



RIVERSIDE COUNTY, CALIFORNIA

# A Guide to Preparing Water Budgets

February 14, 2007

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## Purpose

- A. The intent of this guide is to aid landscape architects to determine the Estimated Annual Water Use (EAWU), generate a monthly Target water budget (TARGET) and formulate an Annual Maximum Allowable Water Budget (AMAWB) for landscape irrigation systems.
- B. Eastern Municipal Water District (EMWD) will not review, approve or ensure the adequacy, efficiency or functional ability of any blue print drawings or as built plans, but **IF** Recycled water is determined to be available the involved landscape and irrigation plans must be designed and approved in accordance with the Procedural Guide and General Design Requirements for Construction of Recycled Water Facilities.
- C. EMWD's Customer Service Department will make the determination if recycled water is to be used.

## EXHIBIT A

### ESTIMATED ANNUAL WATER USE

This is provided to assist architects and designers in estimating the water needs of plant materials listed in the WUCOLS plant guide.

The estimated annual water use for the entire landscaped area per individual irrigation meter can be determined by following these steps:

- STEP 1      Calculate the estimated annual water use (EAWU) for each hydrozone in the landscaped area (per the formula in this exhibit).
- STEP 2      Add the EAWU of all hydrozones in the landscaped area.
- STEP 3      Round off the sum of EAWU for all hydrozones to the nearest whole number as follows: if  $\geq .50$ , round UP; if  $\leq .49$ , round DOWN.

The estimated annual water use of a hydrozone can be calculated using the following formula:

$$\text{EAWU} = \frac{(56.65)(ks)(HA)}{(DE)(AE)(1200)}$$

EAWU = Estimated Annual Water Use in billing units per year (one billing unit = 100 cubic feet = 748 gallons)

56.65 = Reference evapotranspiration in inches of water per year

ks = Species Factors (for a specific plant from the WUCOLS plant guide)

HA = Hydrozone Area in square feet

DE = Distribution Efficiency of the irrigation system expressed as a decimal (found later in this exhibit)

AE = Application Efficiency of the irrigation system expressed as a decimal (found later in this exhibit)

1200 = Conversion factor to produce an answer in billing units (to convert the answer to gallons, multiply the formula by 748)

Typical irrigation system DISTRIBUTION EFFICIENCY or DE for the various types of irrigation heads or emitters are expressed in the following decimals:

< 0.60 for spray heads

< 0.85 for gear-driven, impact, or ball-driven rotors

< 0.85 for bubbler heads

< 0.90 for drip irrigation systems

Irrigation system APPLICATION EFFICIENCY or AE is expressed as a decimal for the following systems:

- < 0.85 for irrigation systems that have a centralized control system or controllers that measure or can be programmed to use evapotranspiration rates, or systems that use other controls such as moisture sensors.
- < 0.65 for irrigation systems which do not have any of the above soil or weather-driven type of controls.

**EXHIBIT B**

**EXAMPLE OF CALCULATING WATER USE**

For a small, individually metered landscape project with two hydrozones and a total landscaped area of 8,000 square feet:

EAWU for hydrozone no. 1	=	$\frac{(56.65)(0.5)(3,000)}{(0.9)(0.85)(1,200)}$	=	92.56 billing units
EAWU for hydrozone no. 2	=	$\frac{(56.65)(0.5)(5,000)}{(0.7)(0.85)(1,200)}$	=	198.35 billing units
SUBTOTAL	=	92.56 + 198.35	=	290.91 billing units (round off to nearest whole number per previous instructions)
<b>TOTAL EAWU FOR THIS PROJECT</b>	=		=	291 billing units per year

**NOTE:** The EAWU for the total established landscaped area per individual irrigation meter **SHOULD NOT EXCEED** the Annual Maximum Allowable Water Budget (AMAWB) for that landscaped area.

## EXHIBIT C

### ANNUAL MAXIMUM ALLOWABLE WATER BUDGET

The annual maximum allowable water budget for the total landscaped area per individual irrigation meter can be determined by following these steps:

STEP 1        Calculate the annual maximum allowable water budget (AMAWB) (per the formula in this exhibit).

STEP 2        Round off the AMAWB to the nearest whole number as follows: if  $\exists$  .50, round UP; if  $\#$  .49, round DOWN.

The annual maximum allowable water budget for the total landscaped area per individual irrigation meter should be calculated using the following formula:

$$\text{AMAWB} = \frac{(56.65)(A_{\text{pnf}})(A_{\text{nf}})((K_{\text{nf}})(K_s))}{1200} + \frac{(56.65)(A_{\text{pf}})(A_f)((K_f)(K_s))}{1200} = \text{AMAWB}$$

AMAWB        = Annual Maximum Allowable Water Budget in billing units per year (one billing unit = 100 cubic feet = 748 gallons).

56.65         = reference evapotranspiration in inches of water per year

$A_{\text{pnf}}$          = Allowable Percentage Non Functional Turf of ETo

$A_{\text{pf}}$          = Allowable Percentage Functional Turf of ETo

EMWD will provide applicant with the Annual Maximum Allowable Water Budget (AMAWB) to be used in the scheduling of irrigation systems, which shall include a water budget for Non Functional and Functional Turf as follows:

Non Functional Turf: ( $A_{\text{pnf}}$ )

- Any customer with a signed EMWD Landscape Irrigation Water Budget Agreement dated prior to February 14, 2007 will retain the water budget calculated using 100% of Reference Evapotranspiration (ETo) for Non Functional Turf.
- Any customer who signs an EMWD Landscape Irrigation Water Budget Agreement dated February 14, 2007 or later will have a water budget that is calculated using 80% of Reference Evapotranspiration for Non Functional Turf.

Functional Turf: ( $A_{\text{pf}}$ )

- Water budgets for Functional Turf are calculated using 125% of Reference Evapotranspiration.

(Additional adjustments, based on site specific conditions, may be considered).

$A_{\text{nf}}$          = Area of non-functional landscape in square feet

$A_f$          = Area of functional landscape in square feet

$K_{\text{nf}}$          = Irrigation Efficiency Adjustment Factor for non-functional landscape

$$K_{\text{nf}} = \frac{(K_{\text{C}_{\text{nf}}}) * 10,000}{(DE_{\text{nf}})(AE_{\text{nf}})} \quad (\text{Default Value} = 1.00)$$

- $K_f$  = Irrigation Efficiency Adjustment Factor for functional landscape  

$$K_f = \frac{(KC_f) * 10,000}{(DE_f)(AE_f)}$$
 (Default Value = 1.25)
- $K_s$  = Soil Adjustment Factor (Default Value = 1.00)
- $KC_f$  = Crop Coefficient for functional landscape (Default Value = .80)
- $KC_{nf}$  = Crop Coefficient for non-functional landscape (Default Value = .60)
- $DE_f$  = Distribution Uniformity Efficiency in % for functional landscape (Default Value = 80%)
- $DE_{nf}$  = Distribution Uniformity Efficiency in % for non-functional landscape (Default Value = 60%)
- $AE_f$  = Application Efficiency in % for functional landscape (Default Value = 80%)
- $AE_{nf}$  = Application Efficiency in % for non-functional landscape (Default Value = 100%)
- 1200 = Conversion factor to produce an answer in billing units (to convert the answer to gallons, multiply the formula by 748).

**CALCULATION EXAMPLE;**

An individually-metered landscape project with a total landscaped area of 40,000 square feet:

**AMAWB** =  $\frac{(56.65)(.80)(40,000)(1.00)(1.00)}{1200}$  +  $\frac{(56.65)(1.0)(10,000)(1.25)(1.00)}{1200}$  = 2100.77

= (2100.77 rounded off to the nearest whole number per previous instructions)

= **2,101** Billing Units per Year

## EXHIBIT D

### MONTHLY TARGET WATER BUDGET

The schedule of monthly target water budgets for the total landscaped area per individual irrigation meter is determined by following these steps:

- STEP 1      Calculate the monthly target water budget (Target) for each month of the year (per the formula in this exhibit).
- STEP 2      Round off each Target to the nearest whole number as follows: if .50, round UP; if .49, round DOWN.

Each monthly target water budget for the total landscaped area per individual irrigation meter is calculated using the following formula:

$$\text{TARGET} = (\text{AMAWB})(\text{MAF})$$

TARGET = Monthly Target Water Budget in billing units per the month chosen to be calculated.

AMAWB = Annual Maximum Allowable Water Budget in billing units per year (rounded off to the nearest whole number and calculated per instructions in EXHIBIT C).

MAF = Monthly Adjustment Factor for the month chosen to be calculated and taken from the following table:

JAN	0.037	MAY	0.108	SEP	0.108
FEB	0.051	JUN	0.125	OCT	0.073
MAR	0.071	JUL	0.140	NOV	0.046
APR	0.073	AUG	0.134	DEC	0.034

#### CALCULATION EXAMPLE;

For the TARGET for the month of August for an individually-metered landscape project with a total landscaped area of 50,000 square feet and an AMAWB of 2,478 billing units per year:

$$\text{TARGET} = (2101)(0.134)$$

$$= (281.53) \text{ rounded off to the nearest whole number per previous instructions}$$

$$= \mathbf{282} \text{ Billing units for the month of August}$$

## EXHIBIT E

### "SPECIES FACTORS AND PLANT WATER NEEDS"

This list is provided to assist architects and designers in estimating the water needs of many (but not all) plant materials.

The water needs of the plants (listed in the WUCOLS guide) appear in the form of a "Species Factor"

For the purpose of this guide, the WUCOLS plant list is organized into one of four categories, each representing a range of Species Factors (ks) as follows:

VERY LOW	Species Factor (VL): ks less than 0.1
LOW	Species Factor (L): ks range = 0.1 - 0.3
MODERATE	Species Factor (M): ks range = 0.4 - 0.6
HIGH	Species Factor (H): ks range = 0.7 - 0.9

A suggestion for using these (ks) values is to use the lower portion of the range if a plant is located in shaded or Northerly exposures, and to use the higher (ks) portion of the range if the plant is located in direct sun or Southerly exposures.

**NOTE:** The (ks) values provided in this exhibit reflect good estimates of the water needs of many plant materials, ( ks) have not been scientifically determined for all landscape plants. Although extensive, the WUCOLS plant guide is by no means complete. Horticultural reference books and horticulturists can provide useful information in estimating the water needs of plants not found in the WUCOLS plants guide. **REMEMBER**, this guide **DOES NOT REQUIRE** that only the plants listed be used. The WUCOLS plant guide will be amended as further data is made available.

## GLOSSARY

The words used in this guide have the meaning set forth below:

- A. **"ALLOWABLE PERCENTAGE"** ( $A_{pf}$  or  $A_{pnf}$ ) means a factor of 1.25 (125%) or .80 (80%) that when applied to reference evapotranspiration, determines the annual maximum allowable water budget for an individually metered landscape project.
- B. **"ANNUAL MAXIMUM ALLOWABLE WATER BUDGET"** or **"AMAWB"** the limit of water use for the entire landscaped area per individual irrigation meter. It is based upon reference evapotranspiration, the allowable percentage and the size of the landscaped area.
- C. **"APPLICATION EFFICIENCY"** or **" $AE_f$ "** for functional landscape (default value 80%) or **" $AE_{nf}$ "** for non-functional landscape (default value 100%) is based upon characteristics of the various types of irrigation system controls such as moisture sensors, etc.
- D. **"CROP COEFFICIENT"** or **" $KC_f$ "** for functional landscape (default value .80) and **" $KC_{nf}$ "** for non-functional landscape (default value .60)
- E. **"DISTRIBUTION EFFICIENCY"** or **"DE"** - Typical irrigation system "DE" for the various types of irrigation heads or emitters are expressed in the following decimals:
1. 0.60 for spray heads
  2. 0.85 for gear-driven, impact, or ball-driven rotors
  3. 0.85 for bubbler heads
  4. 0.90 for drip irrigation systems
- F. **"ESTIMATED ANNUAL WATER USE"** or **"EAWU"** means the estimated annual water use for an established landscape area as calculated in EXHIBIT A. It is based upon reference evapotranspiration, the crop coefficient of the plants involved, and the size of the landscaped area. The EAWU for the entire landscaped area per individual irrigation meter equals the sum of the estimated water use of all hydrozones in that landscape area. NOTE: the EAWU for the entire landscape area per individual irrigation meter SHALL NOT EXCEED the annual maximum allowable water budget of that landscape area.
- G. **"EVAPOTRANSPIRATION"** means the quantity of water evaporated from adjacent soil surfaces and transpired by plants during a specific time. Evapotranspiration data is collected from the Riverside UCR, CIMIS Field Station # 44.
- H. **"FUNCTIONAL LANDSCAPE"** or **" $A_f$ "** a landscaped turf area that serves as a surface for such purposes as playing a sport or gathering for group activities.
- I. **"HYDROZONE"** means a portion of the landscape area having plants with similar water needs.
- J. **"IRRIGATION EFFICIENCY ADJUSTMENT FACTOR"** or **" $K_f$ "** (for functional landscape) & **" $K_{nf}$ "** (for non-functional landscape) mean the measurement of the amount of water beneficially used divided by the amount of water applied. IRRIGATION EFFICIENCY is a product of distribution efficiency (DE) - based upon characteristics of the various types of sprinklers/emitters, and application efficiency (AE) - based upon characteristics of the various types of irrigation system controls such as moisture sensors, etc.
1. Example: 
$$K_f = \frac{(KC_f) * 10,000}{(DE_f)(AE_f)} \quad (\text{default } 1.25)$$
- $$K_{nf} = \frac{(KC_{nf}) * 10,000}{(DE_{nf})(AE_{nf})} \quad (\text{default } 1.00)$$

- K. **"LANDSCAPED AREA"** means the parcel less the building footprint, driveways, non-irrigated portions of parking lots, hardscape-such as decks and patios-and other non-porous areas. Water features are included in the calculations of the landscaped area.
- L. **"MAXIMUM ALLOWABLE WATER BUDGET"** means the upper limit of water use (either "ANNUAL" or "TARGET") for the entire landscaped area per individual irrigation meter. It is based upon reference evapotranspiration, the allowable percentage (1.25 or 80%) and the size of the landscaped area.
- M. **"MONTHLY ADJUSTMENT FACTOR"** or "MAF" means a factor, expressed as a decimal, that, when multiplied by the annual maximum allowable water budget for an individually metered landscape project, determines the target monthly water budget for that project. MAFs are based upon monthly historic average reference evapotranspiration for the area of Riverside County. The MAFs for the twelve months of the year are;
- |     |       |     |       |     |       |
|-----|-------|-----|-------|-----|-------|
| JAN | 0.037 | MAY | 0.108 | SEP | 0.108 |
| FEB | 0.051 | JUN | 0.125 | OCT | 0.073 |
| MAR | 0.071 | JUL | 0.140 | NOV | 0.046 |
| APR | 0.073 | AUG | 0.134 | DEC | 0.034 |
- N. **"NON COMPLIANCE SETTLEMENT CHARGE TIERS"** means a tier structure using the AMAWB as the Base Rate (budget). Any water used over the budget will be billed within the appropriate tiers, as described in section V of the Procedural Guide for Procuring Landscape Irrigation Water. Non compliance settlement charge tiers apply to any landscape irrigation water account that exceeds its AMAWB or ETo ( whichever is highest) at year=s end.
- O. **"NON-FUNCTIONAL LANDSCAPE"** or "A<sub>nf</sub>" a landscaped turf area, including trees, shrubs, and ground covers, used for aesthetic purposes.
- P. **"REFERENCE EVAPOTRANSPIRATION"** or 56.65 inches means a standard measurement of environmental parameters which affect the water use of plants. REFERENCE EVAPOTRANSPIRATION, is given as 56.65 inches of water per year, and represents the annual historic average evapotranspiration of a large field of 4-7 inch tall, cool-season grass that is well watered and located in the area of Riverside County. REFERENCE EVAPOTRANSPIRATION is used as the basis of determining the maximum allowable water budgets.
- Q. **"SOIL ADJUSTMENT FACTOR"** or "K<sub>s</sub>" is an adjustment factor that is applied to the texture of the soil (Sand, Loam, Clay) with a default of 1.00.
- R. **"SPECIES FACTOR"** or "ks" are classified as high (H), moderate (M), low (L), or very low (VL) in irrigation water needs. Each classification corresponds to a species factor range (a numerical value) which is expressed as a percentage of reference evapotranspiration (ETo). Species factors are used with ETo values to quantify water needs for a species. (for more information see the WUCOLS guide).
- S. **"Target"** refers to the monthly water budget, and is uses as an indicator in relationship to the AMAWB
- T. **"WATER USE CLASSIFICATION OF LANDSCAPE SPECIES"** or **"WUCOLS"** list is intended solely as a guide to help landscape professionals identify irrigation water needs of landscape species. It can be used either for the selection of species or to assist in developing irrigation schedules for existing landscapes. It is not intended to be used as a **required or approved** list by EMWD for selection of plant species.