklers with pressure regulating valves;
5. Valve control wire running from each head to the field control satellite.

The primary benefit of a central control system is the water savings. Water cost savings alone can reach 20% to 45% percent annually with a central control system and an efficient proactive management program. Importantly, return-on-investment in a central control system is possible in 1 to 5 years depending on water costs and current irrigation practices. Naturally, the higher the water cost and the less efficient the current practices, the faster the return.

Using input from a weather station or other sources of evaporation data, irrigation schedules can be automatically adjusted, at any time, to replace only that water used by the plant material or lost to evaporation, thus, significantly reducing water use. In addition to the ability to set efficient watering schedules, central control can immediately shut down a single valve or multiple irrigation systems in the event of rain, mainline breakage, or other emergency. This feature alone can save thousands of gallons of water and avert the additional costs incurred in replacing ruined landscaping.



The chart above shows typical irrigation scheduling over a 12-month period in the Sunbelt region of the United States. The "Seasonal Adjustment" indicates adjustments an individual may make throughout the year based on their best judgment. The "Daily Adjustment" shows the adjustments made by the computer based on actual or historical requirements. The difference, labeled "Savings," represents what can be attained with central irrigation control.

Although water savings is the most readily apparent benefit, the central control system is actually an ideal environmental management tool that provides several additional direct and indirect cost savings. In addition to the water, labor and financial savings, there are enormous potential savings in landscaping costs alone. These technologies will help to efficiently reapply water to match the turf's ET usage. They will also maintain a desirable moisture balance within the root zone of the turf areas doing much to prevent the leaching of excess fertilizers and pesticides.

Over-watering can lead to soluble nutrients leaching beyond the root zone thereby predisposing the turf to fungi disease, soil compaction, weed invasion and more. Conversely, the application of too little water results in tissue and cell damage due to desiccation and salt accumulation (concentration) further magnifying the impact of low soil moisture and predisposing the turf to damage from wear, disease, insect and weed invasion.

Case Study

After spending three years and more than $1 million on ET controller pilot studies, Irvine Ranch Water District (IRWD) has proven the benefits of its system. The first extensive study done by the IRWD showed they saved 85 percent of the potential water to be saved in a 40-home test.

The results of the IRWD pilot studies have been impressive:

- 16% average reduction in landscape water use;
- 97% of users found the controller technology convenient;
- 97% of users described their landscape appearance as improved or stayed the same;
- 85% of the users saved water costs;
- 85% of the potential over-watering was saved.

Similar results were seen at other pilot studies throughout the West.

Central Control

The purpose of a central control system is to allow a centrally located computer the ability to automatically program and control all aspects of field irrigation controllers, regardless of their location. When combined with weather sensing instrumentation, the central control system can determine the daily ET rate, and adjust irrigation schedules appropriately by downloading new irrigation programs to the field controllers (called satellites) every day. Water savings can therefore be achieved by precisely computing the amount of water that plants require (as a function of weather, soil conditions, plant type, etc.) In addition to central control of irrigation, the system can also determine when maintenance related activities must be performed, i.e., replacement of broken pipes, station field wiring, etc. Another problem managed is irrigation water runoff, which can be very destructive to asphalt. Central control enables such precision irrigation management that runoff and "puddling" are vastly reduced saving streets from premature repairs and resurfacing.

One of the many benefits of a central control system is the ability to monitor water flow on a minute-by-minute basis. Non-scheduled, manual use of the system can be monitored as well. Once water budgets are created, the system can compare actual usage to the budget and then fine-tune the irrigation system to obtain optimum water savings.

Case Studies

In northern California, the city of Livermore is an ideal example of the positive effects of adding central irrigation control. In 1995, the city had survived the disastrous effects of a drought and had even averted severe water rationing. However, city officials knew it was just a matter of time.

Ed Murdock, Director of Public Works for Livermore, prevailed in his quest to slowly change over the City's irrigation control to a centralized computer monitoring system. Today, 122 of their 295 field controllers (41%) are part of the central computer system while 173 are stand-alone controllers. Areas placed under computer control include the street median strips, landscaping surrounding the public sidewalks, small city parks, and the special assessment districts, which are also under city control.

Murdock described the daily, weekly and monthly tasks of three irrigation workers who maintained the manual system in these three areas – the parks, median strips and lighting and landscape districts. "Prior to 1995, one person was responsible for each area, and regularly checked the controller operations, valves, heads, fixed current problems and assessed potential problems," explained Murdock. "These walkthroughs each took over 6 to 8 hours to complete … then it would start all over again. As a result of our central irrigation computer, these system checks now take less than 35 minutes and we don't even leave the office. Every evening at 6 p.m. we contact the weather station and download the data by 8 p.m., which is then sent out to the 56 field controllers for nighttime watering. At 6 a.m. the computer polls each of the 56 field units for a report that is much more detailed and accurate than what a brief personal look–through could possibly produce. We upload data from each of the 56 controllers asking for a status report concerning the previous night's irrigation activities. From the morning reports, the staff looks for high and low flows for pipe, valve or head breaks, and check electrical current to each valve for solenoid operation. From this information, we create our daily work orders for the staff by 7 a.m."

According to Murdock, the city now has a time and cost effective irrigation operation. In fact, the new central control system has gradually reduced the City's water consumption and provided some unexpected and very positive benefits. In water savings alone, the comparison of the month of June 1999 to the month of June 2000, consumption was reduced from 8,000 CCF of water to only 5,400 CCF. This is proof of huge savings.

In the City of Los Angeles, the threat of rising water rates pushed Rick Cole, Operations Manager of Bel Air Crest, to reduce his community's water usage. As manager of this 500-acre property with almost 300 homes nestled in the Sepulveda pass between Westwood and Sherman Oaks the installation of 21 controllers running 36 stations reduced their volume of water usage in dollars spent by 46% over the same base period in the prior year. "This system was a considerable investment of around $150,000 even for an upscale residential community like ours," recalls Rick Cole, "but the payback period was less than 3.5 years, which made a lot of sense to our board once I could demonstrate this to them."

Randal Ismay, Bel Air Crest's current water and landscape consultant, said, "Other features have saved us a great deal. Having a central control system saves them time. Bel Air's maintenance crews now make much less frequent trips through the community to investigate line breaks and the repair savings alone from blowouts on lines and valves have been significant. Prior to installing their current system that they would cover the entire property in 2-3 weeks looking for problems and then repeat the cycle. Now, they inspect the site every 4-5 weeks and can get through it in 7 days, saving them man hours that can now be used elsewhere."

Manual shutdown of large landscaped areas during the rainy season can take several days to accomplish. For example, in a community with 300 controllers, at 20 minutes per controller, it would take 12.5 days to adjust them all. With central control, schedule changes can be done in minutes and shut downs done in seconds.

In California's City of Aliso Viejo the board of a 45,000 resident community association placed in service a central control system from which calculations were made on the labor savings achieved from their investment. Estimates of their labor savings over a three-year period were calculated to reach $768,000 based on the reduction in crew time spent making inspections for leaks, scheduling adjustments, and traversing the grounds to turn off controllers during rain shutdowns. The payback on an almost $1.2 million investment was 1.5 years.

Manipulating all of the individual irrigation schedules from a central computer eliminates the need for a person or persons (often an entire crew) to make manual adjustments at each controller. This is especially efficient when it rains. Depending on the size of the landscaped areas, the time required to visit each controller on a weekly basis alone can be considerable. Making daily changes, in most cases, would be impossible.

ET-Based Control

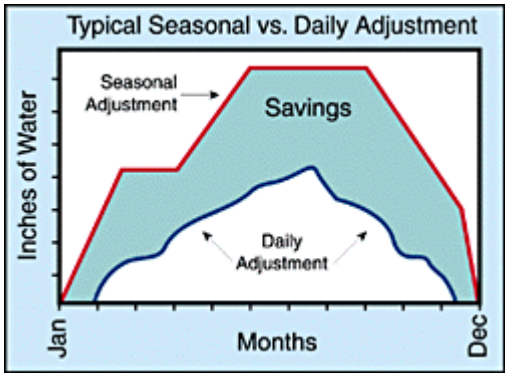
While weather station-based technology has become widely used in agricultural and golf course irrigation scheduling throughout the United States, its use in the residential and commercial landscape markets continues to be very limited. This is likely to change as water utilities begin to take advantage of new technologies that link weather stations, computers and pagers with irrigation controllers – eliminating water waste and replacing it with ET-based irrigation management. For the irrigation industry and the end user, it means a paradigm shift in the way we irrigate our landscapes. The timing could not be better. With more restrictions around the country that limit landscape irrigation during times of drought, the irrigation industry often finds itself at odds with state and local water authorities.

"The only thing more confusing than programming a VCR is programming a water sprinkler controller" said Adán Ortega, Jr., Vice President for External Affairs, Metropolitan Water District for Southern California. "The opportunity to capture the most savings relative to your water scheduling occurs during the transition into the fall and winter seasons. The consequence of not knowing how to adjust watering schedules, particularly in the fall and winter, costs the [Los Angeles] region billions of gallons in wasted water," Ortega said. "It also washes more urban waste – like pesticides and herbicides used on our gardens – onto our beaches and into our oceans, said Ortega." Ed Thornhill, Metropolitan Water District conservation expert agreed, adding this: "Based on weather conditions, we should, on average, only be using a third of the water to irrigate our plants in the fall than in the summer."

"ET", or reference ET, is one of the most important issues to consider when scheduling run times for an irrigation system. The key problem is the low awareness of ET or its impact relative to landscape irrigation. However, ET is a simple concept that offers many benefits. ET is the combination of water that is evaporated and transpired by plants as a part of their metabolic processes. "Historic ET" is the amount of water needed in a year of average weather.

The following graph illustrates this concept. The white area labeled "plant water need" represents Historic ET. Notice that as the days get longer and warmer from March to July, ET, or the plant's need for water, gradually increases. The shaded area represents a very common, but incorrect watering practice, where the irrigation system is turned on full bore around March when rain usually ends. The system is then left running for peak summer water needs until well into the fall when it begins raining again. In the fall, the afternoons may be warm in the Southwest, the days are much shorter and the growing season is ending for most plants. Therefore, plants need much less water. In order to efficiently irrigate, the system must be readjusted to match the actual plant water need curve shown on the chart.

Chart 1. ET-based seasonal adjustment vs. seasonal irrigation schedule adjustments



The benefits of ET-based control for irrigation contractors are as follows:

- Accurate and automated watering schedules are delivered based on climate
- Seasonal and weather-related schedule changes are ensured
- Landscape over-watering end; providing a public relations tool for irrigation
- Contractors are freed from controller scheduling changes
- It provides a partnership between water utilities and irrigation contractors
- Additional revenues for new product installations are possible
- Brings to light poor irrigation designs, providing sales opportunities to install systems with high distribution uniformity
- New opportunities for irrigation systems repairs and enhancements are provided
- Ends "five-day watering schedule" mentality during periods of drought
- Decreases water bills for customers

ET Case Studies

The City of Davis has one of the smartest irrigation systems around and one of the first of its kind in California. It's literally saving millions of gallons of water a year as well as staff time in the City's Parks and Community Services Department. The City's Central Irrigation Control System (CICS) is computer controlled, and responds to information from local weather stations. Using the information supplied from California Irrigation Management Information System (CIMIS) – a network of state-operated weather stations that measure ET – they were able to reduce their water usage by 40%.

"Ten years ago, the City of Davis had sprinkler controllers very much like many people have at their homes, "said Bob Cordrey, Parks Administrator for the City of Davis. "If the power went down, they had to be reset. Whenever the watering schedule changed, they had to be reprogrammed, station by station." The City started phasing in the Central Irrigation Control System in 1991. Today, there are about 100 of the radios connected to their central control stations.

In 1990, The City of Sunnyvale installed a central control system with one weather station and over 70 irrigation controllers. Today they have four weather stations online and manage over 100 irrigation controllers. Before these weather stations were put into place, they were using 72,000 cubic feet of water a year. Since then they have been able to reduce their water usage to 43,000 cubic feet annually, a savings of 40%.

Western Oregon University does not meter water use, however ET data was collected for 110 days during the irrigation season from May 1 to Sep 30 from their weather center station. Using the average ET and dividing it by the reference ET revealed that the basic ET feature automatically adjusted runtimes to use only 71.25% of the base schedules. This means they reduced their water use by 28.75%.

Flow-Sensors

Flow sensors are devices that measure actual flow rates and report them back to a data logger or in some cases directly to the irrigation controller. When used directly with an irrigation controller, flow sensors can monitor individual station flow rates as well as mainline flow rates.

The sensor uses a magnet and reed switch combination to send a pulse signal to the electronics that is proportional to the water flow. This pulse is then converted to a flow measurement in the electronics. The flow sensor is available with a variety of options such as sensor and electronics in a single package to installation of the sensor remote from the electronics.

Flow sensors can be even more useful when used along with a central control system due to the ability of the central system to calculate irrigation schedules based on actual flow rates. This allows system users to manage even the most complex watering constraints involving, limited water supplies, watering times and pump management.

The advantage of flow-sensing control stations is that they measure the duration and quantity of water flowing through the system. If too much water is going through the irrigation system, flow sensors provide the central control system with information enabling staff to spot any discrepancies from anticipated results helping staff locate broken sprinkler heads, cracked pipes, worn out valves, etc.

One of the most troubling (and expensive) losses of water is a system leak. Often, leaks that occur underground can take several months or even years to detect. Leaks of 5-25 gallons per hour may go undetected altogether but they add up to a substantial dollar loss over time. Automatic system flow monitoring can detect leaks in just minutes, potentially saving significant amounts of water and money.

Finally, broken pipes and heads can result in costly soil erosion, wasted water, and more importantly, a public liability of incalculable cost. Central control systems can automatically shut down portions of a system when excess water flow is detected, and warn system operators that a problem exists. Breakages such as these often occur several days before maintenance crews notice them.

Case Study

The City of Sunnyvale in California was able to reduce their water use, lower costs and improve safety substantially over the past several years. “We cut our water use for median strip irrigation by 40 percent resulting in a savings of about 12 million gallons a year of water” said Larry Iaquinto, Sunnyvale Urban Landscape Supervisor. “At one central location, we can now keep track of all our remote sprinkler systems, turn them on and off, and watch for unusual flows which indicate leaks or broken plumbing. The most important savings, however, are the reductions in the exposure of risk, both to our crews working in the streets and to the public driving by the medians. Since installing our

central control system, we saw citizen complaints about sprinkler water in the streets go down by 72 percent. That's a solid indicator that the remote control system is doing its job."

CONCLUSION:

Smart Water Application Technology makes sense and pays for itself. Central control, weather-based information from weather stations, flow sensing capabilities, and two-way radio and wireless technology will make the future of landscape irrigation greener for all. As with many industries, the power of the Internet combined with ubiquitous wireless communication devices like cell phones, pagers, etc. are propelling these changes. As technology and water conservation continue to drive changes in the landscaping industry, consultants, contractors and specifiers will need to become familiar with the irrigation products of today's manufacturers to meet the changing requirements of water purveyors and water users. Widespread familiarity with today's technological capabilities will fuel demand for these products, which in turn will drive prices of the technology to more affordable levels for commercial and residential users. Landscape professionals selling and/or installing these products along with their end-users will be rewarded for savings costs and having greater control and flexibility over their systems, as well as improving their landscape and saving the environment.

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About the Author: Jonathan A. Goldhill is the Principal of Jonathan Goldhill & Associates; a Woodland Hills California based business consulting practice assisting small businesses and entrepreneurial companies with strategy, business planning, and marketing advice. He has spent the past few years providing consulting services in the irrigation industry.