APPENDIX Q

BRIEF AFSIRS DESCRIPTION

AFSIRS MODEL

The following text is adapted from Appendix L of Caloosahatchee Water Management Plan (Flaig and Konyha, 2000)

The Agricultural Field-Scale Irrigation Requirements Simulation (AFSIRS) model was developed in the early 1980s in response for the need to predict irrigation requirements for permitting agricultural water use. The five regional water management districts of Florida needed a reliable method to estimate potential water use for irrigated lands. As a result, AFSIRS was developed by A. G. Smajstrla of the Institute of Food and Agricultural Sciences (IFAS) at the University of Florida, Gainesville under a joint contract by the water management districts.

The AFSIRS model is a numerical simulation model, which allows the user to estimate irrigation requirements (IRR) for Florida crops, soils, irrigation systems, growing seasons, climate conditions and irrigation management practices. IRR for crop production is the amount of water, exclusive of precipitation, that must be applied to meet a crop's evapotranspiration (ET) requirements without significant reduction in yield. IRR, as defined in this model, does not include leaching, freeze protection, or crop cooling requirements, even though water for these purposes may be applied through an irrigation system.

The AFSIRS model is based on a water budget of the crop root zone and the concept that crop ET can be estimated from potential evapotranspiration (ETp) and crop water use coefficients. The water budget approach was used to develop a Florida citrus micro irrigation scheduling model (Smajstrla et al., 1987). Smajstrla and Zazueta (1987, 1988) demonstrated the data requirements and sensitivity of the water budget approach to determining irrigation requirements of Florida nursery and agronomic crops. The water budget includes inputs to the crop root zone from rain and irrigation, and losses from the root zone by drainage and ET. The water storage capacity in the crop root zone is defined as the multiple of the water-holding capacity of the soil and the depth of the effective root zone for the crop being grown. This level of simulation model development produces a functional model that could address the wide variety of crops, soils, and irrigation systems typical of Florida.

The water budget approach to the simulation of IRR requires that the extent of the crop root zone be defined for each crop. This is determined as a function of the annual crop growth stage given as fractions of the crop-growing season. The crop root zone also is subdivided into irrigated and nonirrigated zones and separate water budgets are maintained for each zone. Depending upon the method of irrigation, it is common practice to irrigate only the upper portions of the crop root zone where most of the roots are located, rather than to irrigate the maximum depth to which any few individual roots penetrate. Also, for micro irrigation systems, only a portion of a fraction of the soil surface is normally irrigated with these systems. For other production systems such as those, which use seepage irrigation, the entire crop root zone is irrigated because of the manner in which water is applied. As the nonirrigated root zone dries during drought periods, water becomes less available in this zone, and a greater proportion is then extracted from the irrigated zone in order to meet the total crop ET. When the available water is entirely depleted from the nonirrigated root zone, all extractions are simulated to occur from the irrigated root zone.

Daily ET for each crop is calculated as the multiple of potential ET and the crop water use coefficient (Kc) for that day. The Kc values vary with the growth stage of the crop. Crop water use coefficients were obtained from the literature. Three separate sets of Kc values were examined in this study. Most Kc data were obtained from non-Florida research studies because relatively few studies have been conducted in Florida. No data were available to allow distinctions in Kc values to be made on the basis of management practices, such as the use of plastic mulch.

Irrigation is scheduled based on an allowable level of soil water depletion from the crop root zone. Irrigation amounts are optionally calculated to restore the soil water content to field capacity, to apply a fixed amount of water per irrigation, or to restore the soil water content to a given fraction of field capacity (deficit irrigation). Either net irrigation requirements, which consider only the crop water needs, or gross irrigation L-4 Appendix L CWMP Appendices requirements, which also considers the water application efficiency of the irrigation system being used, can be calculated.

Drainage is defined as that portion of rainfall in excess of rain stored in the soil profile to field capacity or extracted by ET as the water redistributed in the soil. If rainfall is less than the depth required to restore the crop root zone to field capacity, then all of the rainfall is effective, and drainage is zero. If rainfall exceeds the depth required to restore the soil water content in the crop root zone to field capacity, then effective rainfall was calculated as the difference between the current and maximum soil water contents. Drainage is the difference between rainfall and effective rainfall. No drainage was assumed to occur as a result of irrigation. Lateral flows are not considered in AFSIRS.

References

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