

## **Abstract #1242**

### **Managing the Art and Science of Agricultural Irrigation Scheduling.**

El Dorado Irrigation District (EID) is a water utility serving the nearly 100,000 residents in northern California's El Dorado County. A scenic drive along Highway 50 heading east from the Sacramento County line to South Lake Tahoe, takes you through the heart of EID's service area and gives you an overview of the extraordinary geographic diversity of the region.

EID was formally organized in 1925 under California's Irrigation District Law (Water Code §§ 20500 et seq.). EID hold water rights that date back to the gold rush days, and continue to work on securing and maintaining a reliable water supply to meet the growing needs of our customers. Through negotiations with the U.S. Bureau of Reclamation, EID acquired Jenkinson Lake at Sly Park in late 2003. The district has water service contracts with the Bureau and a water right for diversion from Folsom Reservoir that was awarded in 2001 by the State Water Resources Control Board. And EID's recycled water, agriculture irrigation management and water efficiency programs help our customers conserve water and thus contribute to the overall water supply.

Today, EID's facilities and delivery infrastructure for drinking water include 1,200 miles of pipeline, 40 miles of ditches, 6 treatment plants, 33 storage reservoirs and 21 pumping stations. The wastewater treatment system operates 58 lift stations, 300 miles of pipeline and 5 treatment facilities. The El Dorado Hills and Deer Creek wastewater treatment plants produce 2,500 acre-feet of recycled water each year — water that is used to irrigate front and back yards at 1,700 homes as well as commercial and public landscapes. EID estimate these numbers will more than double in the coming decade.

EID customer needs are as broad ranging as the area's diversity. The district provides drinking water for homes, schools and businesses and recycled water from wastewater treatment plants to irrigate front and backyards and public landscapes. EID operate a hydroelectric power project that includes dams, reservoirs and 23 miles of flumes, canals, siphons and tunnels. Further, EID owns and manage several outdoor recreation sites, including Sly Park Recreation Area near Pollock Pines and a 48-unit campground at Silver Lake. In all EID does, the district strive to meet or exceed federal and state standards for water quality, environmental protection and wildlife habitat.

EID's agricultural customers farm over 3,500 acres. Topography limits the size of the commercial planting which range in size from 0.25 acres to over 25 acres. Nearly all of the holdings are family managed ventures. The Apple Hill Growers Association is located in the middle of the EID. Commodities grown in the area include, but not limited to, citrus, avocados, stone fruit, pome fruit, hay, grapes and Christmas trees. Irrigation water requirements for the various commodities range from 48 inches per acre for

peaches grown at low elevation on south slopes to 6 inches for Christmas trees grown at higher elevation on north slopes.

California experienced a severe drought in 1976 and 1977. Nearly one half of Jenkinson Lake's holding capacity was consumed during the summer of 1976. As a result the United States Bureau of Reclamation (USBR) required EID to implement a water conservation program. Thus the EID Irrigation Management Service (IMS) was developed.

The IMS program (the first of its kind in California) was developed through a collaboration that included EID, USBR, University of California, Davis, Soil Conservation Service, UC Cooperative Extension, El Dorado County Farm Advisor Office and Grower Associations. The IMS program was developed to answer the questions "How often do I irrigate" and "How much water do I apply." To answer these questions the three basic functions of the program were determined to be: 1) Sprinkler evaluations to determine the time required to replace depleted water, 2) Determine the amount of water required to refill the soil profile at any time and 3) Provide irrigation scheduling.

In 1977 a study was initiated to determine the growing practices and needs for commercial agriculture customers found within the EID service district. Three growing seasons were spent determining the evapotranspiration (ET) rates of all commodities, cover crop practices and evaluating irrigation systems. From these studies a multiple commodity irrigation scheduling program was developed to achieve more crop per drop.

In 1984 a report was filed with the California Department of Water Resources. This report documented the annual conservation of >2,000 acre feet of water through the IMS program. The report further showed that the irrigation efficiency went from 50% to over 80% and the average irrigation dropped from 6 inches to 4 inches. Overall the IMS program saved 2 irrigations per growing season. In addition the growers noticed the reduction or absence of tail waters as well as the disappearance of a few springs.

Irrigation scheduling in the Sierra Nevada Foothill is very complex problem. This is due to multiple microclimates, soil types, irrigation techniques and commodities. Multiple microclimates are the result of slope, exposure, elevation and wind patterns. An example of this is seen in the precipitation amounts which range from 25 inches per year at the west edge of the county to over 50 inches per year near Pollock Pines. This requires site specific ET rates to be developed from weather information and site specific crop curves.

Commercial crops are currently being grown on 38 soils types as classified by the Soil Conservation Service for El Dorado County. This results in different field capacities and refill points. This combination produces different Allowable Depletion for the various commodities. Therefore a site specific Managed Allowable Depletions (MAD) is required.

Irrigation techniques used are as varied as the growers using them. Practices include overhead (200 gallons per hour, gph), undertree, portable, microspray and drip (<1 gph). In addition practices change over time as new techniques are developed. This requires site specific sprinkler evaluations to allow run time predictions to achieve refill.

Further crop management goals must be known to help the grower achieve the quality of fruit required for his buyer. At the initial stages of the IMS program most of the crops were pome fruits (apples and pears) with a constant MAD through the growing season. Since then the growers have diversified to include stone fruits, nut crops, blueberries, nursery stock and wine grapes. Current practices for wine grapes include deficit irrigation to improve quality. Deficit irrigation practices require changes in the MAD depending on the development stage of the berry. The result is changes in the run times for the predicted irrigation events.

Initially there were over 90 growers participating in the program with over 300 sites being monitored on a weekly basis. It was determined that the only way to handle all of the data was to make this program effective was to utilize a computer program. Initially the WMC (Water Management and Conservation) computer program from USBR was used for the irrigation scheduling prediction. The program was contained on two 5.25" floppy and run on an Apple IIE computer. Weather data had to be entered as well as the weekly water depletion. The program was limited to predicting the water depletion for the next two weeks. This program was used effectively for over 20 years.

EID determined that the prediction software needed to be updated before the start of the 2005 growing season. A survey of the current software revealed that all of the programs could meet only part of the IMS needs. TruePoint Solutions was contracted to produce new prediction software to meet EID's needs. Within two months EID went live with True Irrigation Scheduling Management (TrueISM).

The goal for TrueISM is to promote and advance effective agricultural water management. The program was developed to provide the mechanics of scientific irrigation management in a straightforward and easy to use package. TrueISM is deployed on the service oriented architecture platform utilizing the most current .NET technology that delivers interoperability, scalability and flexibility.

Initially site specific crop curve and sprinkler efficiency are entered into the program. Weekly soil moisture levels are entered into the program. The program then utilizes a variety of data collected from weather stations, tensiometer, neutron probes and individual site details (crop type, soil type, etc) to measure the soil-water content and predict irrigation schedules. The program will generate irrigation reports that can be automatically sent to the participating growers. The report contains site specific information (historical weather, predicted ET, soil-moisture inspections, irrigation events and irrigation schedules) for each site that the grower is monitoring.

A majority of the TrueISM functions are automated which reduces the amount of time need to update the program. This includes daily weather station data. The weather data

can be viewed in either a tabular form or a graph form. In addition, the weather data is color coded to quickly identify any quality control flags associated with the data. The EID program is utilizing data from Station #13 of the California Irrigation Management Information System (CIMIS) to provide daily ET calculations. With this data the program automatically updates the prediction schedule. Currently all of the predicted irrigation events are calculated through the 2016 growing season.

TrueISM stores an unlimited amount of irrigation history that can be used for historical trending and analysis. This historical data will help EID plan water needs for the future years. This data can then be used for drought year(s) irrigation needs and potential water sales to other utilities during wet abundance.

Currently there are 91 growers with 291 sites participating in the IMS program and TrueISM has greatly increased the effectiveness and efficiency of the program. Initially the IMS program was developed as a water conservation program, but it has matured into irrigation water efficiency program. The implementation of the TrueISM program will assist EID to increase the efficiency of irrigation management to everyone's benefit.