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Trends in Golf Course Water Use and Regulation in California

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For the complete report, including all data, please see the February 2008 "News" which is available on the UCR Turf website (http://ucrturf.ucr.edu) under "Publications".

Water is an important issue in California and many other parts of the United States. According to the California State Department of Finance, California is projected to have considerable population growth. Efforts are under way and should be expanded to make sure that water is used more efficiently in every aspect of our lives. Where do golf courses fit in this landscape? Golf courses should project a genuine image that they are not wasting water, and they should be able to show how much water they need to do business. What is a fair amount of water for golf course use? Information in this summary begins to get at best estimates of golf course irrigation water use in southern California.

Legislation and memoranda in California since 1990 indicates a trend for large landscapes, including golf courses, to be placed on a water budget in the future. The water budget approach to conserve irrigation water is important, though other approaches also are very important and actually help to achieve a water budget or conserve potable water. Some of these other approaches include increasing irrigation efficiency, including application efficiency and uniformity and increasing the use of recycled water. Large-landscape water budgets are based on:[reference crop evapotranspiration (ET_o) × ET adjustment factor] × landscape area, where ET (evapotranspiration) adjustment factor means a factor, such as 0.8, that, when applied to ET_o, adjusts for plant factors (crop coefficients) and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape.

Landscape water regulators will require accurate estimates of ET_o to develop objective and fair water budgets which may be in contrast to estimates of reference ET used for routine and operational applications on golf courses and other landscapes. Estimates of ET_o used by water regulators are important because they are the basis of water budgets. ET_o is defined as the ET rate of an actively growing reference crop, not limited by soil water content, and having specified plant and biophysical characteristics. It serves as an evaporative index and can be used in the crop coefficient (K_c) approach for calculating crop evapotranspiration (ET_{crop}) under standard conditions (well watered). In California, the most commonly accepted source of ET_o data is the California Irrigation Management Information System (CIMIS), an integrated network of over 120 automated weather stations located at key agricultural and municipal sites throughout the state. The reference crop for CIMIS ET_o is a clipped, cool-season grass (an irrigated pasture). Currently, there are very important efforts to increase the ability to accurately estimate CIMIS ET_o in municipal areas and microclimates.

Water Budgets in Southern California

Generally speaking, large-landscape water budgets, including golf courses, will be in the range of 80% ET_o × landscape area. It should be noted that the State Model Water Efficient Landscape Ordinance (Model Ordinance) includes a provision that allows "recreational areas," such as golf courses, to use a specified amount of additional water above the Maximum Applied Water Allowance (MAWA) which is 80% ET_o x landscape area. It also should be noted that current activities may result in the reduction of the MAWA in the future. How does

golf course irrigation water use compare to a water budget of 80% ET_o x landscape area? To answer this question, annual irrigation water use was estimated for hypothetical 18-hole golf courses in three southern California climates: southern coastal marine climate (Irvine); transition climate between marine and desert climates (Riverside); and southern California low-desert climate (Indio, Palm Springs area). Each golf course had 3.1 acres of greens, 3.7 acres of tees, 43.7 acres of fairways, and 59.5 acres of roughs (a total of 110 acres). Annual irrigation water use for optimal (well-watered) conditions was estimated by using monthly average CIMIS ET_o, monthly crop coefficients, and other information which can be found in the publication which is cited above. The results of the calculations are shown in Table 1, line A. Generally speaking, most golf courses irrigate in a range between 80% to 100% optimal. Therefore, annual golf course irrigation water use was estimated for the 80% optimal level; this calculation is shown in Table 1, line D. Water budget calculations were made to compare estimated annual golf course irrigation water use to (average yearly CIMIS ET_o x 110 acres); this calculation is shown in Table 1, line B. The water budget calculations are shown in lines C (optimal) and E (80% optimal) in Table 1.

Table 1. Estimated annual irrigation water use and water budget calculations for 18-hole golf courses located in three southern California cities.

			Indio	
	Irvine	Riverside	Irvine K_c	Tucson K_c
	Optimal turfgrass performance[z]			
A. Annual irrigation water use (acre feet)	395	490	686	769
B. (Average yearly ET_o x 110 acres) (acre feet)	455	517	655	655
C. Calculation for water budget: (*A*/*B*) x 100	87%	95%	105%	117%
	Water conservation (80% optimal)			
D. Annual irrigation water use (acre feet)	316	392	549	615
E. Calculation for water budget: (*D*/*B*) x 100	69%	76%	84%	94%

[z] Well-watered conditions.

A water budget in the range of 80% CIMIS ET_o × landscape area is very achievable for a golf course located in the southern coastal marine climate (Irvine). As one moves inland to a transition climate between marine and desert climates (Riverside), the same budget is probably achievable, but it may require some extra attention to irrigation efficiency, including application efficiency and uniformity. A golf course in the low-desert climate of southern California (Indio) probably would have difficulty achieving a water budget based on 80% CIMIS ET_o × landscape area. However, several comments could be made. First, increasing irrigation efficiency above the 70% used in these estimates and reducing the irrigation water requirement are achievable. Second, it is possible to irrigate below 80% optimal, especially in bermudagrass roughs and fairways and especially during the not overseeded warm season. Lastly, it is also possible to reduce the acreage of irrigated turfgrass, especially for roughs. This may be easiest to implement during new golf course construction and possibly during new irrigation system installation.