MEMORANDUM

TO: PHIL ISENBERG, AND THE FULL DELTA STEWARDSHIP COUNCIL

FROM: PETER H. GLEICK, PACIFIC INSTITUTE, OAKLAND (PGLEICK@PACINST.ORG)

SUBJECT: ADDITIONAL INFORMATION SUBMITTED FOR THE RECORD FROM APRIL 15, 2011 HEARING

DATE: 4/22/2011

CC: JOE GRINDSTAFF

Thank you again for the opportunity to provide comments to the Delta Stewardship Council on April 15, 2011. During questioning at the hearing, and in email requests subsequent to the hearing, Council members asked for additional information or raised additional questions. Council Member Randy Fiorini appeared particularly interested in the number of acres under each irrigation method for the various crops found in California and progress in improving efficiency; Chairman Isenberg asked for additional information on the possible rate of efficiency improvements. Here, I would like to provide additional information for the Council's consideration on two issues raised at the hearing and to correct some of Mr. Fiorini's misimpressions about facts and data related to:

1. Actual use of efficient irrigation technologies in California; and

2. The potential pace and speed of improving efficiency of water use.

ACTUAL USE OF EFFICIENT IRRIGATION TECHNOLOGIES IN CALIFORNIA

As noted in my original comments, the use of irrigation technologies in California varies substantially by crop type (Figure 1) and region (Figure 2). Drip and sprinkler systems are increasingly common on orchards and vineyards, but penetration rates of these efficient technologies are not as high as some commonly believe. For example:

Randy Fiorini (at approximately minute 47:30 on): "Every acre I farm is under drip or microsprinkler irrigation… It is my experience throughout the industry that that's the case. There's not really a whole lot left."

Not every farmer is as innovative or efficient as Mr. Fiorini. And while more up-to-date data are needed, the most recent comprehensive statewide survey of irrigation technology indicated that substantial areas of orchards and vineyards are still using flood irrigation (around 20%) (Orang et al. 2005). Flood irrigation is employed on a far higher percentage of vegetable and field crops, with more than 40% of vegetable and 80% of field crops still using this method. As Figure 1 notes, these data are for 2001 – the most recent survey conducted by DWR. We strongly urge that DWR conduct a new survey – the cost is low and the need for good data is critical.

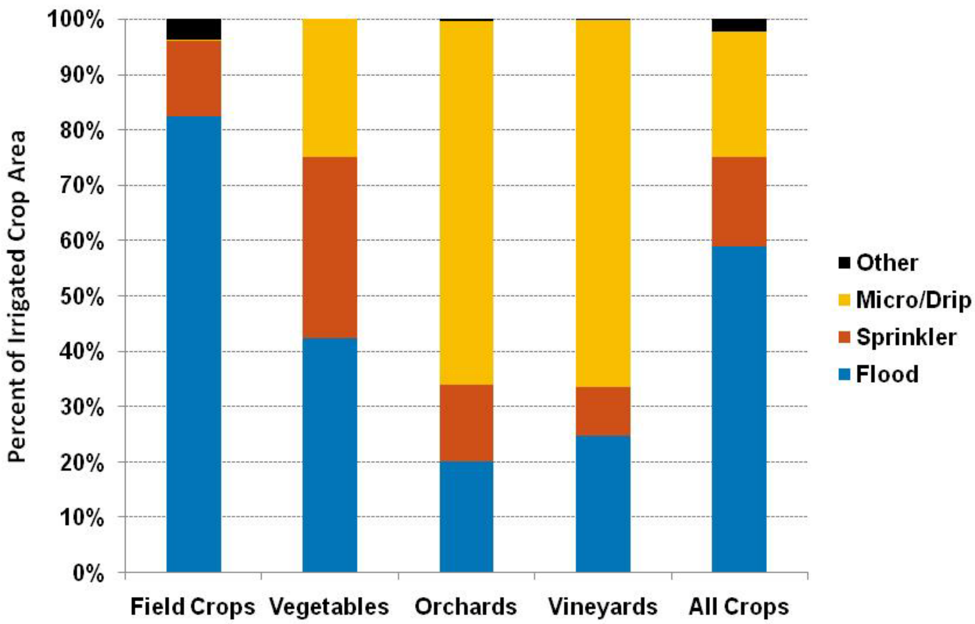

Figure 1. Irrigation Technology by Crop Type, 2001

Source: Based on data in Orang et al. 2005. Note: These data are based on the most recent DWR statewide survey conducted in 2001 and published in 2005. "Other" includes subsurface irrigation where underground pipes or open ditches are blocked to force water into a crop root zone.

There are also important regional differences in the irrigation methods employed throughout California. Figures 2 shows field crop acreage by irrigation method for each hydrologic region in 2001. Separate figures are shown for vegetables, orchards, and vineyards (Figures 3, 4, and 5). For all crop types, there is more acreage using flood irrigation in the San Joaquin River and Tulare Lake hydrologic regions than in any other region throughout the state. As the Pacific Institute clearly states in our reports, some crop types can only be grown effectively and economically using flood irrigation. But nearly 300,000 acres of vineyards – largely appropriate for sprinklers and drip systems – are still grown using flood irrigation in the San Joaquin River and Tulare Lake hydrologic regions. In comparison, fewer than 4,000 acres of vineyards in the rest of the state are grown using flood irrigation. Of all regions in the state, the Central and South Coast hydrologic regions have the least amount of acreage using flood irrigation. The Colorado River hydrologic region still has a significant field and vegetable acreage under flood irrigation, but has largely converted what little orchard and vineyard acreage they have to drip irrigation.

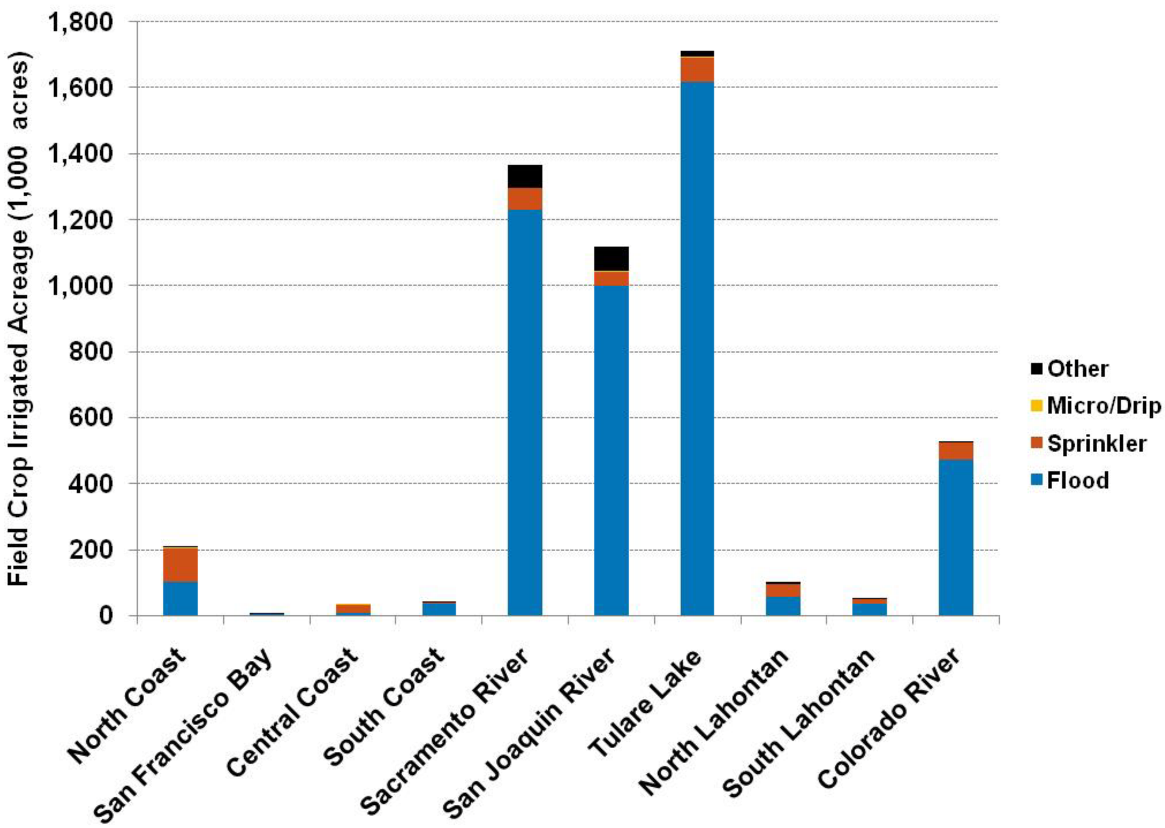

Figure 2. Irrigated field crop acreage by irrigation method for each hydrologic region, 2001
Source: Based on data in Orang et al. 2005.
Note: "Other" includes subsurface irrigation where underground pipes or open ditches are blocked to force water into a crop root zone.

Figure 3, it is worth pointing out, addresses the discussion during the April 15 panel around the irrigation methods used on vegetable acreage, including tomatoes.

Mr. Fiorini asked me (at approximately minute 49:45 on the podcast) "Are you aware of any tomatoes that are grown that aren't on drip tape" and then stated "I'm arguing that most are."

Mr. Fiorini's perception is not supported by the data, though as we note above (and as I noted in my original testimony) better and more up-to-date data are needed. This issue was addressed specifically by Orang et al. (2008): that report evaluated the portion of both fresh and processing tomatoes under different irrigation technologies. I would like to submit for the record that **the most recent data available from DWR indicated that 61% of fresh tomatoes and 68% of processing tomatoes in the state are still flood irrigated** (Orang et al. (2008), reported on p. 98, Table 3).

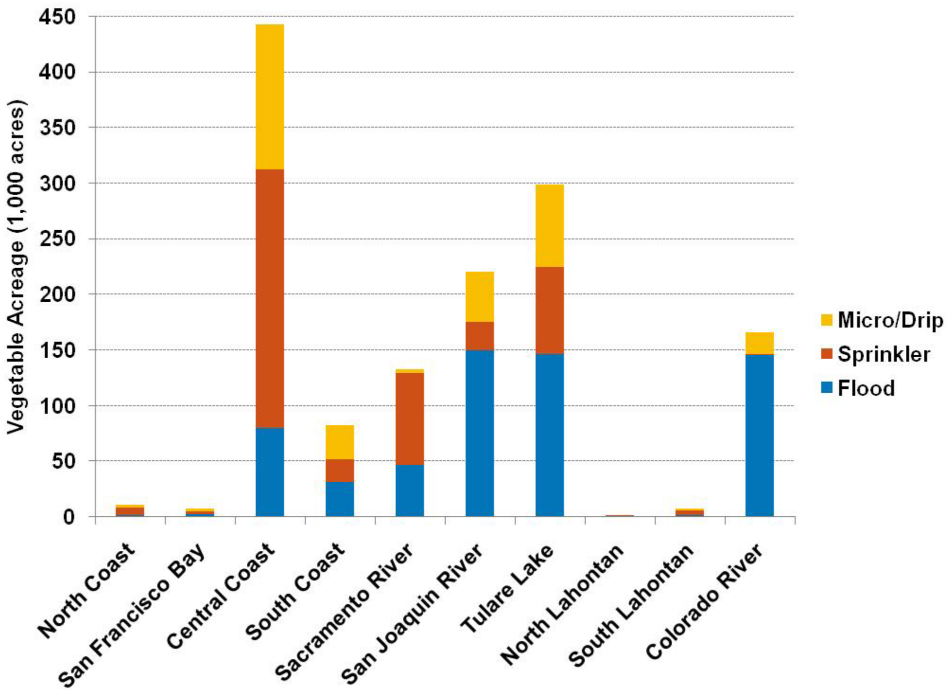

Figure 3. Irrigated vegetable acreage by irrigation method for each hydrologic region, 2001
Note: "Other" includes subsurface irrigation where underground pipes or open ditches are blocked to force water into a crop root zone. Source: Based on data in Orang et al. 2005.

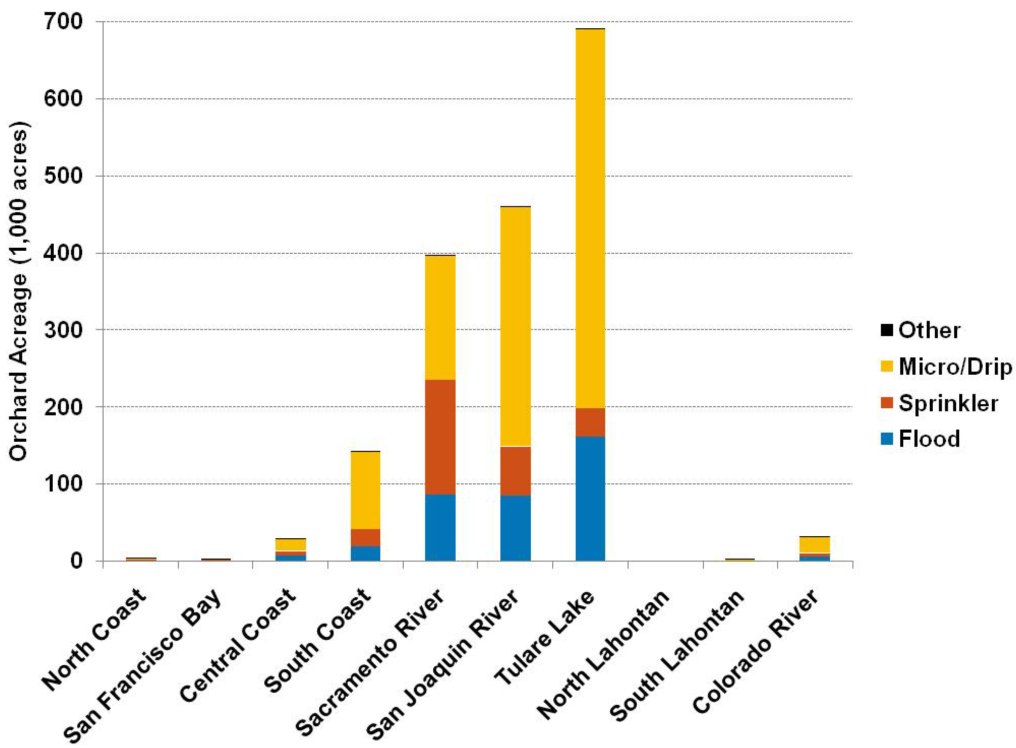

Figure 4. Irrigated orchard acreage by irrigation method for each hydrologic region, 2001
Note: "Other" includes subsurface irrigation where underground pipes or open ditches are blocked to force water into a crop root zone. Source: Based on data in Orang et al. 2005.

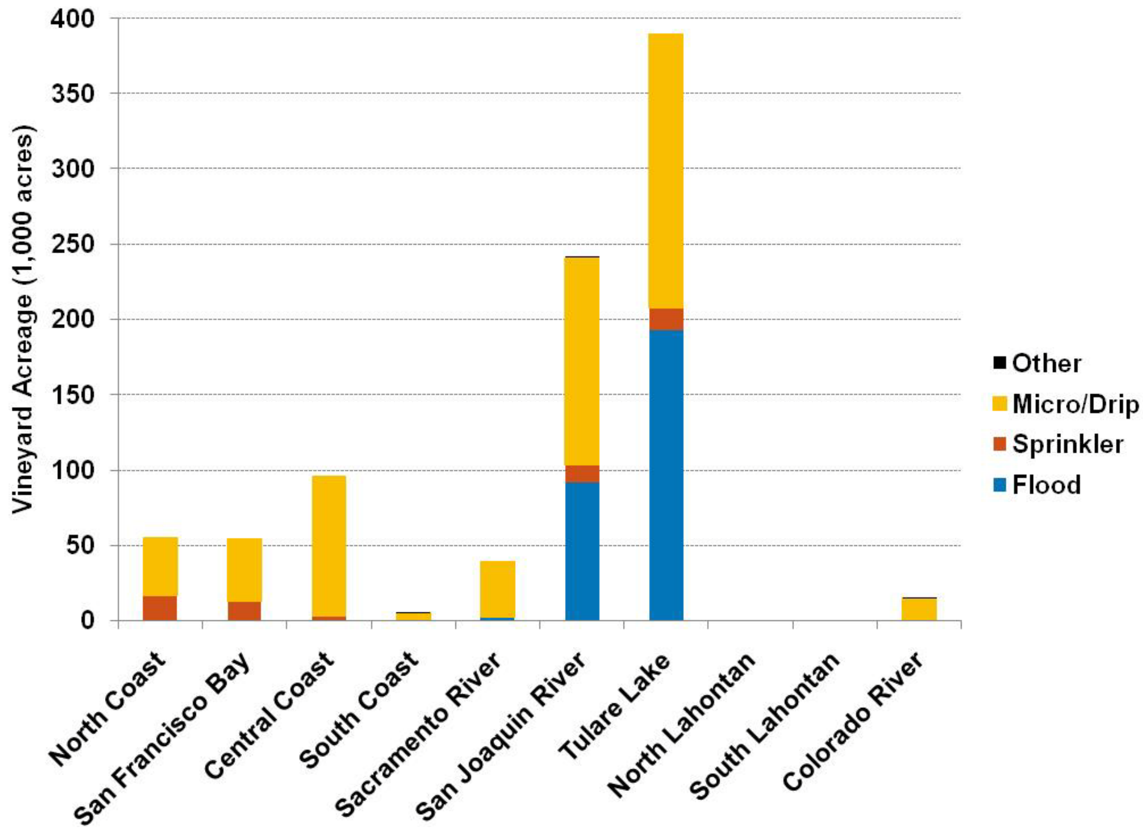

Figure 5. Irrigated vineyard acreage by irrigation method for each hydrologic region, 2001
Note: "Other" includes subsurface irrigation where underground pipes or open ditches are blocked to force water into a crop root zone. Source: Based on data in Orang et al. 2005.

The use of drip systems has very likely increased since the DWR survey was conducted in 2001. Farmers, for example, are increasingly using drip on a growing number of row and field crops due to the production of drip tape and GPS-guided tractors. Unfortunately, more recent statewide data do not exist. We strongly recommend that more frequent and more comprehensive surveys of irrigation methods be conducted (the survey should be completed every 5 years at a minimum and collect more detailed information on irrigation management practices, about which we know very little). At an estimated cost of only $10,000, these surveys provide valuable information about the pace of conversion and the effectiveness of various policy interventions.

Irrigation technologies, however, are only methods to distribute water, not measures of efficiency. A recent University of California Cooperative Extension study, for example, showed that vineyards using drip irrigation systems varied widely in the amount of water applied per acre (from 0.2 acre-feet to 1.3 acre-feet), suggesting that management practices are an important determinant of applied water (Lewis et al. 2008). Thus, effective *management* is essential for achieving the water savings of an efficient irrigation system, and is associated with the highest potential savings.

Irrigation scheduling is an additional essential element of effective water management. Irrigation scheduling provides a means to evaluate and apply an amount of water sufficient to meet crop requirements at the right time. While proper scheduling can either increase or decrease water use, it will likely increase yield and/or quality, resulting in an improvement in water-use efficiency or overall productivity measured as yield per unit water (Ortega-Farias et al. 2004, DWR 1997, Dokter 1996, Buchleiter et al. 1996, Rijks and Gbeckor-Kove 1990).

While a growing number of farmers are using technology-based irrigation scheduling, many **California's farmers still primarily rely on visual inspection or personal experience** to determine when to irrigate (USDA 2008) (see Table 1). Soil or plant moisture sensors, computer models, daily evapotranspiration (ET) reports, and scheduling services, which have long been proven effective, are still fairly uncommon, suggesting there is significant room for improvement in management practices.

Table 1. Method Used by California Farmers to Decide When to Irrigate, 2008.

Method	Percent of Farms
Condition of crop	66%
Feel of soil	45%
Personal calendar schedule	32%
Scheduled by water delivery organization	10%
Soil moisture sensing device	14%
Daily ET reports	12%
Other	5%
Commercial or government scheduling service	10%
When neighbors irrigate	6%
Plant moisture sensing device	3%
Computer simulation model	3%

Source: USDA. (2008). Farm and Ranch Irrigation Survey.
Note: Many farmers use more than one method when deciding when to irrigate, thus the total of all methods exceeds 100 percent.

THE PACE OF EFFICIENCY IMPROVEMENTS

Another key issue raised during the discussion was how fast water conservation and efficiency could be implemented. The short answer is that it depends. Historically, irrigated acreage using drip or microsprinklers has increased by about 20% percent over 10 years, or around 2% per year. This is during a relatively wet period (1991-2001) in the absence of a concerted effort to promote water conservation and efficiency within the agricultural sector. In the presence of a strong driver, however, conversion rates can be much higher. In the Panoche Water District (PWD), for example, approximately 70% of the District has been converted to high-efficiency irrigation systems, e.g., subsurface drip and microsprinklers. The General Manager reports that in 2004/2005 about a quarter of the district used drip irrigation. At that time, the Water District began actively encouraging drip irrigation, offering low-interest loans and grant funding to increase the conversion rate. Over the five year period thereafter, drip irrigation increased by 45% -- a rate of around 9% per year.

Within the urban sector, there have also been a number of highly successful programs that have achieved significant savings over a relatively short time period. For example, in the mid-1990s, the New York City Department of Environmental Protection launched an aggressive toilet rebate program to replace one-third of all water-wasting toilets in New York City with low-flow models using no more than 1.6 gallons per flush. For this program, property owners contracted directly with private licensed plumbers for the installation of a low-flow toilet. After completion of the work, the City provided the property owner with a $240 rebate for the first toilet and $150 for the second toilet. Where possible, the plumber would also install low-flow showerheads and faucet aerators. The program was a huge success. Between 1994 and 1997, 1.3 million low-flow toilets were installed, saving 70 - 90 million gallons per day. Customers saw their water and wastewater bills drop 20 to 40% (EPA 2002). The City was able to defer the need to identify new supply sources and expand wastewater treatment capacity, thereby saving the community even more money.

Similarly, a successful toilet direct install program was implemented in Southern California in the 1990s. In 1992, a pilot partnership to install low-flow toilets was created between the community non-profit group Madres del Este de Los Angeles Santa Isabel (Mothers of East Los Angeles Santa Isabel - MELASI) and the Metropolitan Water District of Southern California, Los Angeles Department of Water and Power, Central Municipal Water District, and California Water Service Company. Toilets were installed in low-income households free of charge, and MELASI was paid $25 for every toilet replaced (Lerner 1997). The modest program provided employment opportunities to community residents, creating twenty-five full-time and three part-time jobs (Lerner 1997). The community-based approach was also a success in terms of water conservation, with one-in-three households contacted participating, and a total of 8,000 toilets replaced in the first year and 50,000 replaced by the end of 1997 (Hamilton 1992, Hamilton and Craft undated, Lerner 1997). Such a successful model could have been, but was not, expanded statewide.

We also note that temporary 10 to 20% or greater water-use reductions during droughts can be achieved through combinations of higher rates, education programs, and voluntary restrictions. These are not true “efficiency” improvements, but provide some insight into the substantial reductions that can be achieved quickly when necessary.

SETTING TARGETS FOR ACHIEVEMENT AND PROVIDING ECONOMIC INCENTIVES

As the recent report, California Farm Water Success Stories (Christian-Smith et al. 2010), documents, quantitative targets are extremely useful for accelerating the adoption of sustainable management practices statewide. These targets can be driven by the private sector or the public sector. For instance, the California Sustainable Winegrowing Program is an industry-driven initiative to expand the use of best practices from the vineyard to the winery. When the program released its first Sustainability Report, it set benchmarks for various practices within the industry and established a target of 20% improvement across all sustainability criteria over the next five years. This has provided the program and its members a valuable tool for evaluating progress toward achieving sustainability objectives.

Within the Coachella Valley, a federally mediated process to reduce excess use of Colorado River water by California prompted significant improvements in water-use efficiency. In 2004, the Coachella Valley Water District began its multi-year agricultural water efficiency initiative, the Extraordinary Water Conservation Program (ECP), to meet state and federal water conservation targets of 73,000 acre-feet over eight years. In addition, initial investments in recycled water were driven, in large part, by the federal Clean Water Act, which not only set quantitative water quality targets but also funded the infrastructure for centralized wastewater treatment facilities to produce recycled water. This case demonstrates that quantitative targets and economic incentives can both be effective tools, and often work synergistically, to accelerate water management improvements.

REFERENCES

Buchleiter, G.W., D.F. Heermann, R.J. Wenstrom. (1996). Economic Analysis of On-Farm Irrigation Scheduling. Evapotranspiration and Irrigation Scheduling: Proceedings of the International Conference. November 3-6, 1996. San Antonio, Texas.

Christian-Smith, J., L. Allen, M. J. Cohen, P. H. Gleick, P. Schulte, C. Smith. (2010). California Farm Water Success Stories. Pacific Institute. Oakland, CA.

Department of Water Resources (DWR). (1997). Fifteen Years of Growth and a Promising Future: The California Irrigation Management Information System.

Dokter, D.T. (1996). AgriMet – The Pacific Northwest Cooperative Agricultural Weather Station Network. Evapotranspiration and Irrigation Scheduling: Proceedings of the International Conference. November 3-6, 1996. San Antonio, Texas.

Environmental Protection Agency (EPA). (2002). Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs. Washington, D.C.

Hamilton, F. (1992). Saving Water & Making Jobs. *Water Conservation News*. Department of Water Resources, Sacramento, California.

Hamilton, F. and J.P. Craft. (undated). CTSI Corporation. Dynamic Community Programming for Water Efficiency. San Rafael, California.

Lerner, S. (1997). Eco-Pioneers, Practical Visionaries Solving Today's Environmental Problems. Cambridge, MA: MIT Press.

Lewis, D. J., G. McGourty, J. Harper, R. Elkins, J. Christian-Smith, J. Nosera, P. Papper, R. Sanford, L. Schwankl, and T. Prichard. (2008). Meeting irrigated agriculture water needs in the Mendocino County portion of the Russian River. University of California Cooperative Extension Mendocino County, University of California Davis Department of Land Air and Water Resources, and University of California Kearny Agricultural Center.

Orang, M.N., R.L. Snyder, and J.S. Matyac. (2005). Survey of Irrigation Methods in California in 2001. Bulletin 160-05. Sacramento, California.

Orang, M.N., J.S. Matyac, and R.L. Snyder. (2008). Survey of Irrigation Methods in California in 2001. JOURNAL OF IRRIGATION AND DRAINAGE ENGINEERING: January/February 2008.

Ortega-Farías, S., C. Acevedo, A. Acevedo and B. Leyton. (2004). Talca Irrigation Management System (TIMAS) for Grapevine. Research and Extension Center for Irrigation and Agroclimatology (CITRA). Universidad de Talca, Casilla, Chile.

Rijks, D. and Gbeckor-Kove, N. (1990). Agrometeorological Information for Effective Irrigation Scheduling. Acta Hort. (ISHS) 278:833-840

United States Department of Agriculture (USDA). (2008). Farm and Ranch Irrigation Survey. Washington, D.C.