VARIANCE: SIGNIFICANT USE OF EVAPORATIVE COOLERS

[Bullet list with numbering for easy referencing in discussion.]

1. Legislative Requirements

1.1. Recommend appropriate variances for unique uses that can have a material effect on an urban retail water supplier's Urban Water Use Objective (UWUO) and the corresponding thresholds of significance (WC Section 10609.16).

1.2. Required content for the recommendation

1.2.1. Confirm unique uypese that warrants considerations.

1.2.2. Recommend variance with appropriate terms and conditions including a threshold of significance (i.e., having a material effect on an urban retail water supplier's UWUO). [*Reminder: Variances are part of the UWUO*.]

1.2.3. Guideline and methodologies for calculating the estimated efficient water use under this variance for UWUO.

2. Scope

2.1. Unique use is confirmed.

2.1.1. Indoor Residential efficient Water Use Standard (IRWUS) focuses on residential water use only. Water use by non-standard home water using devices, including Evaporative Coolers (EC), is excluded from the IRWUS.

2.1.2. In extremely hot and dry climate zones and in certain communities, the use of ECs is more widespread than other cooling methods. *[Reminder: the climate zones are based on energy use, temperature, weather, and other factors, as described in the Title 24 energy efficiency standards glossary section.]*

2.1.2.1. ECs are not effective in cold and humid environments because they cool air by water evaporation.

2.1.2.2. In certain communities, the cost of electricity far exceeds the cost of water, making air cooling by EC more attractive than air cooling using traditional air conditioners (AC).

2.2. Potential material effects are evident.

2.2.1. Studies have estimated water use for EC systems in different climates across California could range from 52 to 132 gallons/day. This is equivalent to about 1 to over 2.5 extra people in the household.

2.2.2. In addition to the water consumed by the process of evaporative cooling, some EC systems require water for a maintenance process of flushing the system to remove mineral build up that has accrued with use.

2.2.2.1. This process has been found to increase water consumption by 10 to 50 percent.

2.2.2.2. Varying age and types of evaporative coolers may be of different efficiencies, and maintenance often requires additional water use.

2.2.3. The use likely continues because of the difference in cost for operating an EC and AC.

2.3. Use of this variance:

2.3.1. This recommended variance is subject to additional review, approval, and potential modifications by the State Water Resources Control Board (State Water Board) during the adoption process. If adopted, any urban retail water supplier that would like to use this variance will need to petition to the State Water Board and receive specific approval on individual water supplier level in order to use the variance in calculating UWUO.

2.3.2. Use of this variance in IRWUS is allowed when meeting the criteria and approved by State Water Board.

2.4. Limitations:

2.4.1. ECs used in commercial, industrial, and institutional (CII) facilities, including warehouses and data centers, are excluded from the UWUO and a variance is not applicable. *[Reminder: CII water use is not within the scope of UWUO. It is redirected to CII Performance Measures and Best Management Practices.]*

3. Recommendations for the Variance and Associated Specifications

3.1. An urban retail water supplier will be allowed to include the variance for significant use of evaporative coolers in calculating its UWUO when all the following conditions are satisfied.

3.1.1. The use of this variance by the urban retail water supplier is previously approved by State Water Board. [*Reminder: The State Water Board's approval is for using the variance but not for the quantity, which varies every year*.]

3.1.2. The estimated efficient water use under this variance is greater than 5% of the sum of the aggregated estimates of efficient water uses based on four established standards, namely, IRWUS, Outdoor Residential efficient Water Use Standard (ORWUS), CII-Dedicated Irrigation Meter Standard (CII-DIMS), and Water Loss Standard.

3.1.3. These conditions should be verified by the urban water retail water supplier every other year before using the variance in calculating UWUO.

3.1.4. The minimum air temperature for calculating efficient water use for evaporative coolers is 70-degree Fahrenheit.

3.2. The variance will specify the water use allowance for use of evaporative coolers at residential properties.

3.2.1. The calculation of allowable water use under this variance should follow psychrometric principles, which requires the urban retail water supplier to have a proper understanding of the EC systems used in their service area. The information required from its customers include:

3.2.1.1. The proof of EC use with a picture and unit specification.

3.2.1.2. The cubic feet per minute rate for the specific unit.

3.2.1.2.1. The number of air change per minute is used to determine air movement in a room (in Cubic Feet per Minutes; CFM). For all ECs, it is usually marked on the front of the cooler, which shall be reported to the urban retail water supplier by customers.

3.2.1.3. In addition to the information related to available ECs, the urban retail water suppliers must obtain the number of EC operating hours in

each residential property in its service area to calculate its total efficient water use for this variance.

3.2.1.4. The collected information is the basis for supporting data for urban retail water suppliers to claim the variance. The information should be public accessible and verified by water supplier.

3.2.2. A representative EC performance efficiency is set at 80% for calculating the estimated water use by EC. [*Note: Based on research and consultation with Western Cooling Efficiency Center (WCEC), typical residential direct evaporative coolers have a range of efficiency between 80% to 95%. The experts at WCEC recommended to use 80% as a representee efficiency for this purpose*.]

3.2.3. All ECs consume water via evaporation to provide cooling. Therefore, the amount of water consumed by any given EC is expressed using an evaporation rate.

3.2.3.1. Evaporation rate depends on dry bulb temperature, wet bulb temperature, EC performance efficiency rate, and size (volume) of the room/home that is being cooled using the EC.

3.2.3.2. Wet bulb temperature, if not available directly from the official weather websites, is to be determined based on dry bulb temperature and relative humidity, as explained in Section 4. *[Note: DWR will provide a tool for the urban retail water suppliers to do this calculation.]*

3.2.4. Attributable water allowance to this variance is to base on the desired air temperature in a specific room of 70 degrees Fahrenheit.

3.3. The calculation of estimated water use under this variance should follow the guidelines and methodologies provided by DWR (see later section).

3.3.1. DWR may recommend revisions of the guidelines and methodologies in the future, as needed.

3.3.2. The water use allowance should be calculated based on data applicable to the condition of the previous year.

3.3.3. Use of alternative data is allowed if the urban retail water supplier can provide evidence that the alternative data is equal to or superior to DWR-provided data or DWR-suggested referenced data.

3.3.4. Urban retail water suppliers should provide all necessary data and information to support the use of this variance and associated calculated amount of estimate water use to be included in UWUO. The data and information should be made publicly available. Where applicable, DWR will specify validation and certification requirements for certain data use.

4. Guidelines and Methodologies for Calculating aggregated estimate of water use for this variance

4.1. Considerations:

4.1.1. The urban retail water supplier will base on the information collected from its customers to develop the calculation. It is recommended that water suppliers make the information public accessible and periodically verify the data with follow-up survey or update requirements for its customers.

4.1.2. It is recommended that the urban retail water supplier establish a report form or a survey to obtain the required information.

4.1.3. The calculation is based on hourly weather information, as temperatures may fluctuate throughout a day.

4.1.3.1. Calculating the water use will require the urban retail water supplier to obtain and maintain a substantial amount of data. The water supplier should consider the system requirements to store that information.

4.1.3.2. The use of alternative data for hourly dry bulb temperature, hourly wet bulb temperature, and relative humidity can be used if the urban retail water supplier provides evidence that the alternative data are superior to DWR-provided data or DWR-suggested referenced data.

4.1.4. DWR will develop an Excel-based utility program for the use of urban retail water suppliers because the underlying calculation and formula are relatively complicated.

Guidelines and Methodologies	Calculation
Data Needed for Calculation	• Hourly weather data (dry/wet bulb air temperature, relative humidity, dew point temperature) • EC indicator (does a home use EC or AC) • Number of EC operation hours • CFM of reported EC systems (CFM is usually marked on the front of the cooler, which shall be reported to the urban retail water supplier by customers)
Wet bulb temperature	$$Tw = T \times \arctan\left[0.151977 \times \sqrt{(rh + 8.313659)}\right] + \arctan(T + rh) - acrtan(rh - 1.676331) + 0.00391838 \times rh^{1.5} \times \arctan(0.023101 \times rh) - 4.686035$$ where: Tw = wet bulb temperature (the equation is an approximation method based on dry-bulb temperature and relative humidity; DWR will provide a tool to calculate this parameter) T = dry-bulb temperature (from CIMIS) rh = relative humidity (%) (from CIMIS)
EC evaporation rate per hour (gallon/hr)	$$\frac{CFM \times \Delta T \times efficiency\ rate}{8700}$$ where: CFM = cubic feet per minute (to be reported by customers to the urban retail water supplier) ΔT = difference between wet bulb temperature and dry-bulb temperature Representative efficiency rate = 0.80 (80%)

Equation	Efficient water use volume = [Number of ECs used (on a dwelling unit basis)] x [total number of operating hours] x EC evaporation rate per hour
Source(s) of Data	***CIMIS***: • Hourly dry bulb air temperature • Hourly relative humidity • Hourly dew point temperature ***To be obtained/developed by water supplier***: • Hourly wet bulb temperature (to be calculated based on DWR tool) • EC indicator (does a home use EC or AC) • Total number of EC operating hours per residential properties • Air change factor of ECs (CFM)
Reporting Requirements (provided to DWR by urban retail water supplier)	• Hourly weather data (dry/wet bulb air temperature, relative humidity, dew point temperature, vapor pressure) • EC indicator (does a home use EC or AC) • Total number of EC operating hours per residential properties • Air change factor of ECs (CFM) • All other supporting data and documentation used to calculate the efficient water use